

# **SANITARY SEWER SYSTEM TECHNICAL SPECIFICATIONS**

**EFFECTIVE JUNE 1, 2014**



**EAST CHERRY CREEK VALLEY  
WATER AND SANITATION DISTRICT**

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**EAST CHERRY CREEK VALLEY WATER AND SANITATION DISTRICT  
SANITARY SEWER STANDARDS AND SPECIFICATIONS**

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## SECTION 1. GENERAL

### 1.01 PURPOSE

This publication provides information relative to engineering, design, materials specifications and construction procedures for sanitary sewer systems within the East Cherry Creek Valley Water and Sanitation District, and is an integral part of the District's Rules and Regulations. The Specifications may be downloaded from the District's website at [www.eccv.org](http://www.eccv.org). District's Specifications may also be purchased at the East Cherry Creek Valley Water and Sanitation District office, located at 6201 South Gun Club Road, Aurora, Colorado 80016, at cost.

### 1.02 DISTRICT SERVICE AREA

The East Cherry Creek Valley Water and Sanitation District Service Area is located in Arapahoe County, Colorado. Generally, the District is located west of Gun Club Road, south of Hampden Avenue, east of Parker Road, and north of Arapahoe Road.

### 1.03 AUTHORITY

These Specifications shall be administered by the District and shall include all interpretation, enforcement, revision, waiver and variance, with all such actions being finally determined by the District.

### 1.04 REVISIONS

These Specifications are effective as of June 1, 2014. Revisions to these Specifications may be made from time to time by the District. Any revision shall be in effect at the date of issuance by the District. Any person using these Specifications should contact the District for information relative to revisions.

### 1.05 DEFINITION OF TERMS

As used in these Specifications and the District Rules and Regulations, unless the context clearly indicates otherwise, the words defined below shall have the respective meaning set forth for them:

**Actual Costs:** All direct and indirect costs attributable to any project or material, equipment, administrative, and overhead expenses, calculated in accordance with the rates set forth in the District Rules and Regulations, and all direct payments to third parties, at cost.

**Board or Board of Directors:** The duly constituted Board of Directors of the District.

**City of Aurora:** The City of Aurora, Colorado.

**Contractor:** Any person who performs any work, either for himself or another, on any sewer facilities, public or private, within the District, including all

subcontractors, agents, employees, officers and other representatives of such person.

**Construction Plans:** Plans and Specifications for the construction of a specific Developer/Owner sanitary sewer system project which have been reviewed and signed by the District and the District's Consulting Engineer.

**District:** East Cherry Creek Valley Water and Sanitation District, Arapahoe County, Colorado, its employees, agents, officers, directors, insurers, and professional consultants.

**District Engineer:** The District's Staff Engineer and/or the District's Consulting Engineer.

**District Manager:** The Manager of the District appointed by the Board of Directors, or any other person duly authorized to perform the duties of the District Manager.

**District System:** The Plant, facilities, systems, assets, and appurtenant property rights owned or directly controlled by the District.

**Foreign Materials:** Objects or substances not appropriate for transmission by a sanitary sewage system, including without limitation paving or construction materials, debris, furniture, appliances, clothing, bicycles, rocks, dirt, trash, grease, oil, sand, and grass, bush or tree clippings.

**Main or Sewer Main:** Those pipes and appurtenant facilities used for carrying wastewater along public streets or easements or rights of way deeded or licensed to the District.

**Main Extension:** The construction of any facilities, or the facilities themselves, which are intended to become a part of the District System upon acceptance by the District in accordance with the Rules and Regulations.

**Metro Wastewater Reclamation District:** The Metro Wastewater Reclamation District, for itself and as operator of the Metro Wastewater Reclamation District treatment facilities.

**Permitted Premises:** The land area and improvements thereto to which sewer service is limited under any particular Tap Permit.

**Person:** Associations, corporations, firms, partnerships and bodies politic and corporate, as well as individuals.

**Property Owner/Owner/Developer:** All of these terms shall be synonymous with each other and shall mean any person who, whether solely or with others, owns real property within the District: When property is owned by more than one person, the term includes all owners thereof. As used in these Specifications, the term shall apply to such person only in connection with his ownership of any specific parcel of real property involved in any specific matter governed by these

Specifications or Rules and Regulations. For purposes of clarity, the masculine singular pronoun is used in these Specifications to refer to Property Owner.

**Record Drawings:** A separate set of construction plans marked to indicate completely and accurately the field-installed condition of facility construction in progress, as required by these Specifications.

**Rules and Regulations:** The comprehensive set of operating rules and requirements, as now or hereafter constituted, adopted by the Board of Directors for the purpose of regulating the design, construction, operation, maintenance, use, repair and replacement of the District System.

**Service Lines:** Any sewer lines or portions thereof located upstream from the upstream end of the wye or saddle fitting on the District's Main, and intended or used to convey wastewater from Permitted Premises to the District System.

**Sewage:** See "Wastewater."

**Swimming Pool Discharge:** Wastewater from any swimming pool, public or private, discharged to the District System, including swimming pool filter backwash effluent and water drained directly from the swimming pool itself.

**Tap or Service Connection:** The physical connection to a District Main which, together with the Tap Permit for same, effects sewer service to any Permitted Premises.

**Tap Permit:** The written authority to make a Tap for sewer service to Permitted Premises from the District System.

**User:** Any person who discharges or causes the discharge of wastewater to the District System.

**Wastewater or Sewage:** The combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants and institutions, including polluted cooling water.

- A. **Sanitary Wastewater:** The combination of liquid and water-carried wastes discharged from toilet and other sanitary plumbing facilities.
- B. **Industrial Wastewater:** The combination of liquid and water-carried wastes discharged from any industrial establishment and resulting from any trade process carried in that establishment, including the wastewater from pretreatment facilities and polluted cooling water.

**Wastewater Utility Ordinance:** East Cherry Creek Valley Water and Sanitation District Rules and Regulations.

## 1.06 ABBREVIATIONS

These Specifications utilize and otherwise make reference to other Standards and Specifications. Where these references are made, they shall refer to the latest edition or revision thereof.

<b>AASHTO</b>	American Association of State Highway and Transportation Officials
<b>ACI</b>	American Concrete Institute
<b>AISC</b>	American Institute of Steel Construction, Inc.
<b>ANSI</b>	American National Standards Institute, Inc.
<b>ASA</b>	American Standards Association
<b>ASTM</b>	American Society of Testing Materials
<b>AWWA</b>	American Water Works Association
<b>IPC</b>	International Plumbing Code
<b>OSHA</b>	Occupational Safety Health Administration
<b>UL</b>	Underwriter's Laboratories
<b>UNI</b>	Uni-Bell Association
<b>UPC</b>	Uniform Plumbing Code



## SECTION 2. SANITARY SEWER DESIGN CRITERIA

### 2.01 GENERAL

All sanitary sewer lines, manholes, service connections, and related public facilities within the East Cherry Creek Valley Water and Sanitation District shall be designed in accordance with these Specifications, and any other applicable Federal, State, and Local regulations. Any deviation from these Specifications shall require written permission from the District, prior to design or construction. Design of all sanitary sewer system construction plans shall be performed under the direct supervision of a Professional Engineer, registered in the State of Colorado. The intent is to provide a consistently designed, long-term, reliable system which can be easily located and maintained by the District.

### 2.02 SEWER SYSTEM PLAN REQUIREMENTS

Construction plans for sanitary sewer system shall meet the guidelines set forth in the Sanitary Sewer System Plan Requirements Check List and General Notes for Sanitary Sewer System Plans found in the Appendix. The checklist and general notes are guidelines and as such, some items may not be applicable to all projects as determined by the District.

### 2.03 FLOW DEVELOPMENT CRITERIA

Sanitary sewer lines shall be designed to transport average and peak sewage flows in accordance with these Specifications. Average and peak flow development criteria presented in following Table 2.1 are minimum criteria, and the District reserves the right to modify flow criteria, at any time, for the design of specific projects. Flow development criteria for proposed uses not shown in Table 2.1 (i.e. car-wash, laundries, auto service stations, supermarkets, places of assembly, hospitals, etc.) shall be determined by the District on a case-by-case basis using generally accepted planning criteria.

Peak sanitary sewer flows shall be calculated as follows:

$$\text{Peak Flow} = (\text{Avg. Flow} \times \text{Peak Factor}) + \text{Infiltration/Inflow}$$

Infiltration and inflow is ten percent (10%) of the Average Flow.

<b>USE</b>	<b>OCCUPANCY</b>	<b>AVERAGE DAILY SEWAGE FLOW</b>	<b>PEAK FACTOR*</b>
Single-Family	3.2 Persons	100 GPCD	4.0
Townhome	2.1 Persons	100 GPCD	4.0
Multi-Family	1.7 Persons	100 GPCD	4.0
Retail/Commercial	N/A	0.3 GPD/SF	4.0
Office	N/A	0.1 GPD/SF	4.0
Elementary School	700 Students/Staff	10 GPCD	4.0
Middle School	1070 Students/Staff	10 GPCD	4.0
High School	2470 Students/Staff	15 GPCD	4.0
Restaurants	N/A	1.5 GPD/SF	4.0

## ABBREVIATIONS

<b>GPCD</b>	Gallons Per Capita Per Day
<b>GPD/SF</b>	Gallons Per Day Per Square Feet Developed Floor Space
<b>N/A</b>	Not Applicable
<b>SF</b>	Square Feet Developed Floor Area
<b>Single-Family</b>	Detached Single-Family Residential Dwelling (Owned)
<b>Multi-Family</b>	Attached Single-Family Residential Dwelling (Rented)
<b>Townhome</b>	Attached Single-Family Residential Dwelling (Owned)
<b>*Peak Factor</b>	Use ASCE Curve "A" for Peak Factor of Outfall Sewers (P.F. max = 4, P.F. min. = 1.7)

### 2.04 SANITARY SEWER SYSTEM HYDRAULIC DESIGN CRITERIA

#### A. General

The sanitary sewer system shall be designed to transport average and peak sewage flows in accordance with these Specifications, and shall prevent deposition of suspended materials within the system.

#### B. Sanitary Sewer Lines

No public, District owned, sanitary sewer line shall be smaller than eight (8) inches in diameter

$$V = \frac{1.49 R^{2/3} S^{1/2}}{n}$$

Where: V	-	Flow Velocity (ft/sec)
R	-	Hydraulic radius (ft), determined by dividing the flow area by the wetted perimeter.
S	-	Slope (Ft/Ft) of the energy grade line, which is approximately equal to the sanitary sewer line design slope.
n	-	Manning's Pipe Roughness Coefficient or "n" Factor = 0.011 (PVC pipe)

The maximum design flow depth at peak flow shall not exceed 83% of the internal pipe diameter (i.e.  $d/D = 0.83$ , ratio flow depth to internal pipe diameter).

Hydraulic characteristics shall be calculated for each reach of the sanitary sewer system to show conformance with these Specifications. Table 2.2 outlines minimum and generally acceptable maximum slopes for sanitary sewer lines as follows.

TABLE 2.2		
Nominal Pipe Diameter (Inches)	Minimum Slope (Ft/100Ft)	Maximum Slope At d/D = 0.83 (Ft/100Ft)
8	0.50	10.0
10	0.35	6.0
12	0.25	4.0
15	0.20	3.0
18	0.20	2.2

It should be noted that the maximum slopes are based on  $d/D = 0.83$ . As flow depth decreases, the allowable maximum slope may also increase, as long as velocities do not exceed 10 fps. The minimum slopes indicated are absolute minimums.

All dead end sanitary sewer lines (i.e. cul-de-sacs) shall have a minimum slope of one percent (1%).

Construction plans shall develop and show average flows, peak flows, and other information at all points of connection to the existing sanitary sewer system as follows:

- $Q_{PEAK}$  Peak Sanitary Sewer Flow
- $Q_{AVG}$  Average Sanitary Sewer Flow
- $V_{PEAK}$  Peak Flow Velocity
- $d_{PEAK}$  Peak Flow Depth in Line at Point of Connection
- $d/D_{PEAK}$  Ratio of Peak Flow Depth to Inside Pipe Diameter
- S Slope of sanitary sewer line
- n Manning's "n" = 0.011 (PVC pipe)

Development Number and type of total ultimate planned units tributary to the point of connection.

Sanitary sewer system layout shall provide a system of lines which generally increase in diameter from higher to lower areas within the basin. Once a line size is increased at any point in the system, it shall not be reduced in size at any downstream location, regardless of available line slope.

## **C. Manholes**

Manholes shall be designed to promote smooth, continuous flow between adjacent reaches of sanitary sewer lines. The minimum drop from any pipe invert upstream and the pipe invert "out" shall be 0.2 feet. Where manholes are designed to collect flows from two or more incoming lines, the design "in" inverts shall be set to keep the largest incoming line (i.e. line contributing the largest flow) lower in the manhole than the other incoming lines. The other, generally smaller incoming line(s) shall enter the manhole a minimum of 0.1 Ft. higher than the invert of the largest line. Maximum inside drop from upstream invert to downstream invert shall be twelve inches (12").

Where new lines are proposed to connect to the District's outfall lines, (i.e. lines 15-inches in diameter or greater), the crown of the incoming line shall match the crown of the outfall line.

Manholes shall have a minimum inside diameter of four (4) feet. Manhole sizing for various line sizes and multiple inlet configurations is presented on the "Standard Manhole" construction detail.

Sanitary sewer lines shall be designed so the angle between any upstream line and the downstream line is ninety degrees (90°), minimum

## **2.05 SANITARY SEWER SYSTEM LOCATION AND ALIGNMENT**

### **A. General Location in Streets**

Where sanitary sewers are located in the street right-of-way, they shall be designed to the following guidelines.

In streets running generally north and south, the sewer line shall be placed ten feet (10') west of the street centerline.

In streets running generally east and west, the sewer line shall be placed ten feet (10') south of the street centerline.

In streets shaped as a "U" or on streets having unusually sharp turns, the water line will conform to the above Specifications as near as is practical, but shall not "zigzag" across the street centerline. An offset from the centerline shall be selected and shall be followed within the street. The final location shall be as determined by the District during plan review.

Curvilinear sewer mains are not allowed. Designs shall attempt to minimize the number of manholes. In no case shall the sewer line be designed closer than three (3) feet to the lip of a crossspan, or gutter, or ten (10) feet to any right-of-way line.

Where stubouts are to be provided for service to future areas, they shall be located in conformance with the "Stubout Configurations" detail.

## **B. General Location in Easements**

Where sanitary sewer lines are proposed in easements, they shall be designed within the easement boundary to the following minimum requirements. Sanitary sewer easements shall be a minimum of thirty feet (30') wide and shall have legal descriptions and drawings prepared in accordance with these Specifications. Wider easements will be required for sewers installed with other utilities, where sewer depth exceeds 12', or other reasons deemed necessary by the District. All easement widths are subject to review and approval by the District. Manholes shall be provided at each end of any easement. Easements shall provide easy access to manholes by a tandem wheeled maintenance truck. If the sanitary sewer line is the only utility proposed to be constructed within the easement, the alignment shall be on the easement centerline. Where easements straddle property lines, the sanitary sewer alignment shall be a minimum of ten (10) feet from one edge of the easement and a minimum of ten (10) feet from the property line. When selecting the location of utility lines within an easement, consideration shall be given to excavation, maintenance, and repair requirements. In no case shall the sewer line be designed closer than 10 feet to any easement boundary. Sewer lines in unpaved easements shall be AWWA C900 DR18 PVC.

The District requires that all utility easements be a separate "out lot" or parcel, entirely on one lot. Easements divided by a property line of two separate owners or lots are not acceptable.

A copy of the Grading Plan and Landscaping Plan showing the proposed conditions at the easements shall be submitted for review by the District.

## **C. Easement Legal Descriptions and Drawings**

Easement legal descriptions and drawings shall be prepared under the direct supervision of a Professional Land Surveyor, Registered in the State of Colorado.

Legal descriptions and drawings shall be prepared on letter sized (8½" x 11") paper, and shall be referenced to the nearest section corner. Legal descriptions may also be tied to a recorded plat. The legal description shall be a "meets and bounds" description, accurately describing to a hundredth of a foot, the point of beginning, each easement line bearing and distance, and the total area contained in acres.

Easement drawings shall be presented at a scale sufficient to clearly show all easement boundaries. The drawing shall show the north arrow, referenced section corner, all bearings and distances, total acres, adjacent property identification, street names, and date of preparation.

Easement legals shall bear a professional land surveyor (State of Colorado) seal and signature. The easement legal and drawing shall be included with the District's Standard Easement Deed. A sample copy of the Standard Deed is included in the appendix. The District reserves the

right to modify the conditions of the Easement Deed, at any time, for specific projects.

Legal descriptions and drawings should be submitted to the District for review along with closure calculations and a Title Insurance Commitment covering the subject right-of-way. A copy of each document listed in the Title Commitment must be included. All expenses incurred in obtaining Title Insurance shall be paid by the Grantor.

The District will not permit construction of a project until all easements related to the project are fully signed and recorded on the County Records.

#### **D. Relation to Other Utilities**

Sanitary sewer lines in streets and easements shall be designed to provide a minimum separation of ten (10) horizontal feet measured between the centerline of any water line or appurtenance and centerline of the sanitary sewer. Horizontal edge-to-edge separation with utilities other than water lines shall be five (5) horizontal feet minimum, and shall in all cases allow for future excavation of the sewer line without causing damage to the adjacent utility.

Where sanitary sewer lines are proposed to cross water lines or storm sewer lines or other utility lines, they shall be designed to cross at an angle close to ninety degrees (90°). Minimum vertical clearance between the edge of sanitary sewer line and edge of the water line or other utility, shall be eighteen inches (18").

#### **E. Depth**

Minimum depth of sanitary sewer lines shall be six (6) feet measured from the top of pipe to final street grade. Lines proposed to be constructed with less than six (6) feet minimum cover shall require written special permission by the District. Maximum depth of sanitary sewer lines shall be reviewed by the District on a case-by-case basis, but in all cases, the maximum depth shall not exceed the depth where future excavation of the installed sewer line cannot be accomplished due to the existing or future location of another utility, street improvements, structure, or foundation.

### **2.06 SANITARY SEWER SYSTEM LAYOUT AT CREEK CROSSINGS**

Where sanitary sewer lines are proposed to cross creeks or drainage-ways, they shall be designed to cross perpendicular to the creek or drainage-way centerline. Manholes shall be provided on each side of the crossing which can be easily accessed by a tandem wheeled maintenance truck. A specific geotechnical investigation shall be performed by the owner for each proposed crossing to evaluate potential 100 Year Flood scour depths of the creek or drainage-way at ultimate development of the drainage basin. After the investigation has been reviewed by the District, minimum depth of the sanitary sewer lines will be

established, as well as any encasement and/or erosion protection requirements. Review by the County, UDFCD, SEMSWA, Corps of Engineers, and other agencies may be required.

## 2.07 MANHOLES

### A. General

Manholes shall be provided at all changes in grade, changes in alignment, dead-end lines, and at junctions with other sanitary sewer lines. Manholes shall be installed on straight sections of line at distances not greater than 400 feet for sanitary sewers 15-inches in diameter or less, and 500 feet for sanitary sewers 18-inches in diameter or greater.

### B. Manhole Size

All manholes shall have a minimum inside diameter of four feet (4'), or two feet (2') greater than the outside diameter of the largest pipe entering or leaving the manhole. The following Table 2.3 should be used as a guideline.

TABLE 2.3 – MANHOLE SIZING	
<u>Two Way Manholes</u>	
Maximum Nominal Pipe Size	Minimum Manhole Inside Diameter
18" or smaller	4' – 0"
21" to 36"	5' – 0"
42" or larger	Sizing by District
<u>Three and Four Way Manholes</u>	
Maximum Nominal Pipe Sizes	Minimum Manhole Inside Diameter
3-Way 8"	4' – 0"
4-Way 8"	4' – 0"
3-Way 12"	4' – 0"
4-Way 12"	5' – 0"
3-Way 18"	5' – 0"
4-Way 18"	6' – 0"

Three and Four way manholes having a pipe larger than 18" shall be sized by the District.

### C. Manhole Depth

Minimum manhole depth shall be as required to provide six (6) feet (or 4.5 feet, if required by the District) of cover over the top of the upstream pipe. Maximum depth shall be reviewed and determined by the District on a case-by-case basis. Where the depth of a manhole is twenty (20) feet or more from cover to invert, an intermediate platform shall be located at the midpoint of the manhole in accordance with the "Intermediate

Platform" construction detail. At the District's discretion "Intermediate Platforms" may also be required in drop manholes and other manholes with less than twenty (20) feet of cover.

**D. Grade Adjustment**

Manholes shall be constructed to permit grade adjustments by use of precast concrete adjusting collars or brick courses not to exceed a total height of twelve (12) inches. In open space or landscaped areas, manhole rims shall be set four (4) inches above grade (or as requested by District) to prevent infiltration from surface runoff. Manholes in areas of unpaved interim conditions will require adjustment to final grade/paving by Owner.

**E. Drop Manholes**

Drop manholes shall not be constructed where the sanitary sewer line design can be modified to provide the maximum inside drop of twelve (12) inches. Where this is not possible, and by special request of the District, drop manholes may be designed and constructed. Maximum permitted outside drop shall be reviewed and determined by the District on a case-by-case basis.

**F. Service Connections to Manholes**

Service connections are generally not permitted at manholes except for the case when one (1) service is permitted to connect at a dead-end manhole. Service connections at manholes shall not be made directly to the manhole. The design and installation of a service at a manhole shall conform to the Service Connection To Dead-End Manhole detail.

**2.08 SANITARY SEWER SERVICE CONNECTIONS**

Sanitary sewer services shall be designed to transport the peak sewage flow from any residential or non-residential use to the sanitary sewer system. Services shall be sized by the Owner's Architect or Mechanical Engineer using the International Plumbing Code (IPC) method, and shall be a minimum of four (4) inches in diameter. Service sizing calculations shall be submitted to the District for review whenever a new service line is proposed and whenever an existing non-residential service changes ownership or intended use. The District is not responsible for the sizing or adequacy of the service line to perform its intended use and assumes no responsibility for the service lines maintenance or operation.

Service wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right or left side connection (looking upstream), and the invert of the sewer main at wyes and plugs shall be shown in tabular form on the plans. Sanitary sewer services shall be located a minimum of ten (10) feet from water services, typically on the downhill side of the water service.



No connection between the District main and a service line shall be made except in a public street or in some other place to which the District has at least as free a right of access as it would have in a public street.

## **2.09 CLEANOUTS**

Permanent cleanouts are not permitted on East Cherry Creek Valley Water and Sanitation District lines. Cleanouts should be designed on private service lines in accordance with International Plumbing Code Section 708 and any other local jurisdictional plumbing regulations.

## **2.10 OIL, SAND AND GREASE INTERCEPTORS**

### **A. General**

All restaurants, cafeterias, supermarkets, bakeries, food processing, or other food preparation facilities shall have a grease interceptor installed on the sewer service line. The grease interceptor sizing and location shall be determined by the Owner's Engineer based on the criteria outlined below. All calculations shall be submitted to the District for review. Construction, ownership and maintenance of the grease interceptor shall be the Owner's responsibility. Bypasses are not permitted around grease interceptors.

Facilities which discharge any quantities of sand, oil or other inert debris into the sanitary sewer service shall have a sand and oil interceptor installed on the sewer service line. Examples of such facilities include, but are not limited to: automobile service stations, mechanical repair shops, car washes, garden nurseries, warehouses, and parking garages with floor drains. The sizing and location of the sand and oil interceptor shall be determined by the Owner's Engineer based on the criteria outlined below. All calculations shall be submitted to the District for review. Construction, ownership and maintenance of the sand and oil interceptor shall be the Owner's responsibility. Bypasses are not permitted around sand and oil interceptors.

In all cases, sand, oil and grease interceptors shall be located on the service line outside the building served, upstream of the location where human waste enters the service, and so installed and connected as to be easily accessible for inspection and cleaning. The District will determine whether a sand, oil, and grease interceptor is required whenever a new service line is proposed, and whenever an existing service line changes ownership or intended use. If the District determines that an existing facility needs to have a sand, oil, and/or grease interceptor installed, the Owner shall be required to provide the interceptor at his own cost, even if the interceptor was not originally required on the service line.

### **B. Engineering Review**

Two (2) sets of plans and specifications, including complete mechanical and plumbing sections with interceptor detail and calculation shall be

submitted to the District for review prior to construction. This submittal will be accompanied by a narrative explanation of the operation or process from which the interceptor will be receiving drainage. Interceptor designs must meet the criteria set forth in the following paragraphs and in accordance with the appropriate sections in the District's Rules and Regulations.

**C. Criteria**

When determining the minimum size of interceptor required, the following will be considered. It is the Owner's and/or Owner's Engineer's responsibility to determine the adequate size of the interceptor.

**1. Grease Interceptor Criteria**

**Method 1: 2006 UPC Formula**

**Step 1 – Meals per Peak Hour = Seating Capacity X Meal Factor**

Meal Factors

Fast Food (45 min).....	1.33
Restaurant (60 min).....	1.00
Leisure Dining (90 min).....	0.67
Dinner Club (120 min).....	0.50

**Step 2 – Waste Flow Rate:**

With Dishwasher.....	6 gallon flow
Without Dishwasher.....	5 gallon flow
Single Service Kitchen.....	2 gallon flow
Food Waste Disposer.....	1 gallon flow

**Step 3 – Retention Time**

Commercial kitchen waste/dishwasher.....	2.5 hours
Single service kitchen.....	1.5 hours

**Step 4 – Storage Factor**

Commercial kitchen – 8 hour operation.....	1
Commercial kitchen – 16 hour operation.....	2
Commercial kitchen – 24 hour operation.....	3
Single service kitchen.....	1.5

**Step 5 – Capacity**

Multiply values from Steps 1-4. The result is the minimum approximate grease interceptor size for this application.

<b>Meals per Peak Hour</b>		<b>Waste Flow Rate</b>		<b>Retention Time</b>		<b>Storage Factor</b>		<b>Capacity (gal)</b>		<b>Interceptor Size (gal)</b>
(1)	x	(2)	x	(3)	x	(4)	=	(5)		

## Method 2: Drainage Fixture Unit Calculation

Where food is prepared, but as a general rule not consumed on the premises, or where seating capacity or number of meals served cannot adequately be determined, the following rule shall apply:

The following table establishes the drainage fixture unit values for various pieces of kitchen equipment, which may require connection to a grease interceptor. One drainage fixture unit shall equal 7.5 GPM. The total number of drainage fixture units shall be multiplied by 7.5 GPM to determine maximum rate of flow (GPM) possible into the grease interceptor. The volumetric capacity of the unit shall be five times the maximum rate of flow.

### Fixture Unit Values

Type of Fixture	Fixture Unit Value
Clothes Washer .....	3
Combination Sink and Tray with Food Waste Grinder .....	4
Combination Sink and Tray with one 1 ½ Inch Trap .....	2
Combination Sink and Tray with Separate 1 ½ Inch Traps .....	3
Pot or Scullery Sink .....	4
Prep Sink .....	2
Service Sink (Standard Trap) .....	3
Service Sink (P Trap) .....	2
All Other Fixtures:	
1 ¼ Inch or less Trap Size .....	1
1 ½ Inch Trap Size .....	2
2 Inch Trap Size .....	3
2 ½ Inch Trap Size .....	4
3 Inch Trap Size .....	5
4 Inch Trap Size .....	6

Example: A total of 21 fixture units are to be discharged to a grease interceptor. 21 F.U. x 7.5GPM x 5 minute retention = 787.5 gallons.

### Method 3: for Schools (Public and Private)

The sizing of grease interceptors for school kitchens shall be as follows:

Number of students x .6 (average daily participation) x 2.5 gallons per meal served equals volumetric capacity of grease interceptor. Example: 650 students x .6 ADP = 390 meals. 390 meals x 2.5 gallons/meal = 975 gallons.

## 2. Sand Oil Interceptor Criteria

### a. Materials and Structures

All sand and oil interceptors shall be two compartment, pre-cast concrete tanks. The smallest compartment shall have 1/3 the capacity of the entire interceptor.

### b. Location

All sand and oil interceptors shall be located outside, on private property, within thirty (30) feet and not less than five (5) feet from the facility served, unless otherwise approved by the District, and shall be accessible at all times for maintenance and inspection.

### c. Sizing

No combination sand and oil interceptor smaller than 750-gallon capacity shall be installed at a single bay facility.

The sizing shall be reviewed by the District and shall be as follows:

Three (3) inch diameter flow drains are rated at six (6) drainage fixture units (DFU)

Four (4) inch diameter flow drains are rated at eight (8) DFU

Sizing formula shall be as follows:

$DFU \text{ connected} \times 7.5 \text{ GPM} \times 5 \text{ minutes} = \text{Interceptor Size.}$

#### i. Trough Drains

Where trough drains are used, each bay, or compartment, or area equaling the square foot surface of a standard service station bay which is served by a trough drain shall be rated at six (6) DFU per bay.

#### ii. Vehicle Wash Drains

Vehicle wash drains will be rated at eight (8) DFU each regardless of size.

### d. Connections to Interceptors

i. (All drains from the kitchen, food preparation, and dishwashing areas shall be connected to the grease interceptor.

- ii. Garbage grinders not connected to the grease interceptor shall not be used for disposal of grease. However, the District, at its discretion, may require any garbage grinder to go through the grease interceptor.
- iii. All drains from automotive servicing areas, etc., will be connected to oil and sand interceptors.

e. Design Review

Drawings shall be submitted to the District indicating, but not limited to the following:

- i. Building use and size, site layout, proposed service locations, size, alignment, grades and tie-in locations.
- ii. Service sizing calculations.
- iii. Proposed interceptor location with respect to the building, street improvements and landscaping.
- iv. Interceptor sizing and by-product rate of generation calculations.
- v. Interceptor shop drawings.
- vi. Process description of system generating sand, oil or grease.
- vii. The proposed maintenance schedule.

The District will review the above information in order to verify that an interceptor will be installed that is generally in conformance with accepted practices. The District is not responsible for the sizing or adequacy of the interceptor to perform its intended use, and assumes no responsibility regarding the interceptors' maintenance or operation.

The District requires precast vaults located outside the building for grease traps within the District.

## 2.11 INDUSTRIAL PRETREATMENT

Any development which generates industrial wastewater will be required to install a pretreatment process prior to the sewage effluent entering the public sanitary sewer system. It is the industrial development Owner's responsibility to be in compliance with the Sewer Service Section of the District's Rules and Regulations. The Owner is required to contact the District and Metro Wastewater Reclamation District to determine the type and degree of pretreatment required.

## 2.12 UNDERDRAINS

Underdrain systems shall not be considered part of the District's sanitary sewer system. Underdrain systems shall not be designed, reviewed, accepted, subject to construction observation, or maintained by the District.

The District reserves the right to deny any proposed underdrain system from being constructed beneath the sanitary sewer system. If the District permits an underdrain system, the Owner must provide proof that the underdrain system will be owned, maintained, and repaired by some entity other than the District, such as, the County, the Homeowners Association, etc.

Underdrain system sizing, capacity, and type of construction shall be designed by the Owner's consulting engineer. The following guidelines are presented to protect the sanitary sewer system from any adverse impacts of the underdrain system.

- A. The underdrain system shall be designed and constructed as a groundwater conveying system that is independent of the sanitary sewer foundation and bedding material.
- B. Sanitary sewer bedding shall not be used in the underdrain systems. Filter fabric shall be placed beneath the sanitary sewer system and above the proposed underdrain systems.
- C. All pipes proposed to be installed beneath the sanitary sewer system shall have a pipe class equal to or greater than the sanitary sewer pipe.
- D. All pipes proposed to be installed beneath the sanitary sewer system shall be solid wall pipe. This is to contain any water collected in home foundation drains inside the underdrain pipe system. If perforated drains are anticipated, submit the geotechnical or other reports detailing the need for perforated underdrain pipe in the areas the underdrain is in the common trench with the sanitary sewer pipe. If underdrains are approved, the Type B Standard Bedding with Underdrain is required.
- E. Underdrain systems shall have adequate daylight points as underdrain systems are not permitted below the District's outfall sanitary sewer lines. Clay cut-off walls shall be installed with solid wall pipe downstream of the cut-off wall where the underdrain system alignment daylights away from the sanitary sewer system.
- F. Underdrain systems shall not pass beneath any manhole or structure, but shall be routed around the manhole or structure using solid wall pipe.
- G. Underdrain cleanouts shall not be permitted to be installed in sanitary sewer manholes.
- H. Details for construction around manholes and cut-off walls shall be submitted to the District for review.

- I. The locations of the underdrain system and daylight points shall be referenced on the Construction Plans.

The following note should be placed on all sanitary sewer system construction plans for developments with underdrain systems:

"Underdrain systems are not a part of the District's sanitary sewer system and shall not be designed, reviewed, accepted, subject to construction observation, owned, or maintained by the District."

## **2.13 PROTECTION OF WATER SUPPLIES**

### **A. Water Supply Inter-Connections**

There shall be no physical connection between a public or private potable water supply system and a sanitary sewer, or appurtenance thereto which would permit the passage of any sanitary sewage or non-potable water into the potable water supply.

### **B. Relationship to Water Supply Source**

While no general statement can be made to cover all conditions, it is generally recognized that sanitary sewers must be kept remote from public water supply wells or other water supply sources and structures in accordance with the applicable Colorado State and/or County Health Department Standards.

### **C. Relationship to Water Lines**

Sewers shall be located a minimum of ten (10) feet horizontally from existing or proposed water lines (centerline to centerline distance). Where sewer lines cross water mains, the sewer pipe shall be a minimum of eighteen inches (18") clear distance vertical separation from the water line. If this clear distance is not feasible, the crossing must be designated and constructed so as to protect the water line. Minimum protection shall consist of the installation of an impervious and structural sewer. For example:

Example 1 - Where 18" clear distance is provided between the bottom of sewer and top of water line, one length of AWWA C-900 PVC pipe, at least 20 feet long shall be centered over the water line. Joints of the sanitary sewer pipe shall be encased in a concrete collar at least 6" thick and extending at least 6" either side of the pipe joint.

Example 2 - Where 18" clear distance is not provided, AWWA C-900 PVC sewer pipe with reinforced concrete encasement shall be used. Encasement shall be in accordance with the "Concrete Encasement Detail," found in Section 5 and shall extend a minimum distance of 10 feet from either side of the water main.

In all cases, suitable backfill or other structural protection shall be provided to preclude settling and/or failure of any pipe.

## **2.14 ENCASEMENTS AND CASINGS**

### **A. Concrete Encasements**

Concrete encasements may be required by the District, under the following conditions:

1. Where sewer lines are at a depth too shallow to sustain traffic loads or any other load to which they are, or will be subjected
2. At locations where horizontal or vertical movement or loading of the sewer line may be experienced (i.e., in stream beds)
3. At potable water supply crossings
4. At any other location designated by the District

Concrete encasements shall provide concrete and reinforcement in accordance with the "Concrete Encasement" Detail in these specifications, and shall be of a length to completely span the condition encountered. The concrete encasement detail is generally acceptable for most conditions but the District may require a special, site specific concrete encasement on a case by case basis.

### **B. Pipe Casings**

Pipe casing shall be used where bores or protective installations are required and in locations required by the District. All pipe casings shall be constructed to conform to the casing pipe and carrier pipe detail.



## **SECTION 3. CONTRACTORS' CONSTRUCTION REQUIREMENTS**

### **3.01 GENERAL CONSTRUCTION STANDARDS**

All excavations affecting or involving any part of the District System, and all work on Main Extensions, Taps, or other District facilities shall be performed in conformity with and are subject to the requirements and conditions set forth herein. Whenever any provision of these Specifications or the Rules and Regulations imposes a duty addressed in this Section upon a Property Owner, the term "Contractor" set forth in this Section shall be deemed to apply also to the Property Owner.

#### **A. Compliance**

Contractor shall comply with all District, Aurora, State and Federal Rules, Regulations, Standards and Specifications.

#### **B. Permits**

The Contractor shall be solely responsible for determining and obtaining any and all permits required for the work from other governmental entities or agencies having jurisdiction, and shall perform the work in accordance with any and all applicable ordinances, regulations, laws and orders of, or permits issued by such entities or agencies.

#### **C. Subsurface Structures**

The District will make available to the Contractor record drawings showing the location of its facilities in the vicinity of the work, but the Contractor shall be finally and solely responsible for determining the existence and location of all subsurface structures in such area.

If a Contractor damages any District facilities during construction, he shall immediately notify the District. The Contractor shall provide bypass pumping, at his own cost, until the District reviews the damage and proposes remedial measures. All costs to repair the District facilities shall be borne by the Contractor. Repairs shall be performed in accordance with the "Sanitary Sewer Line Repair" detail and the District site specific recommendations.

Any Contractor who damages District facilities shall indemnify and hold the District harmless against any and all claims for damage resulting therefrom, and shall indemnify and hold the District harmless against any and all claims for damages to any such structures.

#### **D. Warranty**

All materials and workmanship furnished by the Contractor shall conform to these Specifications and to all plans and designs accepted by the District, and shall be free from all defects due to faulty or nonconforming

materials or workmanship for a period of one year. The one year period will begin on the substantial completion date granted by the District.

**E. Independent Investigation**

Contractor shall thoroughly examine the work site to ascertain for himself all soil, geological, groundwater and other conditions to be encountered which might affect the work being undertaken. The Contractor shall enter into such work relying on his own investigation and information, and not on any statements or representations, if any, that have been made by the District.

**F. Indemnification**

By undertaking any work subject to this section, Contractor agrees to indemnify and hold harmless the District from any and all liability, claims, and demands, on account of injury, loss, or damage, including without limitation claims arising from bodily injury, personal injury, sickness, disease, death, property loss or damage, or any other loss of any kind whatsoever, which arise out of or are in any manner connected with any work subject to this section if such injury, loss, or damage is caused in whole or in part by, or is claimed to be caused in whole or in part by, the act, omission, error, professional error, mistake, negligence, or other fault of Contractor, or which arise out of any Workmen's Compensation claim of any employee of the Contractor. Contractor agrees to investigate, handle, respond to, and to provide defense for and defend against such liability, claims or demands at the sole expense of Contractor. The Contractor also agrees to bear all other costs and expenses related thereto, including court costs and attorney fees, whether or not any such liability, claims, or demands alleged are groundless, false, or fraudulent. Nothing in this subsection shall be deemed to impose upon Contractor any obligation to defend or hold the District harmless against claims for damages legally caused by any unlawful act or omission of the District.

**G. Insurance**

1. Contractor shall procure and maintain, at its own cost, a policy or policies of insurance sufficient to insure against all liability claims, demands, and other obligations assumed by Contractor. The Contractor shall not be relieved of any liability, claims, demands, or other obligations assumed by reason of its failure to procure or maintain insurance, or by reason of its failure to procure or maintain insurance in sufficient amounts, durations, or types.
2. To the extent the same may be commercially available, Contractor shall procure and maintain, and shall cause all subcontractors of the Contractor to procure and maintain, the minimum insurance coverages listed below. Such coverages shall be procured and maintained with forms and insurers acceptable to the District. All coverages shall be continuously maintained to cover all liability, claims, demands, and other obligations assumed by Contractor.

In the case of any claim-made policy, the necessary retroactive dates and extended reporting periods shall be procured to maintain continuous coverage.

- a. Workmen's Compensation insurance to cover obligations imposed by applicable laws for any employee engaged in the performance of the work, and Employers' Liability with a minimum limits of FIVE HUNDRED THOUSAND DOLLARS (\$500,000) each accident, FIVE HUNDRED THOUSAND DOLLARS (\$500,000) disease-policy limit, and FIVE HUNDRED THOUSAND DOLLARS (\$500,000) disease-each employee. Evidence of qualified self-insured status may be substituted for the Workmen's Compensation requirements of this paragraph.
  - b. General liability insurance with a minimum combined single limit of ONE MILLION DOLLARS (\$1,000,000) each occurrence and TWO MILLION DOLLARS (\$2,000,000) aggregate. The policy shall be applicable to all premises and operations. The policy shall include coverage for bodily injury, broad form property damage (including completed operations), blanket contractual, independent contractors, for explosion, collapse, and underground hazards. The policy shall contain a severability of interests provision.
  - c. Comprehensive Automobile Liability insurance with minimum combined single limits for bodily injury and property damage of not less than ONE MILLION DOLLARS (\$1,000,000) each occurrence and ONE MILLION DOLLARS (\$1,000,000) aggregate with respect to each of Contractor's owned, hired or non-owned vehicles assigned to or used in performance of the services. The policy shall contain a severability of interests provision.
3. The policy required by paragraph (2) above and by paragraph (3) above shall be endorsed to include the District and its officers and employees as additional insureds. Every policy required above shall be primary insurance and any insurance carried by the District shall be excess and not contributory insurance to that provided by Contractor. No additional insured endorsement to the policy required by paragraph (1) above shall contain any exclusion for bodily injury or property damage arising from completed operations. Contractor shall be solely responsible for any deductible losses under any policy required above.
  4. Failure on the part of Contractor to procure or maintain policies providing the required coverages, conditions, and minimum limits shall constitute cause for issuance of a Stop Work Order. In addition, without waiving any other available remedy, the District

5. The District relies on, and does not waive or intend to waive the monetary limitations or any other rights, immunities, and protections provided by the Colorado Governmental Immunity Act, as now or hereafter constituted, or otherwise available to the District.

### **3.02 REQUIRED SUBMITTALS**

No Contractor shall begin any excavation or any other work on any Main Extension, Tap, or other District facilities until he has obtained the prior authorization of the District therefore, and has submitted, in addition to any other materials required elsewhere herein, the following, accepted as to form by the District:

#### **A. Written Agreement**

A document duly signed by Contractor (1) acknowledging his consent to be bound by the provisions of the "General Construction Standards"; (2) warranting that the work will conform to such provisions and will be free from defects due to faulty or nonconforming materials and workmanship; (3) agreeing to indemnify the District as provided above in 3.01 Paragraph F, and (4) agreeing to pay any and all applicable fees and charges provided by these Specifications and the Rules and Regulations in connection with the work.

#### **B. Insurance Certificate**

Certificates prepared by Contractor's insurance agent in form satisfactory to the District evidencing that policies providing the required coverage, conditions, and minimum limits are in full force and effect. The certificate shall identify the work being performed and shall certify that should any of the coverage afforded under the policies be cancelled before the expiration date thereof, the issuing company will mail 30 days prior written notice to the District. District reserves the right to request and receive a certified copy of any policy and any endorsement thereto.

#### **C. Fees**

The full amount of all fees payable in advance, or any required costs deposits, or both.

### **3.03 STOP WORK ORDERS**

#### **A. Order**

The District may revoke any authorization for work and issue a Stop Work Order upon a determination that the Contractor has violated or is about to violate any condition of any plan acceptance, any provision of these Specifications or Rules and Regulations, or any other standard, specification, or rule imposed by the District. A Stop Work Order shall take effect immediately upon the entry thereof by the District and notice to the Contractor, and shall remain in full force and effect until rescinded in writing by the District.

#### **B. Effect**

It is unlawful for any person to do any work in violation of the terms of any Stop Work Order issued pursuant to this section except such as may be permitted by the District in order to render the construction site safe and secure.

### **3.04 CURE OF DEFECTS**

#### **A. Order to Cure**

If the District determines that any part of the work was not performed in conformity with these Specifications, Rules or Regulations or accepted plans, or is defective, of poor or unworkmanlike quality, or is otherwise not in conformity with any applicable warranty, it may give written notice thereof to the Contractor. Such notice shall specify the non-conformity, direct the Contractor at his cost to perform specified remedial work, and specify the period of time determined by the District reasonably necessary for completion of the remedial work.

#### **B. District Cure**

If the Contractor fails within the time stated following such notice to cure the non-conformity specified therein, the District, in addition to and without waiving any of its other remedies, may perform the work and charge the Contractor for its actual costs incurred in connection therewith, calculated in accordance with the rates set forth in the Rules and Regulations.

### **3.05 PRECONSTRUCTION MEETING**

A Preconstruction Meeting shall be arranged by the District Engineer and held prior to the start of any work. The District Engineer, Contractor, Soils Engineer, Surveyer, and Developer, or Developer's Engineer, must be represented at this meeting, which shall generally be held at the District Office. After the Preconstruction meeting is held, the Contractor shall, at least 48 hours prior to the start of construction, notify the District of its construction schedule and start date.

### **3.06 CONSTRUCTION PLANS**

Construction Plans shall be reviewed and signed by the District and the District's Consulting Engineer. The signed plans and a copy of these Specifications shall be kept on the project site by the Contractor at all times.

AutoCAD and pdf drawings must be delivered to the District at the preconstruction meeting. See section 3.11 –Record Drawings for format.

### **3.07 DEFECTIVE MATERIALS**

All materials not conforming to the requirements of these Specifications shall be considered defective. Whether in place or not, such material shall be removed immediately from the site of the work, unless otherwise permitted by the District. Rejected material, the defects of which have been subsequently corrected, shall not be used until the District has reviewed them and found them acceptable. The District will not consider conveyance and acceptance of a project if the Contractor fails to comply promptly with any order of the District made under the provisions of this Section.

### **3.08 DESIGN REVISIONS DURING CONSTRUCTION**

Should the Contractor encounter field conditions that prevent construction to occur in conformance with the reviewed and signed plans, a meeting shall be scheduled by the Contractor with the Owner's engineer and the District to discuss an alternative design. The Contractor's construction shall not deviate from the signed plans without the review of the District, or Owner's engineer.

### **3.09 CONSTRUCTION WATER**

The Contractor shall be responsible for obtaining any water required for various phases of construction. Arrangement and coordination of permits shall be made through the appropriate Water District or other agency.

### **3.10 TEMPORARY HANDLING OF SEWAGE**

Certain work in connection with tying into the existing sanitary sewer facilities may require the temporary handling of sewage either by temporary ditching, pumping, bulk heading at low flows, or other means to be accepted by the District. Sewage so diverted shall be handled in a manner so as not to create a public nuisance or health hazard. Any temporary ditching shall be backfilled and compacted, and the ground elevations restored to original conditions. A plan for temporary handling of sewage should be presented by the Contractor at the preconstruction meeting with the District.

Handling of sewage shall conform, and be acceptable to current Colorado Department of Health requirements and/or applicable City/County Health Department requirements.

### 3.11 RECORD DRAWINGS

The Contractor shall maintain on the job site, a separate set of full-size Construction Plans marked up to fully indicate field installed conditions. These drawings shall be maintained in a current condition at all times until completion of the work and shall be available for review by the District at all times. All variations from the reviewed and signed Construction Plans, for whatever reason, including those occasioned by optional materials, and those required by coordination between trades, shall be indicated. These variations shall be shown in the same general detail utilized in the original design. Upon completion of the work, the marked up set of drawings shall be furnished to the District and District Engineer for review. After review of the marked up drawings, the drawings will be returned to the Owner's Engineer with comments. The Owner's Engineer shall use the marked up plans to prepare half-sized (11 x17") mylars and AutoCAD and pdf files of the drawings. The mylars shall be a reverse read, wash-off (moist erasable) photographic 4 mil mylar reproduction. In addition to half-sized mylars, the Owner's Engineer shall supply an electronic copy of the record drawings (AutoCAD and pdf formats) as well as CAD linework for all water and sewer pipelines and associated appurtenances. This linework shall be tied to plat street centerlines and shall be accurate in relationship to Arapahoe, Douglas, Adams, and/or Denver County parcels. See following paragraph for other accuracy standards. Submit two (2) sets of mylar drawings and two disks of the electronic files.

Required disk format/record electronic files: CAD files (.dwg) shall be provided in the latest commercially available release of AutoCAD. Drawings are to be purged of all extraneous information, shall be "bound" to insert all reference files, shall be accompanied by any non-native fonts, and shall be free of complex file pathing which complicates file openings when transferred from disk. Binding of reference files shall be done using AutoCAD's Xref "Insert" option so as to avoid layer and block name corruption. Files should be on PC compatible CD and should be in Datum NAD 1983 State Plane Colorado Central FIPS 0502 (US Feet) and in decimal units. The subject parcel(s) shall reference a minimum of two physical monuments and; the monuments shall be (a) sections corner(s) and/or quarter corner(s).

The following construction information shall be added to the mylars at a letter and pen size that will be legible after reduction is completed.

Date Installed: \_\_\_\_\_  
Contractor: \_\_\_\_\_  
Field Administrator: \_\_\_\_\_  
Soils Engineer: \_\_\_\_\_  
Surveyor: \_\_\_\_\_

The finalized half-size drawings and disks with electronic files must be presented to the District prior to probationary acceptance of the project.

### **3.12 REPLACEMENT OF EXISTING STREET IMPROVEMENTS**

In areas where existing pavement, concrete improvements, storm or drainage improvements are removed during construction, they shall be replaced in kind to the limits disturbed by the sewer line construction. All replacement shall be in accordance with the appropriate City, County, or State Highway Department Standards.

### **3.13 SAFETY; TRAFFIC CONTROL**

The Contractor shall determine, initiate, maintain and supervise all measures necessary to protect the public during construction.

Traffic shall be controlled at those locations throughout the project area in order to maintain an efficient and orderly vehicular and pedestrian traffic flow. All traffic control, construction signing, and residential access, etc., shall be handled in conformance with the Uniform Traffic Control Manual and the appropriate City, County, or State Highway Department Standards.

The Contractor shall furnish, construct, maintain, and finally remove detours, road closures, lights, signs, fences, barricades, flares, miscellaneous traffic devices, flagmen, drainage facilities, reconstruct paving and such other items and services as are necessary to adequately safeguard the public, both traveling and otherwise, from hazard and inconvenience. He shall erect and maintain such warnings and directional signs as may be required by the City, County, or State Highway Department.

Should the progress of construction require closure of residential access, the Contractor shall notify the residents which may be affected at least 24 hours in advance of such closure, and provide temporary access. Prior to the start of construction, the Contractor shall notify affected residents as well as the appropriate police and fire departments, giving the approximate starting date expected, completion date, and the name and telephone number of a responsible person representing the Contractor who may be contacted at any hour.

### **3.14 CONSTRUCTION OBSERVATION**

The District shall decide any and all questions that may arise during construction as to the quality and acceptability of the materials furnished, the work performed, or the manner of performance of the work.

No observation or testing will be performed by the District on weekends or holidays without the express agreement of the District secured in advance. Whenever any observation, inspection or testing is required by any specific provision of these Specifications or the Rules and Regulations, or by the terms of any permit or plan approval, the Contractor shall give the District such notice as is required and shall not cover or otherwise obscure the work until the observation, inspection or testing has been made. The Contractor shall at his cost uncover or otherwise make such work accessible for observation, inspection or testing when ordered to do so by the District if he violates this requirement.



The observations, testing and reviews performed by the District are for the sole and exclusive benefit of the District. No liability shall attach to the District by reason of any observations, testing, or reviews required or authorized by these Specifications or the Rules and Regulations, or by reason of the issuance of any approval or permit for any work subject to this section.

The District is not a guarantor of the construction Contractors' obligations and performance of contract.

Observations of work in progress and on-site visits are not to be construed as a guarantee by the District of the Contractors' performance.

The District is not responsible for safety in, on, or about the Project site, nor for compliance by the appropriate party of any regulations relating thereto.

The District exercises no control of the safety or adequacy of any equipment, building components, scaffolding, forms, or any other work aids used in or about the project, or in the superintending of the same.

### **3.15 GEOTECHNICAL OBSERVATION**

Geotechnical observation and backfill density tests will be performed by the Owner's Soils Engineer to provide acceptable fill control, bedding compaction, and foundation suitability. All supervision necessary to control fill and compaction tests will be at the expense of the Owner. If the first compaction test does not meet with the Specifications, the sub-standard areas shall be reworked and additional compaction tests will be performed until the Specification is met. Any deviation from the plans, Specifications, or soils report, must be corrected by the Contractor to the satisfaction of the District. Copies of all compaction tests shall be provided to the District on the working day following the test. The location and frequency of compaction testing will be determined by the District on a case-by-case basis.

### **3.16 FEES**

Contractor or Owner will pay the District all fees imposed and assessed by the District for reviews, observation, inspections, tests, approvals, and any other undertakings performed by the District or its professional consultants in connection with the administration and enforcement of these Specifications and the Rules and Regulations.

## **SECTION 4. MATERIALS, TESTING AND INSTALLATION**

### **4.01 GENERAL**

All sanitary sewer system materials, construction and testing shall be in accordance with these Specifications. Any material proposed as "an equal" must be reviewed and found acceptable by the District prior to design or construction unless specified otherwise by the District. PVC pipe material shall be used for sanitary sewer system construction.

### **4.02 POLYVINYL CHLORIDE (PVC) PIPE**

#### **A. General**

All non-pressurized plastic pipe and fittings shall be polyvinyl chloride (PVC) and shall meet the requirements of ASTM D 1784 "Rigid Poly (Vinyl Chloride) and Chlorinated Poly (Vinyl Chloride) Compounds" and ASTM D 3034 SDR 35, (sizes 8-inches through 15-inches) or ASTM F 679 SDR 35 (18" through 27"), "Type PSM Polyvinyl Chloride (PVC) sewer pipe and fittings" latest revision. Pipe and fitting markings shall include the appropriate ASTM and Cell Classification Numbers (12454-B or 12454-C or other ASTM approved classifications). Unmarked pipe and fittings will be rejected.

#### **B. Straightness**

Maximum allowable curvature as measured from the concave side of the pipe shall not exceed 1/16" per foot of length.

#### **C. Joint Type**

PVC joints shall be made using an integral bell and spigot type rubber gasketed joint. Each integral bell joint shall consist of a formed bell and a single rubber gasket. Gaskets shall conform to ASTM F-477.

#### **D. Thickness Class**

All PVC sewer pipe shall have an SDR ratio of 35 unless otherwise specified by the District.

#### **E. Laying Lengths**

PVC pipe shall have normal laying length of either 18 or 20 feet.

#### **F. Installation and Testing**

Per these Specifications.

#### **4.03 AWWA C 900 POLYVINYL CHLORIDE PIPE (PVC)**

##### **A. General**

All AWWA C900 polyvinyl chloride pipe (PVC) furnished under these Specifications, shall be manufactured in strict accordance with AWWA Standard Specifications C900, latest revision, with the following additional requirements:

##### **B. Size of Pipe**

This Specification includes PVC pressure class pipe eight inches (8") through twelve inches (12").

##### **C. Thickness Class**

Pipe furnished under this Specification shall be a minimum of Class 150, SDR 18 with a minimum sustained pressure requirement of 500 psi and a burst pressure requirement of 755 psi at 73.4° F.

##### **D. Laying Lengths**

Pipe shall have a normal laying length of twenty (20) feet, or ten (10) feet where designated for curves. Random lengths shall not be acceptable.

##### **E. Joint Type**

Pipe joints shall be made using an integral bell and spigot type elastomeric gasketed push-on type joint. Solvent cement joints are strictly prohibited. Gaskets shall conform to ASTM F-477.

##### **F. Installation and Testing**

Per these Specifications.

#### **4.04 SANITARY SEWER PIPE FITTINGS**

##### **A. Fittings and Branches**

Branches of the size and type shown on the reviewed and signed Construction Plans shall be furnished for service connections. In line "wyes" are the only fittings acceptable for service connections to new construction. "Wye" branches shall have their axis approximately 45° (unless otherwise specified on the plans to the longitudinal axis of the pipe. All branches shall be of sufficient length to permit making a proper joint when the connecting pipe is inserted in the branch socket.

Service connections to existing PVC pipe requires the use of a long body style "wye" saddle and rubber gasket secured to the pipe using a solvent weld and double stainless steel straps.

Secure connections to existing concrete or vitrified clay pipe requires the use of a PVC "tee" saddle and rubber gasket secured to the pipe with double stainless steel straps. The service connection shall be encased in concrete.

**B. Plugs**

Pipe plugs shall be 3/4" in thickness and shall have a factory-made polyvinyl chloride (PVC) joint material bonded to the pipe. The material shall be molded and cured to a uniform hardness and compressibility, and form a tight compression coupling when assembled. The material used for the compression joint shall conform with the type of pipe material specified.

Neoprene (synthetic rubber) plugs shall be equal to those manufactured by Gladding McBean and Company or equal. The joint formed by the plug and pipe shall be a tight compression coupling when assembled.

**C. Installation and Testing**

Fitting installation shall be in accordance with the manufacturer's recommendations.

**4.05 MANHOLES**

**A. General**

This Section outlines the material and installation requirements for manholes. Excavation, foundations and backfill requirements are described in Section 4.12. All manhole structures shall be designed for H-20 traffic loading in accordance with AASHTO Specifications.

**B. Cast-In-Place Concrete Bases**

Cast-in-Place manhole bases shall extend a minimum of eight-inch (8") below the pipe invert and the overall outside base dimensions shall be one foot (1') greater than the outside diameter of the manhole barrel sections. The base shall be constructed of premixed concrete having a 28-day compressive strength of 3,000 psi, minimum. The concrete shall be composed of well-graded, well-washed, aggregate, ranging from sand to gravel one and one-half inches (1-1/2") in maximum diameter.

The mix shall contain five (5) sacks of Type II cement to the cubic yard and only enough water shall be used in the mix to give a slump test result of two-inches (2"). Air entrained in the mix when placed, shall be between 3% and 5%. Base reinforcing steel shall be in accordance with the "Standard Manhole" detail found in Section 5 of these Specifications.

Sewer lines and manhole block-outs shall be set before any concrete is placed and shall be rechecked for alignment and grade after the concrete pour, but before the concrete has set. Inlets and outlets to the manhole

shall be located as indicated on the reviewed and signed Construction Plans.

All base deflectors shall be smooth and of the proper radius to provide a smooth flow transition in accordance with the "Base and Deflector" detail. The concrete base shall be shaped with concrete hand tools and shall receive a hard steel trowel finish before the concrete sets.

The accumulation of water on the surface of the concrete due to water gain, segregation, or other causes during placement and compacting, shall be prevented as much as possible. Provisions shall be made for the removal of such accumulated water. Under no circumstances shall new concrete be placed in standing water.

When concrete placement is performed during cold weather, the temperature of the concrete mix shall not be lower than 50° F. When concrete is placed during hot weather, the temperature of the concrete mix shall not be higher than 90° F.

When concrete is placed on grade without the use of forms, the ground shall be moistened or other provisions made to prevent the ground from drawing water from the concrete mix.

### **C. Precast Concrete Bases**

Contractors shall obtain written permission from the District prior to installing precast manhole bases. Generally, precast bases are only allowed where construction of a cast-in-place base is impractical. An example of where precast bases may be used is where a new sanitary sewer line is proposed to tie-in to an existing line in a busy street intersection.

Material Specifications for precast bases are as follows:

1. Minimum 4000 psi concrete compressive strength within 48 hours of manufacturing using Type II cement.
2. All base and barrel sections shall be poured monolithically. Reinforcement shall include #4 bars on 12-inch centers.
3. All areas of seam tears, cracks and honeycombs shall be patched and resurfaced prior to final curing.
4. Prior to coring the pipe openings and installing the pipe connection boot, all exposed reinforcing shall be coated with coaltar or epoxy paint.
5. Pipe boots or gaskets are to be placed in the cored openings - and shall be Trelleborg Forsheda 910 Connector seal meeting all ASTM 923 requirements.

6. Inverts and benches shall be extended completely across the base with a 0.20' minimum drop across the manhole invert.

The Contractor shall place a minimum of six inches (6") of one and one-half inches (1-1/2") crushed rock under the structure for leveling and structural stability. Once the base is installed, the Contractor shall make the required pipe connections and place pipe bedding. Subsequent to placing the pipe through the Forsheda boot/gasket, the Contractor shall place a one-inch (1 ") thick bead of butyl rubber sealant Conseal CS-102 or CS-202 concrete sealant or equal between the pipe and the core hole.

The void area between the precast invert, benches, and pipe shall be filled with concrete.

All key lock lifting holes shall be filled with grout prior to backfilling.

#### **D. Precast Barrel Sections**

Precast concrete barrel sections are to be used for all sanitary sewer construction.

Minimum wall thickness shall be as follows:

4' I.D. Barrel	=	5" Wall Thickness
5' I.D. Barrel	=	6" Wall Thickness
6' I.D. Barrel	=	7" Wall Thickness

Reinforcement shall be Grade 60 and for circumferential placement shall consist of one line of steel in compliance with ASTM C-478 latest revision, and shall not be less than 0.12 square inches per linear foot in 4' I.D. manholes, and not less than 0.17 square inch per linear foot in manholes 5' I.D. and greater. Spacing of circumferential steel shall not exceed 6." All splices shall be welded or lapped not less than 40 diameters of wire.

Slabs shall be reinforced with two layers of steel with a minimum area of 0.12 square inch per linear foot in both directions in each layer. Openings in flat slabs shall be additionally reinforced with a minimum of the equivalent of 0.20 square inches of steel at 90°. Straight rods used to reinforce openings shall have a minimum length equal to the diameter of the opening plus 2." Covers shall be reinforced with two layers of steel with a minimum area of 0.12 square inches per linear foot in both directions in each layer.

Concrete curing for precast material shall take place in a steam curing chamber or other moisture controlled environment for such time and at such temperature as may be needed to enable concrete to meet the minimum 3000 psi compressive strength requirement. Type II cement shall be used for all components.

Each manhole section shall be placed in accordance with the manufacturer's recommendations in a plumb position. A flexible plastic

joint sealing compound (Ram-neck) shall be used between each manhole section and shall be continuous around the entire manhole section circumference. The eccentric cone and steps shall be located over the largest bench area. All exterior and interior joints shall be grouted.

Grout shall be applied to all joint surfaces in accordance with the manufacturer's mixing and application recommendations. All surfaces receiving grout shall be moistened before grout is placed. Grout shall have a troweled finish and shall be protected from a rapid moisture loss using a covering of wet rags or polyethylene sheets. The temperature of the grout and the surfaces receiving the grout shall maintain a temperature between 65° F and 85° F until the grout has set.

#### **E. Steps**

Manhole steps shall be plastic steps manufactured by MA Industries, Inc., Model No. PS2-PF-DF (Double Face) made from copolymer polypropylene plastic with grade 60 steel reinforcement. Aluminum manhole steps are not allowed. Manhole steps shall not be used to lift manhole sections.

#### **F. Intermediate Platforms**

Manhole platforms shall be installed in all manholes having a depth, ring to invert of 20-feet or more, and in drop manholes or other manholes designated by the District. Material requirements and installation shall be in conformance with the "Intermediate Platform" construction detail.

#### **G. Ring and Covers**

Cast iron rings and covers shall conform to the drawings and details found in these Specifications. The castings shall weigh not less than 400 pounds, and shall conform to ASTM A-48. Ring and covers shall be Denver Light Pattern Cast Iron in areas of no vehicular traffic and Denver Heavy Pattern Cast Iron in streets and highways.

Locking covers may be required in select locations designated by the District.

Manhole rings and covers shall be set to the final grades shown on the plans. Manhole rings shall be securely attached to the manhole riser section with a grout bed and plastic joint sealing compound (Conseal CS-202 or equal) in pavement, or with a concrete collar in unpaved areas. After the rings are securely set in place, covers shall be installed and the assembly shall be cleaned and scraped of foreign materials.

#### **H. Flat Top Cover**

Flat top covers shall only be used with written permission of the District. Flat covers shall be a minimum of 8" thick and designed to withstand a minimum H-20 traffic loading.

**I. Final Grade Adjustments**

Final grade adjustments shall be made using a minimum of four inches (4") of concrete grade rings. Concrete grade rings shall make up the riser section providing the riser section does not exceed twelve inches (12") vertically.

Brick courses and steel grade rings are not allowed for vertical adjustment. If the riser section exceeds the vertical limitation, the riser and eccentric cone section shall be removed and the appropriate sized barrel section added, followed by cone and grade ring replacement.

Slanted final grade adjustments, to account for street cross slopes, shall be made using brick chips and cement mortar.

**J. Interior Lining**

All outfall manholes, drop manholes, or other manholes as determined by the District, shall have an interior lining. Coating material specifications and installation methods shall be submitted to the District for approval.

**K. Exterior Coating**

Exterior joints of manhole structures shall be coated with a waterproof bituminous membrane, or equal. The membrane shall be applied after the joints are grouted and shall lap the joint a minimum of six inches (6"). The Contractor shall submit material specifications for the exterior coating to the District for review prior to construction. The exterior coating shall be applied per manufacturer's recommendations.

**L. Manhole Testing**

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to any concrete base pour. The District may require that concrete cylinders be sampled from base pours and tested at 28 days to show conformance with the required 28-day compressive strength requirement of 3000 psi. Slump and air entrainment may also be tested during concrete base pour, at the District's discretion.

No other specific testing procedures are established for manholes. Manhole construction will be observed by the District and shall conform to the requirements of this Section.

**4.06 SANITARY SEWER SERVICE CONNECTIONS**

**A. General**

The purpose of this sanitary sewer service connection specification is to address the actual connection between the public sanitary sewer system and the private service line. The District is responsible for the sanitary sewer main line and manholes, only.



All sanitary sewer services are privately owned. The sewer service line includes the connection to the main line (tee or wye fitting) and all pipe and associated appurtenances upstream of the main line connection. Section 4.5 of these Specifications describes the material requirements for fittings, branches and plugs.

## **B. Service Connections to New Construction**

New main line construction shall use PVC in-line "wye" fittings for 4" and 6" service connections, or manholes for 8" service connections. Construction shall be in conformance with this Section and the "Service Connections to New Construction" construction detail found in Section 5 of these Specifications.

All in-line PVC wye fittings shall be of equal pipe class to the PVC materials used in public main line construction. Fitting material shop drawings shall be submitted to the District for review prior to construction.

In-line wye fittings shall be installed at the locations indicated on the reviewed and signed plans. The "wye" shall be rotated to provide entrance into the main line at the "ten" or "two" o'clock position. The Contractor shall record the connection invert elevation and distance from the nearest downstream manhole immediately upon installation. This information shall be shown on the record drawings.

## **C. Service Connections to Existing Construction**

Service connections to existing sanitary sewer lines shall be made using either a "tee" or "wye" saddle depending on the existing main line material. Construction shall be in conformance with this Section and the "Service Connections to Existing Construction" construction details in these Specifications.

Connection to existing PVC material shall be made using a gasketed "wye" saddle with double stainless steel straps. The existing PVC sewer line shall be scored to the shape of the wye using a template approved by the saddle manufacturer. The hole shall be cut with a hole cutter or keyhole saw and cleanly machined by hand to remove all burrs, rough edges, and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the saddle. The saddle shall be solvent welded to the pipe and drawn tight against the pipe using double stainless steel straps.

Upon completion of the tap, the main line, tapping saddle and service line within the sanitary sewer line trench shall be bedded and compacted prior to backfilling.

Connection to existing concrete or clay sewer lines shall be made using a PVC tee saddle and gasket with double stainless steel straps. When connecting to an existing concrete or clay main, a long-body style PVC tee saddle shall be used. The sewer main shall be "core drilled" with a

circular bit. Necessary precautions shall be taken so that the removed circular segment is not lost in the sanitary sewer main. Percussion taps shall not be allowed. A percussion tap is defined as breaking the existing pipe material out in a circular fashion using a hammer and chisel or similar method.

The circular hole shall be cleaned by hand to remove all rough edges and debris. The exterior of the main shall be wiped clean and prepared with an approved solvent prior to the installation of the gasket tee saddle. The saddle shall be drawn tight against the gasket and existing line by means of double stainless steel straps.

Upon completion of the tap; the tapping saddle shall be reinforced with a concrete collar. The main and tapping saddle shall be bedded with materials and compacted prior to backfilling.

**D. Service Connections to Dead-End Manholes**

One service line may be connected to a dead-end manhole when it is not possible to make the connection to the main line. The service line shall connect behind the manhole in conformance with the "Service Connection to Dead End Manhole" detail drawing.

**E. Observation of Service Line Connections**

The Contractor shall notify the District 24 hours prior to making any service connections so the District may be on-site to observe the connection. In the event the tap and service line are covered prior to District observation, it shall be re-excavated by the Contractor, and cleared allowing for visual inspection of the tap and main.

**F. Testing of Service Line Connections**

No specific testing is required for the in-line fittings, or saddle type connections by the District. However, the Contractor shall video inspect the main line sewer for all new service connections and provide a copy of the inspection video to the District for review.

All service lines shall be plugged at the end of the service with a watertight plug manufactured for use with the service line material. End plugs must be able to withstand the internal pressure of leakage testing in accordance with these Specifications.

**4.07 CLEANOUTS**

Permanent cleanouts are not permitted on East Cherry Creek Valley Water and Sanitation District lines. Cleanouts should be installed on private service lines in accordance with International Plumbing Code Section 708 and any other local jurisdictional plumbing regulations.

#### **4.08 OIL, SAND AND GREASE INTERCEPTORS**

All public and/or private facilities which generate sand, oil and/or grease by-products shall install an appropriate interceptor per Section 2.11 of these Specifications.

The District may observe construction of oil, grease, and sand interceptors for adherence to District standards. Prior to use of newly installed interceptors, a District representative must inspect and pass the completed construction. No testing will be performed by the District. However, sewer die testing may be requested to verify connections to the interceptor.

The responsibility of cleaning and maintaining the grease interceptor in efficient operating condition shall be the Owner's and/or lessee's responsibility.

The District retains the right as allowed by Colorado State Statute, to review all interceptors during regular business hours, on an unscheduled basis, to determine if the unit is operating and being maintained on a regular basis. Grease interceptors shall be kept accessible for periodic observation by District personnel.

#### **4.09 ENCASEMENT**

##### **A. General**

Reinforced concrete encasement shall be constructed to the limits shown on the Construction Plans. However, should field conditions differ from the information shown on the reviewed and signed plans, (e.g., ground elevations, creek locations), the encasement limits shall be reviewed in the field by the District, prior to any encasement construction.

##### **B. Materials**

Encasements shall be constructed of concrete made from well-graded aggregate and Type II cement, having a minimum twenty-eight (28) day compressive strength of 3000 psi, slump of 2"-4," and air entrainment of 3% to 5%.

Reinforcement steel used in encasements shall be ASTM A36 steel.

##### **C. Installation**

Reinforced concrete encasement shall be installed in accordance with the "Concrete Encasement" construction detail. Minimum clear distance between steel reinforcement and the edge of the concrete encasement shall be three inches. The encasement shall be formed using undisturbed soils or concrete foamwork. Concrete shall be vibrated around steel reinforcement using vibration equipment or manual poling and shall not be placed on a frozen or unstable foundation. Suitable concrete protection shall be provided to reduce rapid moisture loss and to protect the concrete from freezing.

## **D. Testing**

The Contractor shall submit the concrete mix design to the District for review at least 48 hours prior to encasement construction. The District may require that concrete cylinders be sampled on-site and tested at twenty-eight (28) days to show conformance with the required twenty-eight (28) day compressive strength requirement of 3000 psi. Slump and air entrainment may also be tested at the time of concrete pour, at the District's discretion.

### **4.10 MARKER POSTS**

Marker posts are required adjacent to manholes or other appurtenances installed outside of paved rights-of-way in order to provide a physical reference for field location.

Marker posts shall be three (3) inch diameter steel posts, painted yellow, and filled with concrete. The appurtenance description, size, type, and distance from the post shall be stenciled directly on the marker post

Marker posts shall be installed at the locations indicated on the reviewed and signed plans and at other locations requested by the District during construction. Marker post installation shall be performed in accordance with the detail drawings.

### **4.11 SANITARY SEWER SYSTEM INSTALLATION**

#### **A. Excavation**

##### **1. General**

Excavation for sanitary sewer lines, manholes, fittings and other appurtenances shall be an open trench excavation to the depth required by the reviewed and signed Construction Plans.

All excavations shall be properly supported in the manner as required by OSHA or as required by State laws and municipal ordinances, and as may be necessary to protect life, property and the work.

##### **2. Limits of Excavation**

- a. Length - Except by expressed written permission of the District, the maximum length of open trench shall be 600 feet or the distance necessary to accommodate the amount of pipe installed in a single day, whichever is smaller. The distance is the collective length at any location, including open excavation, pipe laying, appurtenances, construction, and backfill. The trench shall not be left open when the Contractor has left the project

site and is not engaged in construction operations, unless temporary fences or barricades are provided. Traffic barriers shall be placed by the Contractor as required by the representative City, County, or State, or as stipulated by local conditions, to ensure construction safety at all times.

- b. Width - Trench width at the ground surface may vary with and depend upon the depth, type of soils, and position of surface structures. In general, the minimum clear width of the trench, sheeted or unsheeted, measured at the top of the pipe should be one foot (1') greater than the outside diameter of the pipe. The maximum clear width of the trench at the top of the pipe should not exceed a width equal to the outside pipe diameter plus two feet (2') (see details). If the above defined trench widths must be exceeded, or if the pipe is installed in a compacted embankment, the pipe embankment shall be compacted to 95 percent Standard Proctor Density, to a point at least two and one-half (2.5) pipe diameters from both sides of the pipe or to the undisturbed trench walls, whichever is less.

### 3. Trenching By Hand or Machine

Hand methods for excavation shall be employed in locations directed by the District. The Contractor shall use whatever equipment or hand methods necessary to protect all existing utilities.

### 4. Bracing Excavations

All excavations shall be properly supported in the manner as required by OSHA or as required by state laws and municipal ordinances, and as may be necessary to protect life, property and the work. Excavations shall be so braced, sheeted and supported that they will be safe, and the ground alongside the excavation will not slide or settle. Excavations shall be so braced or sheeted so as to provide conditions under which workmen may work safely and efficiently at all times.

The sheeting, shoring and bracing shall be so arranged as to not place any stress on portions of the completed work until the general construction thereof has proceeded far enough to provide ample strength.

Care shall be exercised in the withdrawing or removing of sheeting, shoring, bracing and timbering to prevent the caving in or collapsing of the excavation faces which are being supported.

5. Rock Excavation

Solid rock, boulders, and large stones shall be removed to provide a minimum clearance of at least nine inches (9") below the pipe and fittings.

In general, blasting will be allowed in order to expedite the work if a permit by the local authority having jurisdiction is granted. All explosives and appurtenances shall be transported, handled, stored and used in accordance with the laws of the local, state and federal governments, as applicable.

All blasting shall be controlled so as not to injure any existing structure or facility. Owners or occupants of nearby structures or facilities must be notified at least seventy two (72) hours in advance of blasting, in writing, by the Contractor. The notice shall state the anticipated date and time of blasting, and entity responsible for performing the blasting.

Blasting shall be controlled so as not to make any excavation unduly large or irregular as to shatter the rock on the bottom or sides of any excavation or surface upon or against which concrete is to be placed. If, in the opinion of the District, blasting could cause damage to rock foundations, supports, or structures, blasting shall not be allowed, and excavation shall be continued by jack-hammering, barring, wedging or other methods.

**B. Tunneling and Boring**

Tunneling or boring may be required by the City, State or County Highway Department where construction crosses major roadways. Boring and casing materials and construction methods shall be reviewed by the District on a case-by-case basis but will generally conform to the requirements outlined on the "Casing Pipe and Carrier Pipe" detail found in Section 5 of these specifications.

**C. Grading and Stockpiling**

The Contractor shall control stockpiling and grading in such a manner to prevent water from flowing into excavations. Obstruction of surface drainage shall be avoided and means shall be provided to allow storm water to flow uninterrupted into existing gutters, other surface drains or temporary drains. Excavated material shall not be placed or stockpiled closer than two feet (2') from the top edge of the trench. All grading and stockpiling shall be done in accordance with the approved Grading, Erosion, and Sediment Control Plans and Permits and shall conform to the regulations of any jurisdictional stormwater authorities.

## **D. Foundations and Subgrade**

### **1. General**

All manholes or vault foundations and pipe subgrade installation shall be in a stable condition. Any and all questions relative to foundation and subgrade stability shall be coordinated through the District and the Owners' Geotechnical Engineer. The Geotechnical Engineer will be responsible for determining if the foundation and/or subgrade is stable prior to the utility installation.

### **2. Stable Foundations and Subgrade**

The trench bottom shall be excavated six inches (6") below the invert of the pipe unless otherwise designated on the plans. Before the pipe is laid, the foundation shall be prepared by backfilling with bedding material conforming to these Specifications. The bedding shall be thoroughly tamped to achieve a relative density of 70% as determined by ASTM D-2049.

### **3. Dewatering**

The Contractor shall provide and maintain at all times during construction, ample means and devices with which to promptly remove and properly dispose of all water from any source entering the excavations or other parts of the work. Dewatering shall be accomplished by methods which will ensure a dry excavation and preservation of the final lines and grades at the bottoms of excavations. These methods may include well points, sump pumps, suitable rock or gravel drains placed below the bedding, temporary pipelines and other means, all of which shall be subject to the review of the District.

Dewatering of the sewer line trenches shall commence when groundwater is first encountered, and shall be continuous until such time that, in the opinion of the Owner's Geotechnical Engineer, it is safe to allow the water table to rise. Pipe trenches shall contain sufficient backfill to prevent pipe flotation.

The Contractor shall dispose of the water from the work site in a suitable manner without damage to adjacent property or endangering public health or safety in conformance with a dewatering permit. Obtaining and complying with the dewatering permit is the responsibility of the Contractor. Water shall not be drained into the sanitary sewer system.

### **4. Foundations in Unstable Soil**

When excessively wet, soft, spongy, unstable or similarly unsuitable materials is encountered at the surface upon which the bedding material or foundations are to be placed, dewatering shall

be performed and unsuitable materials shall be removed to a depth as determined in the field by the Owner's Geotechnical Engineer and the District.

The degree of soil instability will determine the limits of over excavation. In general, over excavation will be required, and stabilization rock shall be installed as indicated on the "Special Bedding" construction detail until the foundation and/or subgrade is stable as determined by the Owner's Geotechnical Engineer and the District.

5. Overdepth Excavation

Where excavation is inadvertently or otherwise carried below subgrade and/or foundation elevations, suitable provision shall be made to adjust the deeper excavation beneath pipe or structures. Over-depth backfilling, with bedding material or on-site material, shall be compacted to provide a firm and unyielding foundation, as directed by the Owner's Geotechnical Engineer and the District.

6. Foundations in Rock

Where rock is encountered, it shall be removed below grade. The trench shall be backfilled with clean imported bedding material to provide a compacted foundation cushion. The minimum clearance between rock and the pipe shall be nine inches (9").

**E. Bedding**

1. General

All pipe bedding materials for stable and unstable installation conditions shall be reviewed by the Owners' Geotechnical Engineer and the District, prior to delivery of the bedding to the construction site. The area indicated in the bedding details from the trench bottom to twelve inches (12") above the pipe shall be referred to as the "pipe zone." Bedding materials and installation shall meet or exceed the requirements of this section.

2. Bedding Material

The pipe bedding, using either clean well-graded sand, squeegee or 3/4-inch gravel conforming to these Specifications shall be placed in the pipe zone and compacted to the requirements set forth in this Section. The following classes of bedding material are permitted:

3. Class A Bedding

Class A (Squeegee) bedding shall be used for the bedding of PVC sanitary sewer lines at depths of cover less than 16 feet. Class A



bedding shall consist of placing select bedding material (known as "squeegee") defined as follows, from six inches (6") below the bottom of the pipe to a point twelve inches (12") above the top of pipe.

Class A (Squeegee) bedding material shall conform to the following limits:

<b>Class A Bedding (Squeegee)</b>	
<b>Sieve Size</b>	<b>Total Percent Passing by Weight</b>
3/8"	100%
No. 200	0-3%

4. Class B Bedding

Class B bedding shall be reviewed for use by the District for bedding of PVC sanitary sewer main at depths of cover between 16 feet and 22 feet. Class B bedding shall consist of placing crushed aggregate, as defined below, from nine inches (9") below the bottom of the pipe to a point twelve inches (12") above the top of the pipe.

Class B bedding shall be clean crushed aggregate conforming to ASTM D 448 No. 67, as follows:

<b>Class B Bedding</b>	
<b>Sieve Size</b>	<b>Total Percent Passing by Weight</b>
1"	100%
3/4"	90%-100%
3/8"	20%-55%
No. 4	0%-10%
No. 8	0%-5%

5. Bedding Installation

The pipe shall be bedded as indicated in the "Standard Bedding" and "Special Bedding" details. The Contractor shall be responsible for accurately shaping the pipe subgrade to fit the bottom of the pipe. The intent is to relieve the bell of the pipe from all loading and provide continuous bearing of the pipe barrel on the bedding. Use of a drag template shaped to conform to the outer surface of the pipe will be required if other methods do not give satisfactory results.

The pipe shall be centered in the trench, adjusted to line and grade and bedding shall be simultaneously placed on both sides of the pipe as not to disturb alignment and grade. The bedding

material shall be sliced under the haunches of the pipe to fill all voids. The slicing shall be performed when the bedding material covers approximately one-third (1/3) of the pipe's diameter.

6. Bedding Compaction

All bedding material shall be compacted to a minimum Relative Density of 70 percent, as determined by ASTM D-2049. Each lift shall be solidly tamped with the proper tools so as not to injure, damage or disturb the pipe. Backfilling shall proceed simultaneously on each side of the pipe. Water settling for compaction is generally not permitted and must be reviewed by the District prior to its use.

7. Bedding Testing Requirements

Bedding material shall be tested by the Owner's Geotechnical Engineer for gradation requirements set forth herein, and test reports shall be submitted to the District, prior to delivery of and bedding material to the project site.

Bedding compaction shall be tested using the "Sand Cone Method" in conformance with ASTM D1556 or other methods reviewed by the District. Compaction test results shall be submitted to the District on the working day following the test. If compaction tests do not meet these Specifications, the sub-standard area shall be reworked and retested until these Specifications are met. The location and frequency of bedding compaction testing will be determined by the District on a case by case basis.

**F. Sanitary Sewer Line Installation**

1. General

Pipe shall be laid without a break in grade from structure to structure, with the bell ends of the pipe grade. Pipe shall be laid to the lines and grades shown on the reviewed and signed construction plans and shall form a close concentric joint with the adjoining pipe. The interior of the sewer pipe shall be cleaned of all dirt and superfluous material of all descriptions, as the work progresses.

When pipe laying is not in progress, the open end of the pipe shall be closed with a tight fitting cap or plug to prevent the entrance of foreign matter into the pipe. These provisions shall apply during the noon/lunch hour, and breaks, as well as overnight and on holidays. In no event shall sanitary sewers be used as drains for removing water which has infiltrated into the trench.

A water-tight plug (Pollard, or equal), shall be installed at the point of connection to the existing system at the start of construction, and shall not be removed without permission of the District.

2. Material Review Before Installation

All pipe and fittings shall be carefully examined for cracks, sun damage, and other defects before installation. Spigot ends of pipe shall be examined with particular care as this area is the most vulnerable to damage from handling. Defective materials shall be removed from the site.

3. Laying of Sanitary Sewer Pipe

Placement of PVC pipe in the trench shall conform to ASTM Standard D2321 or Uni-Bell Standard UNI B5 and these standard Specifications. Under no circumstances shall PVC pipe be dropped or dumped into the trench.

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipe laying crew cannot put the pipe into the trench and place it without getting earth into it, the District may require that before lowering the pipe into the trench, a heavy tightly woven canvas bag of suitable size, or plastic caps, shall be placed over each end of the pipe and left there until the connection is made to the adjacent pipe. During laying operations, no debris, tools, clothing or other materials shall be placed inside the pipe.

As each length of pipe is placed in the trench, the spigot end shall be centered in the bell or coupling and the pipe forced home and brought to correct line and grade. The pipe shall be secured in place with bedding material. Precautions shall be taken to prevent dirt from entering the joint space.

4. Alignment and Grade

The sewer line shall be laid and maintained to the required lines and grades as shown on the approved construction plans.

Where obstructions or field conditions are encountered during construction which interfere to such an extent that an alternation in the reviewed plans is required, the District shall have the authority to change the plans.

Laser beam equipment or the batter board system may be used to provide line and grade. The District prefers the use of the laser beam system.

When using the batter board system, batter boards shall be installed on each side or on the same side of the trench. Stakes

supporting the batter boards shall be placed the same distance apart as the grade stakes set by the Owners' Surveyor. Three batter boards shall be in use at all times. The cross members or straight edges crossing the sewer ditch shall be set according to the grade showing on the grade stakes. A centerline grade string and plumb-bob shall be used to keep the sewer pipe in line. A grade rod shall be used to provide accurate grade on the invert of the sewer pipe. The quality of the batter boards and the grade rod shall be reviewed for acceptability by the District. If so instructed, the Contractor shall replace grade and line equipment to meet the requirements of the District.

5. Joint Installation

When manufacturer's prefabricated joints are used in the laying of sanitary sewer lines, such lines shall be jointed using lubricants, primers, adhesives, solvents, etc., recommended by the pipe manufacturer. All factory fabricated joints shall be placed, fitted, joined and adjusted in such a manner as to obtain the degree of water tightness required and be in compliance with recommended methods of manufacturer, and as accepted by the District.

6. Fittings and Branch Installations

Pipe "wyes," shall be furnished and installed along with the sanitary sewer line. Wyes of the size(s) specified on the reviewed plans shall be installed for all sanitary sewer service connections as shown on the reviewed and signed construction plans. The longitudinal barrel or branch fittings to be placed in line and grade with the sanitary sewer mains shall be of the same diameter, quality and type as the adjoining sewer line.

Installation, earthwork and bedding for branches shall conform to the applicable provisions set forth for the sewer line. Unless otherwise specified, the branch of "wye" fittings shall be inclined upward at an angle not greater than 45° from a horizontal line. No wye or tee for a sanitary sewer service connection branch may be placed closer than 5 feet, to the downstream edge of any structure, or 3 feet from the bell or spigot end of a pipe section, and shall be in conformance with the "Service Connection to New Construction" detail. The Contractor shall hand tamp the backfill under every "wye" branch after it is installed.

All joints for plugs shall be installed in order to withstand the internal pressure of the leakage and/or infiltration test; however, joints shall be made in such a manner that they may be removed without injury to the socket.

7. Pipe at Manholes or Structures

A pipe joint of the same inside diameter as the adjoining pipe shall be placed at the inlet(s) and/or outlet to each manhole or structure as shown on the reviewed and signed plans.

Pipe bells shall not be cast into manholes or structures. The bell shall be cut off so that the plain end of the pipe is flush with the inside wall of the manhole or structure, or as otherwise shown on the accepted Construction Plans.

**G. Backfilling**

1. General

All trenches shall be backfilled after pipe, fittings and appurtenances have been installed and reviewed. When a compaction requirement value is specified herein, the optimum moisture content and density shall be determined in accordance with the appropriate ASTM specification.

2. Backfill Material

Backfilling shall be done with on-site material, sand or gravel. No oil cake, bituminous pavement, concrete, rock or other lumpy material shall be used in the backfill unless these materials are scattered and do not exceed 6" in any dimension. Material or perishable, organic, spongy, frozen debris, or otherwise unacceptable nature shall not be used in backfilling. No material greater than 4" in any dimension shall be placed within 1 foot of any pipe, manhole or structure. Backfill material shall be subject to the review of the District.

Permission to use controlled low strength material (CLSM, flowfill, flashfill, etc.) shall be requested from the District in writing and include submittal of proposed mix design from a ready-mixed concrete producer.

Within the street right-of-way, the road subgrade and final grade, including base course and asphalt placement, shall be replaced in strict accordance with any Federal, State, and Local regulations.

3. Backfill Installation

In street rights-of-way, the portion of the trench above the "pipe zone" to the finished roadway surface shall be backfilled, compacted and/or consolidated by methods reviewed by the District Engineer to obtain a Standard Proctor Density of 95% (ninety-five percent) or equivalent relative density. In easements and other areas outside street rights-of- ways, the remaining portion of the trench above the "pipe zone" shall be backfilled,

compacted and/or consolidated by methods reviewed by the District to obtain a Standard Proctor Density of 90% (ninety percent) or equivalent relative density.

Backfill to be compacted by heavy compaction equipment shall be placed in uniform horizontal lifts not exceeding 15" in depth or as specified by the District. Heavy compaction equipment shall not be used closer than three feet to walls at the top of any structure nor closer than three feet to the top of the pipe. Before each lift is compacted, the material therein shall be brought within 1% above or 3% below the optimum moisture content for the specified compaction.

Flooding, pooling, or jetting shall not be allowed unless reviewed by the District, prior to construction.

Any damage to the pipe as a result of the Contractor's backfill and compaction operation shall be repaired and/or replaced by the Contractor.

#### 4. Backfill Compaction Tests

Compaction tests shall be taken by a qualified testing laboratory at locations designated by the District. All expenses involved in these tests shall be borne by the Contractor or Developer.

Copies of test results shall be provided to the District. In all cases where the tests indicate sub-standard compaction, additional compactive effort and tests will be required until these specifications are met. Final acceptance of the lines by the District will be contingent upon satisfactory compaction results. Leakage and deflection testing of the sewer main shall not be performed until backfill compaction conforms to these specifications.

#### H. Final Clean Up

Prior to probationary acceptance, the Contractor shall clean street right-of-ways and easements of all rubbish, excess materials, temporary structures and equipment and shall leave the same areas to plus or minus 1/10 of a foot from the elevations that existed prior to construction or the final grades as shown on the reviewed and signed plans.

### 4.12 SANITARY SEWER LINE TESTING AND ACCEPTANCE

#### A. Visual Review Prior to Installation

The following imperfections in any type of pipe or special fitting will be considered defects and cause rejection.

1. Any cracks, lumps, blisters, pits or flakes on any interior or exterior surface of a pipe or fittings.

2. When the pipe varies from a true circle more by than 5% of its internal diameter.
3. When a pipe or fitting, designated to be straight, deviates from a straight line more than 1/16" per linear foot. The deviation shall be measured using a straight edge at a point midway between the ends of the pipe.
4. When a piece is broken from either the socket or spigot end.

**B. Jetting**

Prior to any testing, the lines shall be hydraulically cleaned at a water pressure of not less than 1000 psi to remove debris, dirt or other foreign matter. The lowest manhole (or manholes) within the project shall be plugged with a water-tight plug (Pollard or equal) on the downstream outlet of the manhole and all water, silt and debris shall be pumped from this manhole and disposed of properly. Jetting will be performed at the Owner's cost. The Owner may select his own service Contractor or request assistance from the District in finding qualified contractors.

**C. Alignment and Grade Testing**

After the sewer line and all appurtenances have been installed and flushed, and satisfactory compaction test results have been submitted to the District, but prior to paving, 100% of the line shall be visually reviewed by the District for alignment and grade.

Alignment will be reviewed by closed circuit television inspection and surveying. Grades will be reviewed by surveying pipe inverts at manholes and reviewing the video recording. The full diameter of the pipe should be visible when viewed between consecutive manholes. Closed circuit television inspection must be performed with water flowing through the pipe, or with a camera equipped with an inclinometer. Two (2) copies of the video inspection recording DVD's shall be provided to the District.

Sags, high points or other alignment or grade problems shall be repaired by the Contractor to the District's satisfaction. Contractor shall perform additional video inspections to verify that corrections have been completed to the District's satisfaction.

**D. Low Pressure Air Testing**

Each section of sanitary sewer line between manholes shall be low pressure air tested in accordance with UNI-BELL UNI-B-6, Latest Revision and as specified herein.

1. Plugs

All outlets from the pipe section being tested shall be plugged and braced to prevent plug blow-out during the pressure test. Either mechanical or pneumatic plugs may be used.

2. Pressurizing Equipment

All pressurizing equipment used in pressure testing shall include a regulator or relief valve set no higher than 9 psi to prevent over-pressurizing the line and to prevent plug displacement.

The above ground air control equipment shall include a shut-off valve, pressure regulating valve, pressure relief valve, input pressure gauge, and a continuous monitoring pressure gauge having a pressure range from 0 to at least 10 psi. The continuous monitor gauge shall be at least 4-inches (4") in diameter, with a minimum division of 0.10 psi and an accuracy of  $\pm 0.04$  psi.

Two separate hoses shall be used. One to connect the control panel to the sealed line for introduction of low pressure air, and another separate hose connection for measurement of air pressure buildup in the line.

3. Line Pressurizing

Low pressure air shall be slowly introduced into the sealed line until the air pressure reaches a value of 4.0 psi.

If the line being tested is in a groundwater condition, the internal air-pressure value of 4.0 psi shall be increased to include the addition of groundwater pressure on the pipe.

The additional pressure shall be calculated by adding 0.433 psi internal air pressure for each foot of water over the sealed pipes invert, but the maximum allowable internal air pressure in the pipe shall not exceed 9.0 psi. Therefore, the low pressure air test may be used in a groundwater condition as long as the average depth of water over the line does not exceed 11.5 feet. Should the average groundwater depth exceed 11.5 feet, the infiltration test (as described later in this section) shall be performed.

4. Pressure Stabilization

After a constant pressure of 4.0 psi (or 4.0 psi greater than groundwater back pressure over the pipe) is reached, the air supply shall be throttled to maintain the 4.0 psi air pressure for 2 minutes. This allows the temperature of the air to equalize with the temperature of the pipe.



5. Timed Pressure Loss

After pressure stabilization, the air hose from the air supply shall be disconnected or shut off. The continuously monitoring pressure gauge shall be observed while the pressure is decreased to 3.5 psi (or 3.5 psi greater than the back pressure of any groundwater over the pipe). At that time, timing shall commence using a stopwatch, and the time interval measured until the internal pressure reaches 3.0 psi (or 3.0 psi greater than the back pressure of any groundwater over the pipe).

6. Passing Test Requirements

If the timed pressure loss is greater than the minimum time outlined in the following Table, the Section undergoing the test shall pass. If the minimum time in Table 4.1 is not met, the air loss is considered excessive and the test fails.

<b>TABLE 4.1 SPECIFICATION TIME REQUIRED FOR A 0.5 PSIG PRESSURE DROP FOR SIZE AND LENGTH OF PIPE INDICATED</b>										
Pipe Diameter (in.)	Minimum Time (min:sec)	Length for Minimum Time (ft.)	Time for Longer Length (sec.)	100 ft.	150 ft.	200 ft.	250 ft.	300 ft.	350 ft.	400 ft.
8	3:47	298	.760 L	3:47	3:47	3:47	3:47	3:48	4:26	5:04
10	4:43	239	1.187 L	4:43	4:43	4:43	4:57	5:56	6:55	7:54
12	5:40	199	1.709 L	5:40	5:40	5:42	7:08	8:33	9:58	11:24
15	7:05	159	2.671 L	7:05	7:05	8:54	11:08	13:21	15:35	17:48
18	8:30	133	3.846 L	8:30	9:37	12:49	16:01	19:14	22:26	25:38
21	9:55	114	5.235 L	9:55	13:05	17:27	21:49	26:11	30:32	34:54
24	11:20	99	6.837 L	11:24	17:57	22:48	28:30	34:11	39:53	45:35
27	12:45	88	8.653 L	14:25	21:38	28:51	36:04	43:16	50:30	57:42
30	14:10	80	10.683 L	17:48	26:43	35:37	44:31	53:25	62:19	71:13
33	15:35	72	12.926 L	21:33	32:19	43:56	53:52	64:38	75:24	86:10
36	17:00	66	15.384 L	25:39	38:28	51:17	64:06	76:55	89:44	102:34

7. Line Repair or Replacement

If the section being tested fails, the Contractor may be required to videotape the sewer line to determine the location of the defective area. The defective pipe shall be repaired or replaced and the low pressure air test performed until the test requirements are satisfied. Contractor shall perform additional video inspections to verify that corrections have been completed to the District's satisfaction.

## E. Pipe Deflection Testing

At least thirty (30) days after construction and after flushing, all sanitary sewer systems constructed of PVC pipe shall be tested for vertical ring deflection using a deflectometer, properly sized "Go, No-Go" Mandrel, or sewer ball. Maximum allowable vertical ring deflection is five percent (5%) of the pipe's inside diameter. The following Table 4.2 outlines the acceptable Mandrel diameter for different sizes of PVC pipe.

<b>TABLE 4.2 5% DEFLECTION MANDREL DIMENSIONS</b>		
<b>Nominal Size</b>	<b>Base Inside Diameter</b>	<b>5% Deflection</b>
<b>Inches</b>	<b>Inches</b>	<b>Mandrel</b>
8"	7.665	7.28
10"	9.563	9.08
12"	11.361	10.79
15"	13.898	13.20
18"	16.976	16.13
21"	20.004	19.00
24"	22.480	21.35
27"	25.327	24.06

### 1. Line Repair or Replacement

If the section being tested fails deflection testing, the Contractor may be required to videotape the sewer line to determine the location of the defective area. The defective pipe shall be repaired or replaced and deflection testing performed until the test requirements are satisfied. Contractor shall perform additional video inspections to verify that corrections have been completed to the District's satisfaction.

## F. Infiltration Testing

Where specified by the District, infiltration testing shall be performed instead of low pressure air testing. This generally would occur when a severe groundwater condition is present. The allowable infiltration for any portion of the sanitary sewer system shall not exceed 50 gallons per inch of inside pipe diameter per mile, per day, including manholes. The amount of infiltration shall be measured using a pipe weir, flume or other method proposed by the District. Groundwater pumping or dewatering shall not occur adjacent to lines being tested for a period of at least three days prior to the infiltration test.

The following Table 4.3 outlines the allowable units of infiltration for various sizes of pipe.

<b>TABLE 4.3 – ALLOWABLE LIMITS OF INFILTRATION 50 Gal/Inch Dia/Mi/Day or 0.04 Gal/Inch Dia/100'/Hr</b>	
Diameter of Sewer (Inches)	Infiltration Gal/Hr/100' (Gallons)
8	.32
10	.40
12	.48
15	.60
18	.72
21	.84
24	.96
27	1.08
30	1.20
33	1.32
36	1.44

**G. Probationary Acceptance**

Probationary Acceptance of the sanitary sewer system will not be granted by the District until all tests are successful, all items listed for correction by the District have been accomplished, and record drawings have been submitted to the District.

**H. Final Acceptance**

At least eight (8) months after final backfill operations, and probationary acceptance, but no later than thirty (30) days prior to final acceptance of the project, pipelines constructed of flexible materials may be re-tested for vertical ring deflection by a Go-No-Go gauge, at the District's discretion.

Maximum ring deflection of the pipeline shall be limited to Five percent (5%) of the internal pipe diameter. Installed pipe exceeding this deflection limit shall be considered to have reached the limit of its serviceability and shall be replaced and retested prior to final acceptance.

The District shall determine the footage to be tested, but in no case shall the test section be less than 400 feet or the distance between successive manholes, whichever is less. The Go-No-Go gauge shall be reviewed for acceptability by the District prior to testing.

One year following the date of Probationary Acceptance, the District shall review the project. All requirements of the District, as written, stated or otherwise found in the current District Rules and Regulations, Conveyance and Acceptance documents, licenses, permits, easements, agreements or standards and specifications, must be complete and acceptable to the District. All fees, charges, expenses and reimbursables due the District must be paid in full; and, any Special Conditions attached to the project must be completed prior to final acceptance of the project.

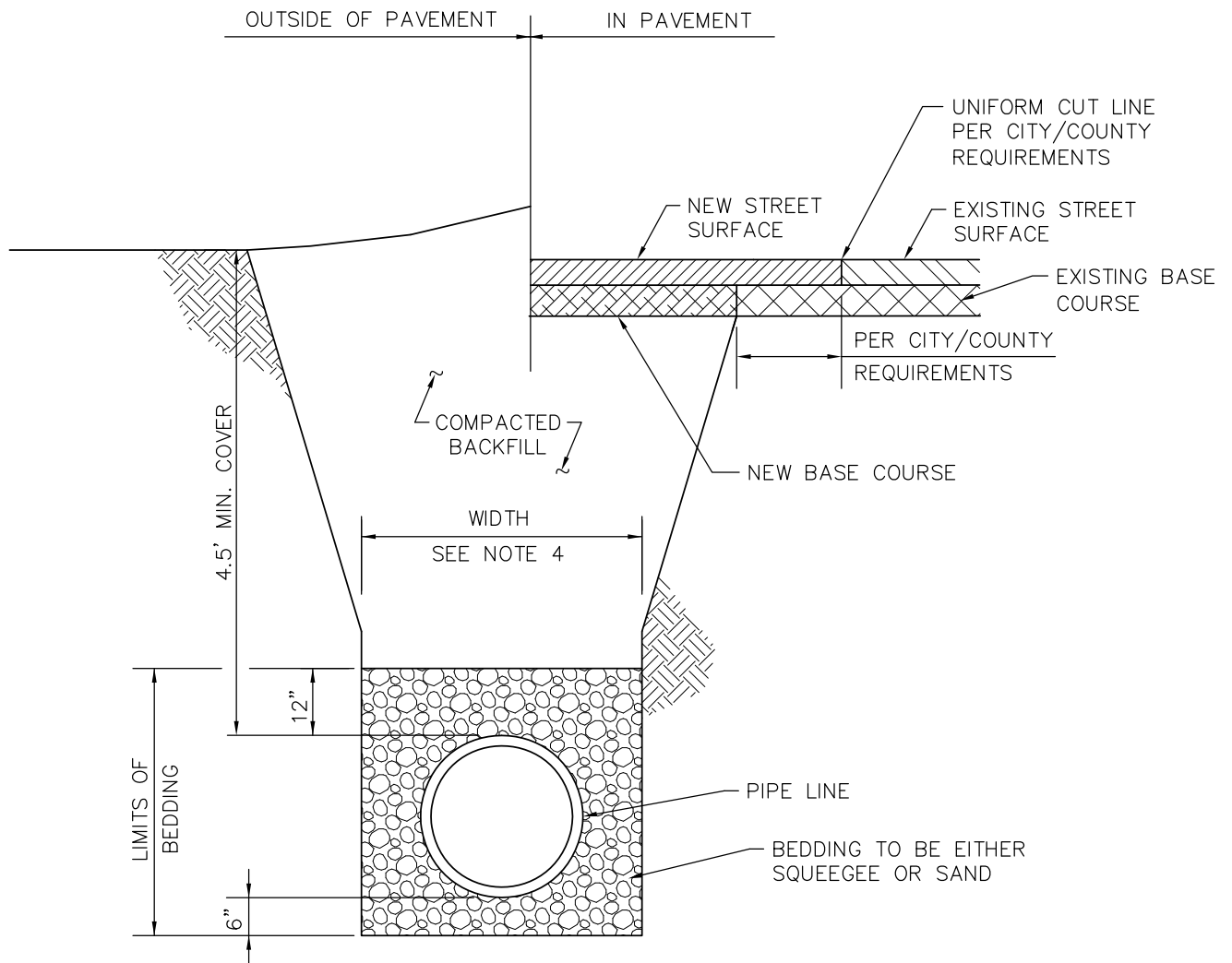
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## APPENDIX A

### SEWER SYSTEM CONSTRUCTION DETAILS

ECCV-1S	Standard bedding for sewer line
ECCV-2S	Special bedding for sewer lines
ECCV-3S	Standard bedding with underdrain
ECCV-4S	Precast manhole
ECCV-5S	Manhole base and deflector detail
ECCV-6S	Manhole knockout detail
ECCV-7S	High point manhole detail
ECCV-8S	Outside drop manhole- 15 in and smaller
ECCV-9S	Outside drop manhole- 18 in and larger
ECCV-10S	24 in ring and cover
ECCV-11S	24 in ring and bolt down cover
ECCV-12S	Bolt down 30 in ring and cover
ECCV-13S	36 in X 24 in double ring and cover
ECCV-14S	Composite lock down ring and cover
ECCV-15S	Intermediate Platform Detail
ECCV-16S	Compact composite step
ECCV-17S	Composite Step
ECCV-18S	Service connection to new construction
ECCV-19S	Sewer service connection to existing main
ECCV-20S	Service connection to dead end manhole
ECCV-21S	Concrete encasement
ECCV-22S	Steel marker post
ECCV-23S	Carsonite marker post
ECCV-24S	Sanitary sewer line repair
ECCV-25S	Cleanout detail
ECCV-26S	Dead end cleanout detail
ECCV-27S	Commercial grease interceptor 1 of 2
ECCV-28S	Commercial grease interceptor 2 of 2
ECCV-29S	Sand and oil interceptor 1 of 2
ECCV-30S	Sand and oil interceptor 2 of 2
ECCV-31S	Restrained Casing Spacers

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TYPICAL TRENCH SECTION

NOTES:

1. MINIMUM COVER TO BE 4.5' BELOW OFFICIAL STREET GRADE.
2. TRENCH TO BE BRACED OR SHEETED AS NECESSARY FOR THE SAFETY OF THE WORKMEN AND PROTECTION OF OTHER UTILITIES IN ACCORDANCE WITH APPLICABLE LOCAL, STATE AND FEDERAL SAFETY REGULATIONS.
3. PIPE SHALL BE BEDDED FROM 6" BELOW THE BOTTOM OF THE PIPE TO 12" ABOVE THE TOP OF THE PIPE.
4. TRENCH WIDTH SHALL NOT BE MORE THAN 16" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.
5. SHOULD THE TRENCH BE EXCAVATED WIDER THAN ALLOWED, A CONCRETE CRADLE SHALL BE PLACED WITH 2500 P.S.I. CONCRETE FROM TRENCH BOTTOM TO PIPE SPRINGLINE.
6. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 6" UNDER AND 12" OVER PIPE WILL REQUIRE 90% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.

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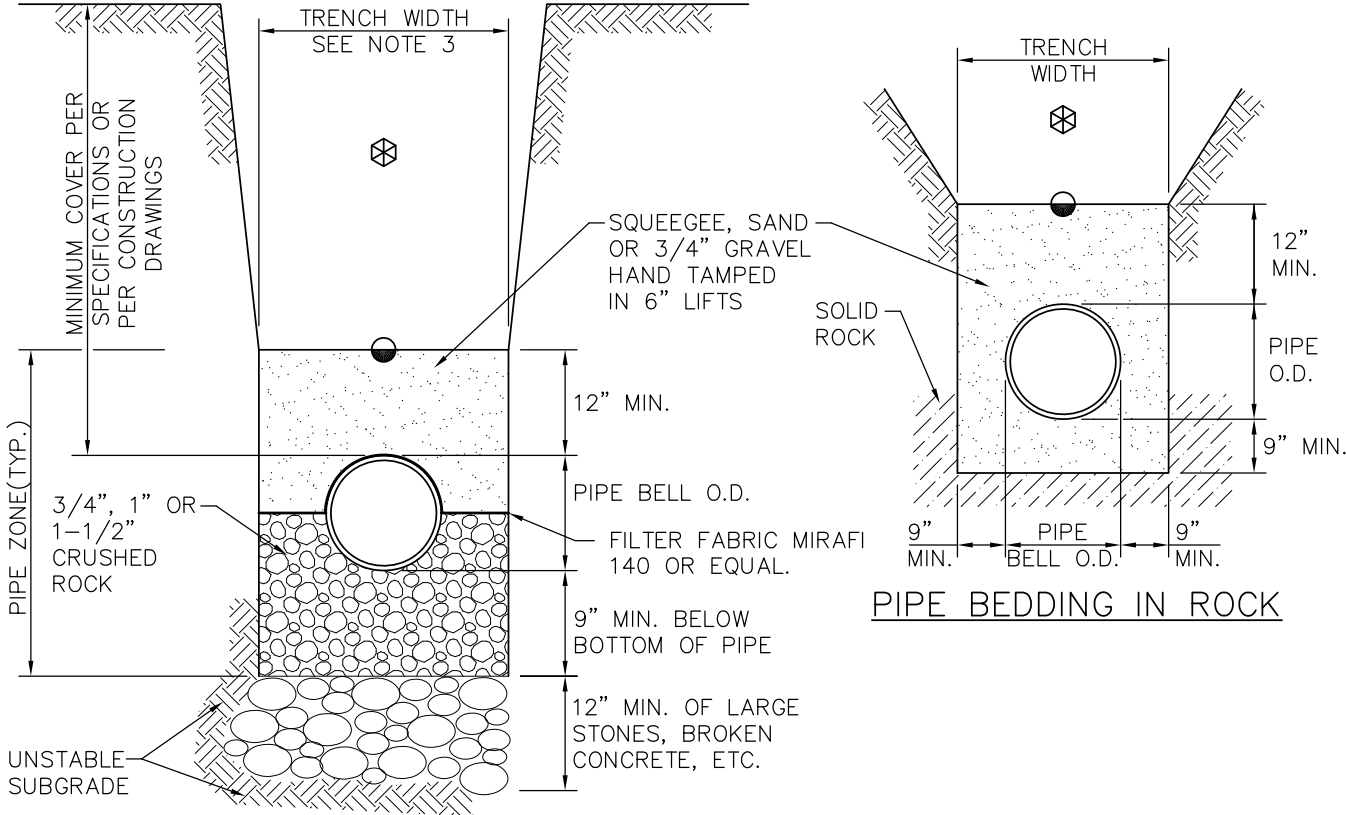
Water & Sanitation District

**STANDARD BEDDING FOR  
SANITARY SEWER LINES**

DRAWING NO.: ECCV-1S

DATE: 2-2014

REV. DATE:




**UNSTABLE SUBGRADE**

- MACHINE COMPACTED TRENCH BACKFILL
- LIMITS OF SLOPING OR BENCHING OF TRENCH WALLS
- UNDISTURBED GROUND

**NOTES:**

1. MIN. COVER TO BE BELOW FINAL STREET GRADE.
2. TRENCH TO BE BRACED OR SHEETED AS NECESSARY FOR THE SAFETY OF THE WORKMEN, THE PROTECTION OF OTHERS UTILITIES AND TO MEET LOCAL, STATE AND FEDERAL REQUIREMENTS.
3. TRENCH WIDTH SHALL NOT BE MORE THAN 16 INCHES NOR LESS THAN 12 INCHES WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE LAID THEREIN (BELL OR COUPLING O.D. IF APPLICABLE).
4. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 9 INCHES UNDER AND 12 INCHES OVER PIPE WILL REQUIRE 90% S.P.D., TRENCH ZONE ABOVE BEDDING MATERIALS, FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.

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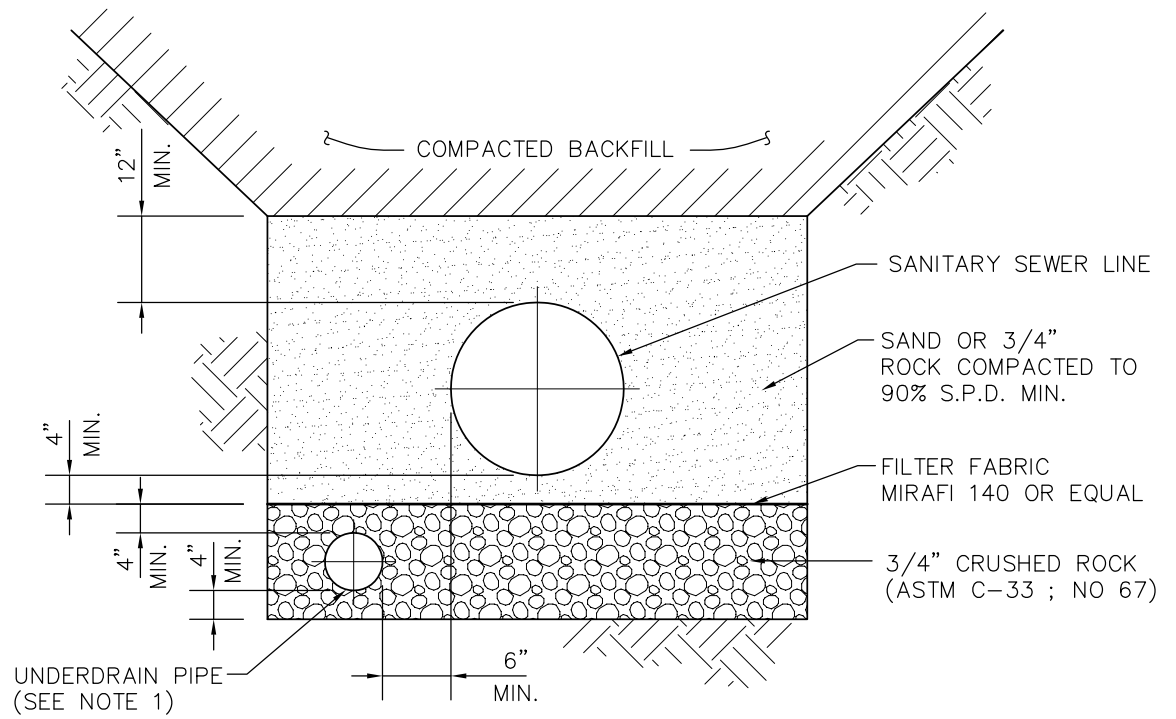


**ECCV**  
 Water & Sanitation District

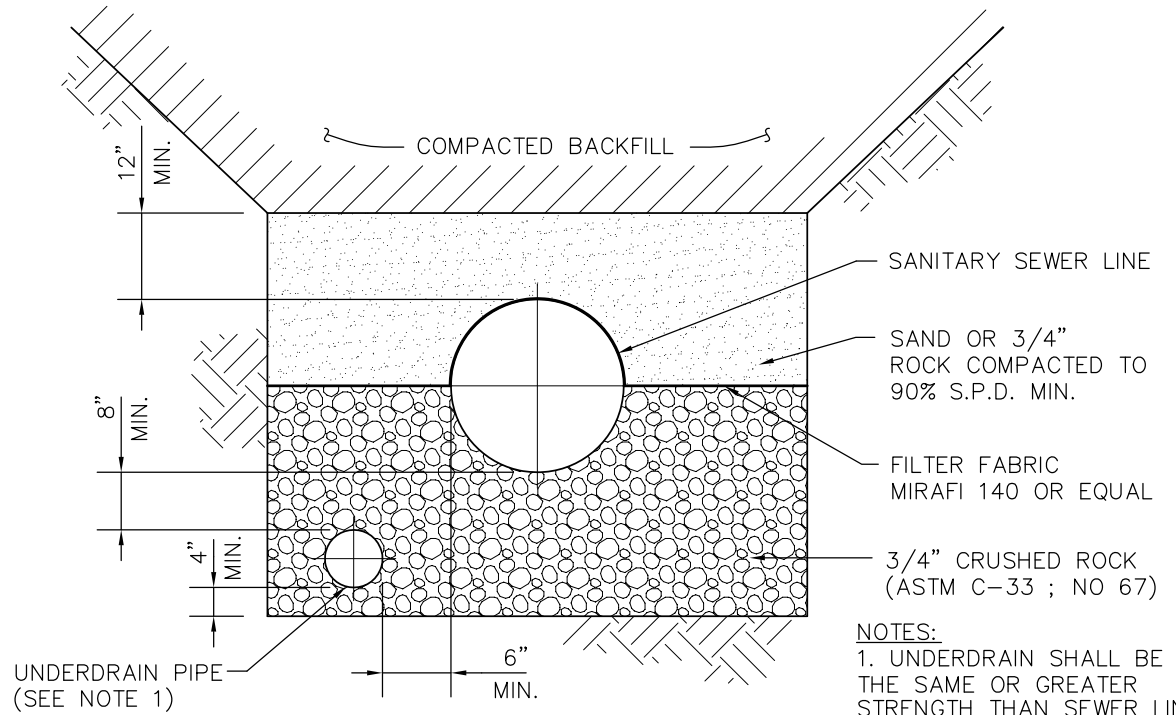
**SPECIAL BEDDING FOR  
 SANITARY SEWER LINES**

DRAWING NO.: ECCV-2S	
DATE: 2-2014	REV. DATE:





TYPE A



TYPE B

- NOTES:**
1. UNDERDRAIN SHALL BE THE SAME OR GREATER STRENGTH THAN SEWER LINE.
  2. OWNERSHIP, OPERATION AND MAINTENANCE OF THE UNDERDRAIN SYSTEM IS NOT THE RESPONSIBILITY OF THE DISTRICT.

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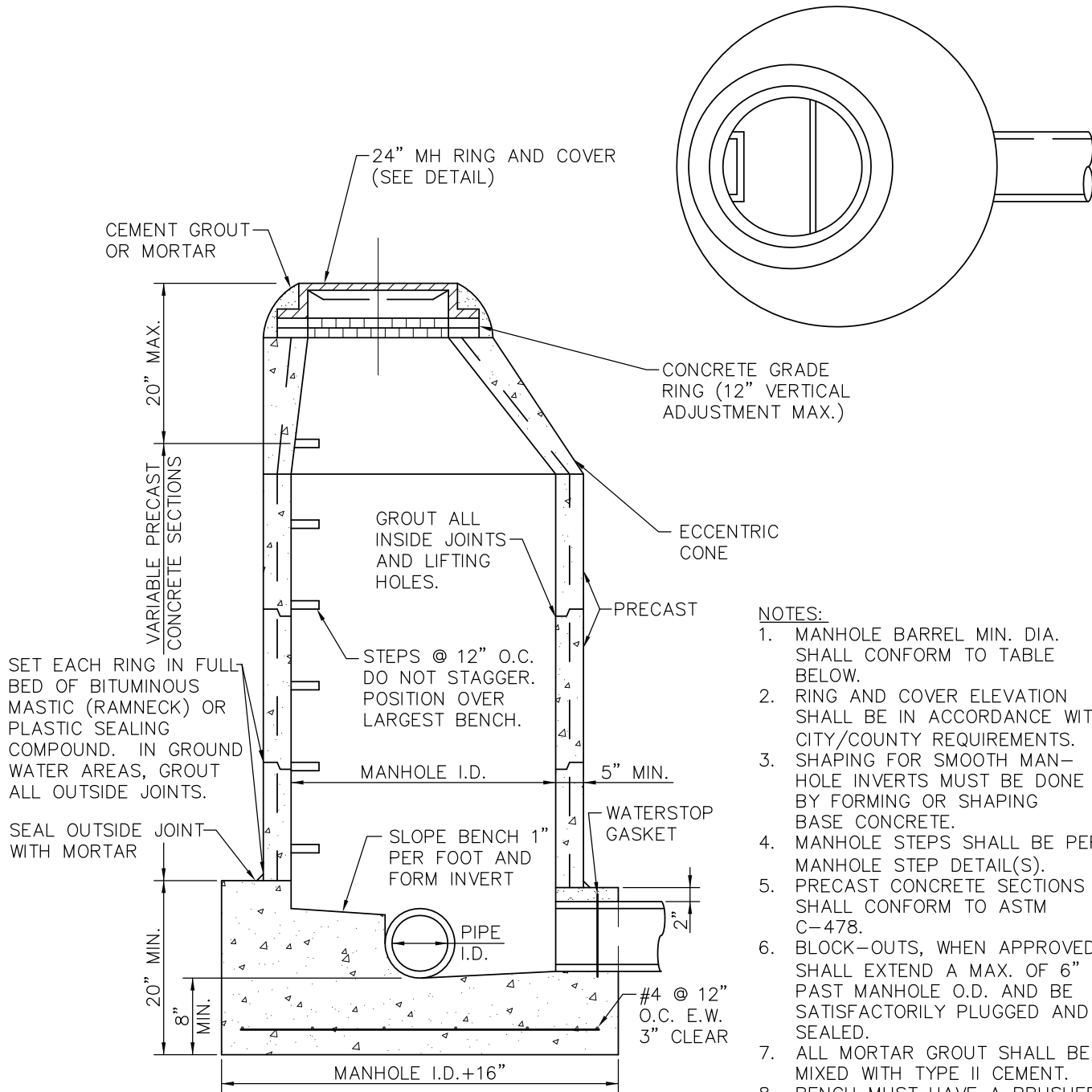


**STANDARD BEDDING  
 WITH UNDERDRAIN**

DRAWING NO.: ECCV-3S

DATE: 2-2014

REV. DATE:




- NOTES:**
1. MANHOLE BARREL MIN. DIA. SHALL CONFORM TO TABLE BELOW.
  2. RING AND COVER ELEVATION SHALL BE IN ACCORDANCE WITH CITY/COUNTY REQUIREMENTS.
  3. SHAPING FOR SMOOTH MANHOLE INVERTS MUST BE DONE BY FORMING OR SHAPING BASE CONCRETE.
  4. MANHOLE STEPS SHALL BE PER MANHOLE STEP DETAIL(S).
  5. PRECAST CONCRETE SECTIONS SHALL CONFORM TO ASTM C-478.
  6. BLOCK-OUTS, WHEN APPROVED, SHALL EXTEND A MAX. OF 6" PAST MANHOLE O.D. AND BE SATISFACTORILY PLUGGED AND SEALED.
  7. ALL MORTAR GROUT SHALL BE MIXED WITH TYPE II CEMENT.
  8. BENCH MUST HAVE A BRUSHED, NON-SKID SURFACE.
  9. OUTFALL MANHOLES REQUIRE INTERNAL LINING WHICH WILL BE SPECIFIED BY THE DISTRICT ON A CASE BY CASE BASIS.
  10. MANHOLES IN HIGH GROUNDWATER AREAS WILL REQUIRE EXTERNAL LINING AS SPECIFIED BY THE DISTRICT ON A CASE BY CASE BASIS.

PIPE I.D.	MANHOLE I.D.	RING & COVER
18" & SMALLER	4'-0"▲	24"
21" TO 48"	5'-0"	30"
54"	6'-0"	30", 36" W/ 24"
60" & LARGER	SPECIAL DESIGN	INNER COVER

▲ WHENEVER MORE THAN A TWO WAY MANHOLE OF MAX. PIPE I.D. IS REQUIRED, THE MANHOLE SHOULD BE INCREASED TO LARGER DIA., EG. 18"x18"x18", REQUIRES 5'-0" I.D.

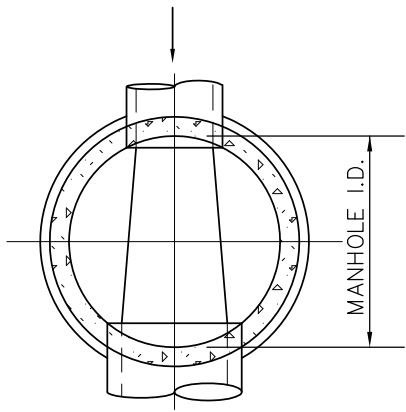
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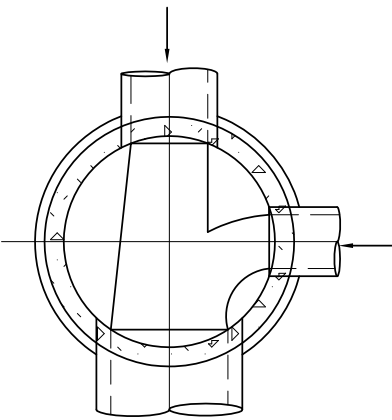
**ECCV**  
Water & Sanitation District

**STANDARD MANHOLE**

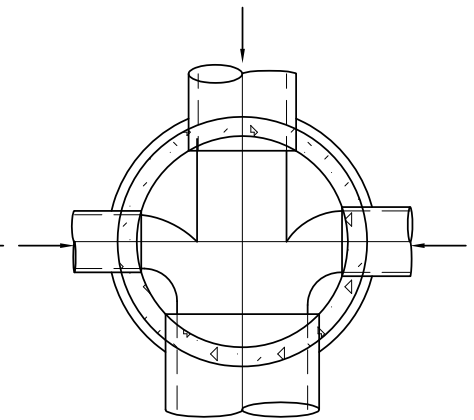
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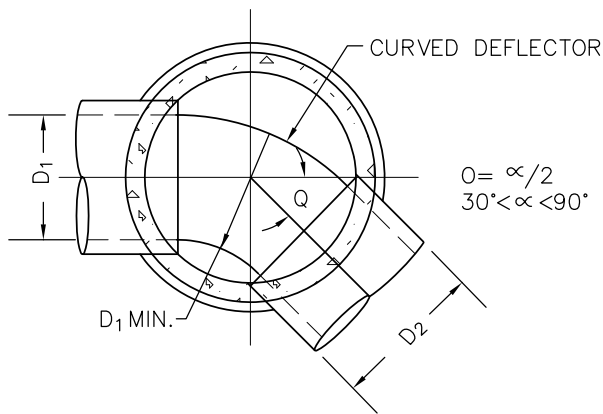
THROUGH PIPE



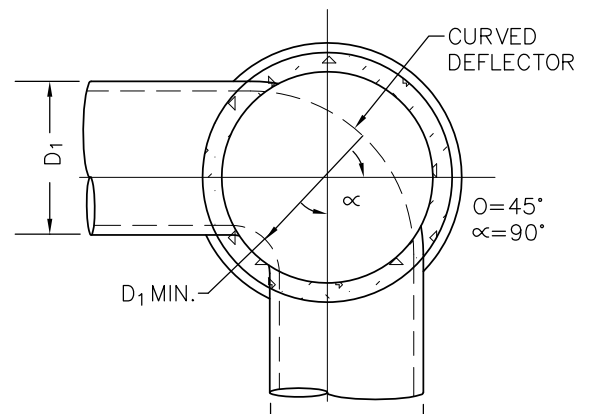
THROUGH PIPE  
ONE COLLECTION LINE



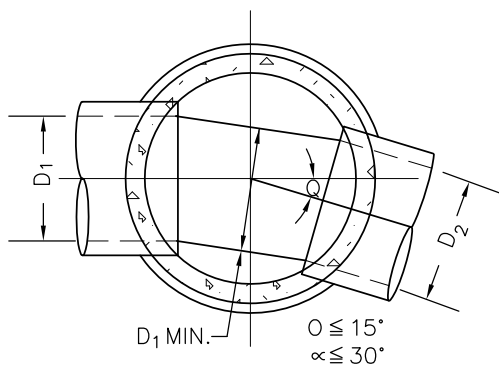
THROUGH PIPE  
TWO COLLECTION LINES



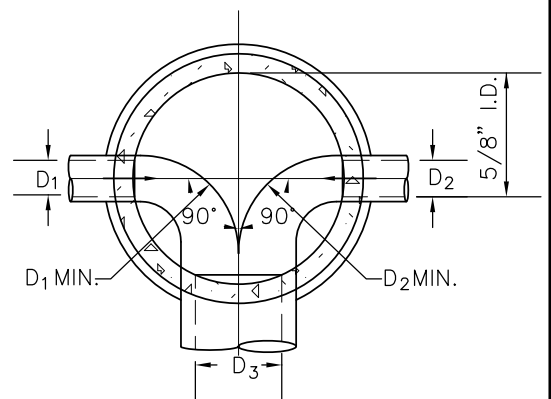
INTERMEDIATE ANGLE



SHARP ANGLE



INTERMEDIATE ANGLE



OPPOSED LATERALS

**NOTE:**  
DETAILS SHOWN ARE TYPICAL  
ONLY FOR INSTALLATIONS  
WITH A MAXIMUM OF UP TO  
18 INCH DIFFERENCE IN INVERTS  
(INSIDE DROP)

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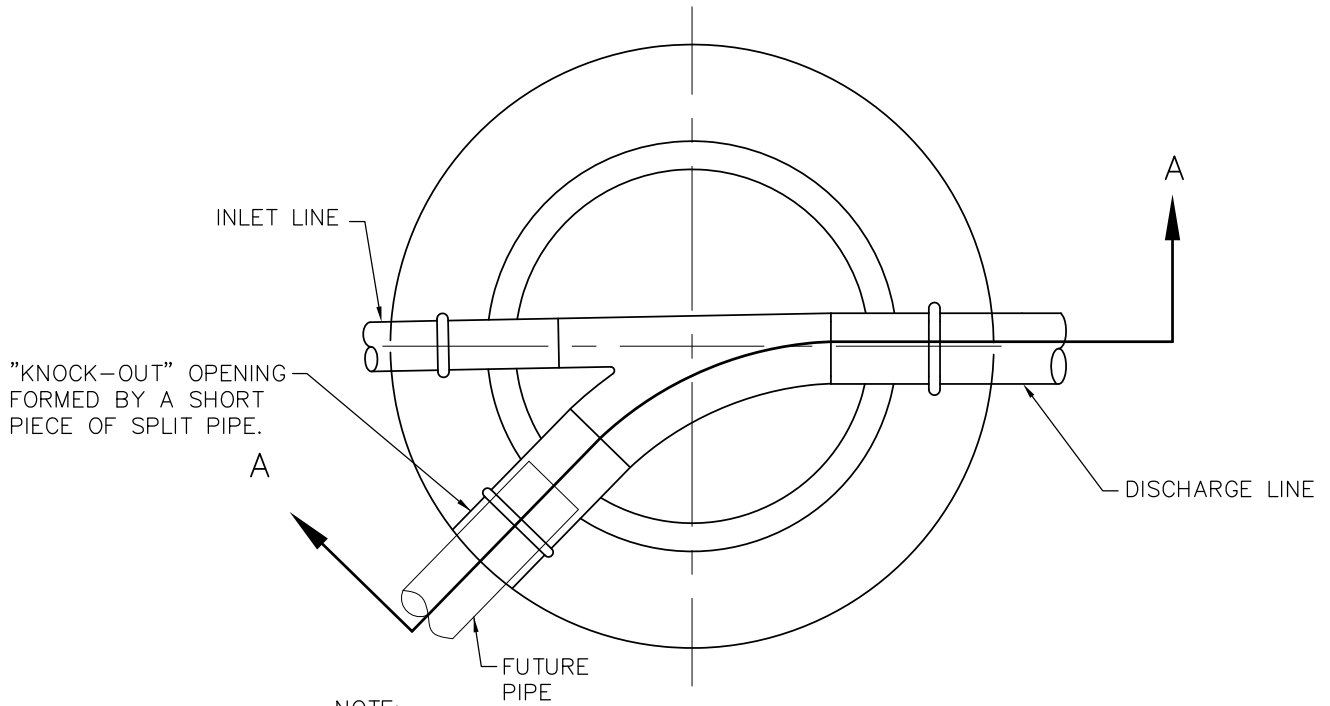
Water & Sanitation District

**MANHOLE BASE AND  
DEFLECTOR DETAIL**

DRAWING NO.: ECCV-5S

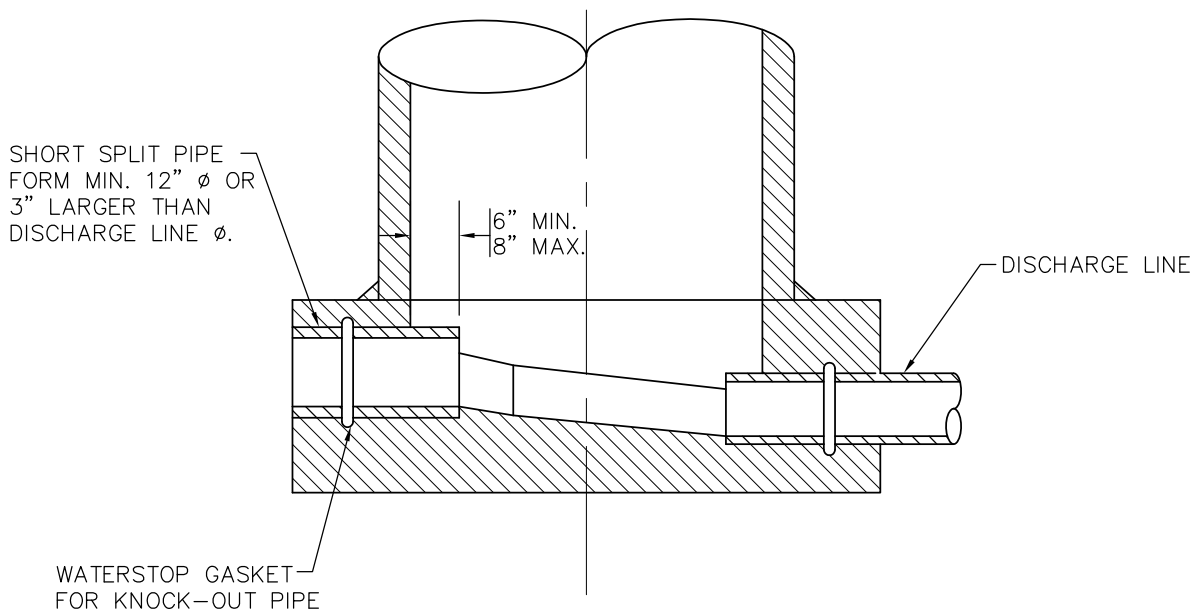
DATE: 2-2014

REV. DATE:



**NOTE:**

"KNOCK-OUT" OPENING IN BASE SHALL BE FORMED WITH A SHORT PIECE OF "SPLIT PIPE" AND BENCH FORMED ACCORDINGLY. THE PIPE SHALL BE A MINIMUM OF 12" IN DIA. OR 3" LARGER THAN THE DISCHARGE LINE SIZE. AN "O" RING GASKET SHALL BE USED ON THE LINE TO FORM A GASKET "KEY" FOR USE WHEN THE FUTURE PIPE IS CONSTRUCTED. AFTER THE CONCRETE HAS SET THE "SPLIT PIPE" SHALL BE BROKEN OUT AND THE HOLE CLOSED WITH BRICK AND MORTAR.



SECTION A-A

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**Engineers & Scientists**

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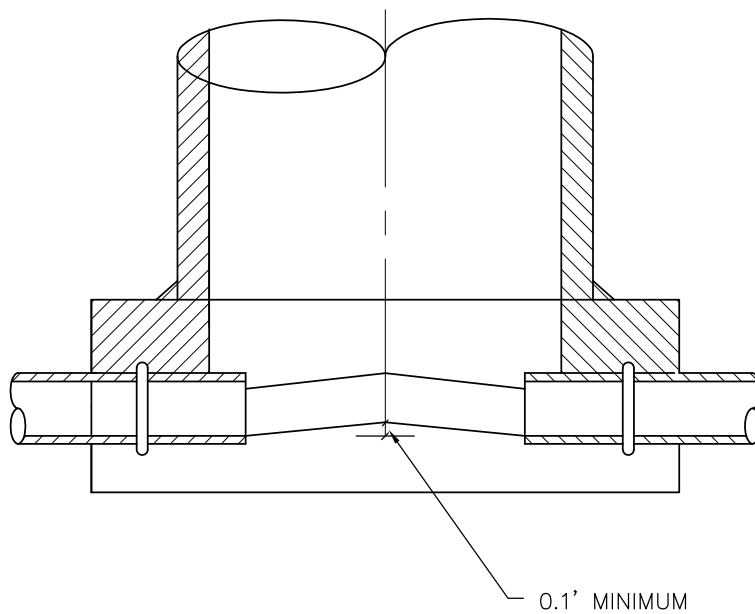


**KNOCK-OUT FOR CAST-IN-PLACE  
 MANHOLE BASE DETAIL**

DRAWING NO.: ECCV-6S

DATE: 2-2014

REV. DATE:



**Kennedy/Jenks Consultants**  
**Engineers & Scientists**

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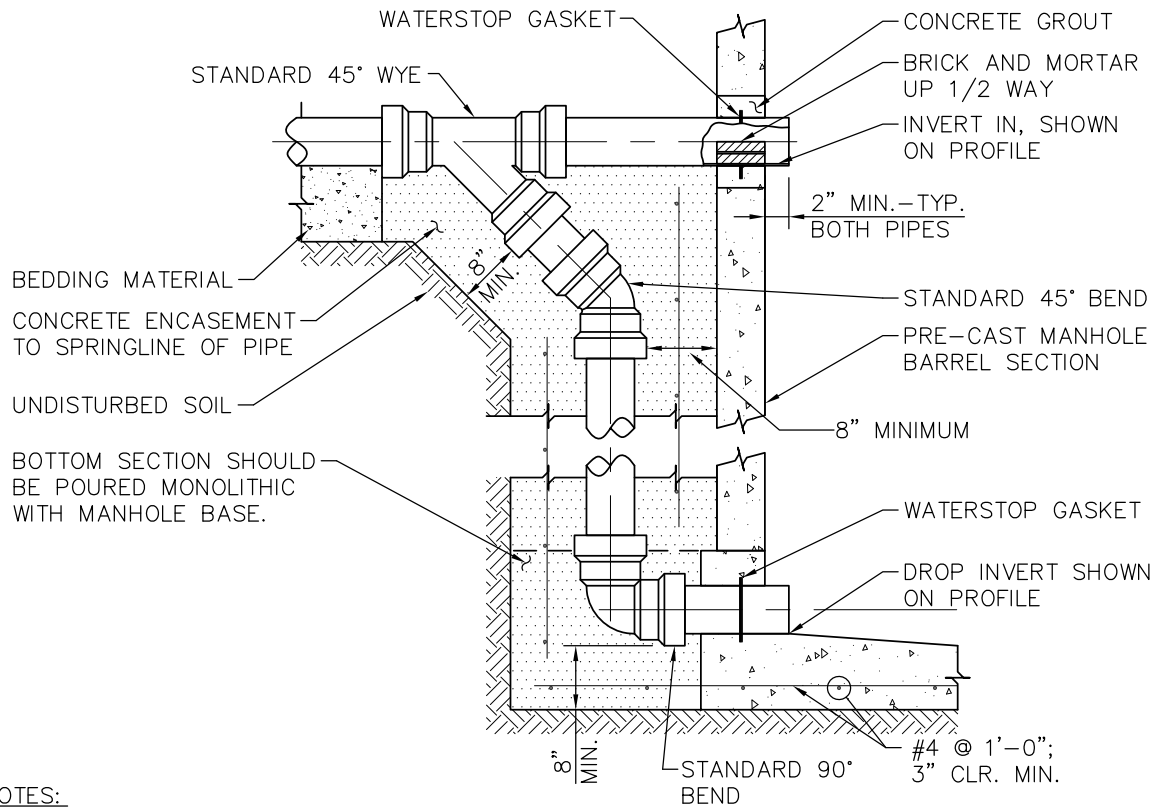


**HIGH POINT  
 MANHOLE DETAIL**

DRAWING NO.: ECCV-7S

DATE: 2-2014

REV. DATE:



**NOTES:**

1. P.V.C. (ASTM D-3034 SDR-35) PIPE AND FITTINGS ARE SHOWN.
2. CONCRETE ENCASUREMENT SHALL BE CLASS II, TYPE III-VIBRATED AND Poured MONOLITHIC WITH MANHOLE BASE MIN. 8" THICK ALL AROUND DROP.
3. DIAMETER OF DROP PIPE SHALL NOT BE LESS THAN THE LINE DIAMETER.
4. ANY DROP OVER 4'-0" REQUIRES VERTICAL AND HORIZONTAL RE-INFORCEMENT (#4 @ 1'-6" O.C.-3" CLEAR) IN ADDITION TO THE REINFORCEMENT SHOWN IN THE MANHOLE BASE.
5. MAXIMUM ALLOWABLE DROP SHALL BE SUBJECT TO THE APPROVAL OF THE DISTRICT ENGINEER.

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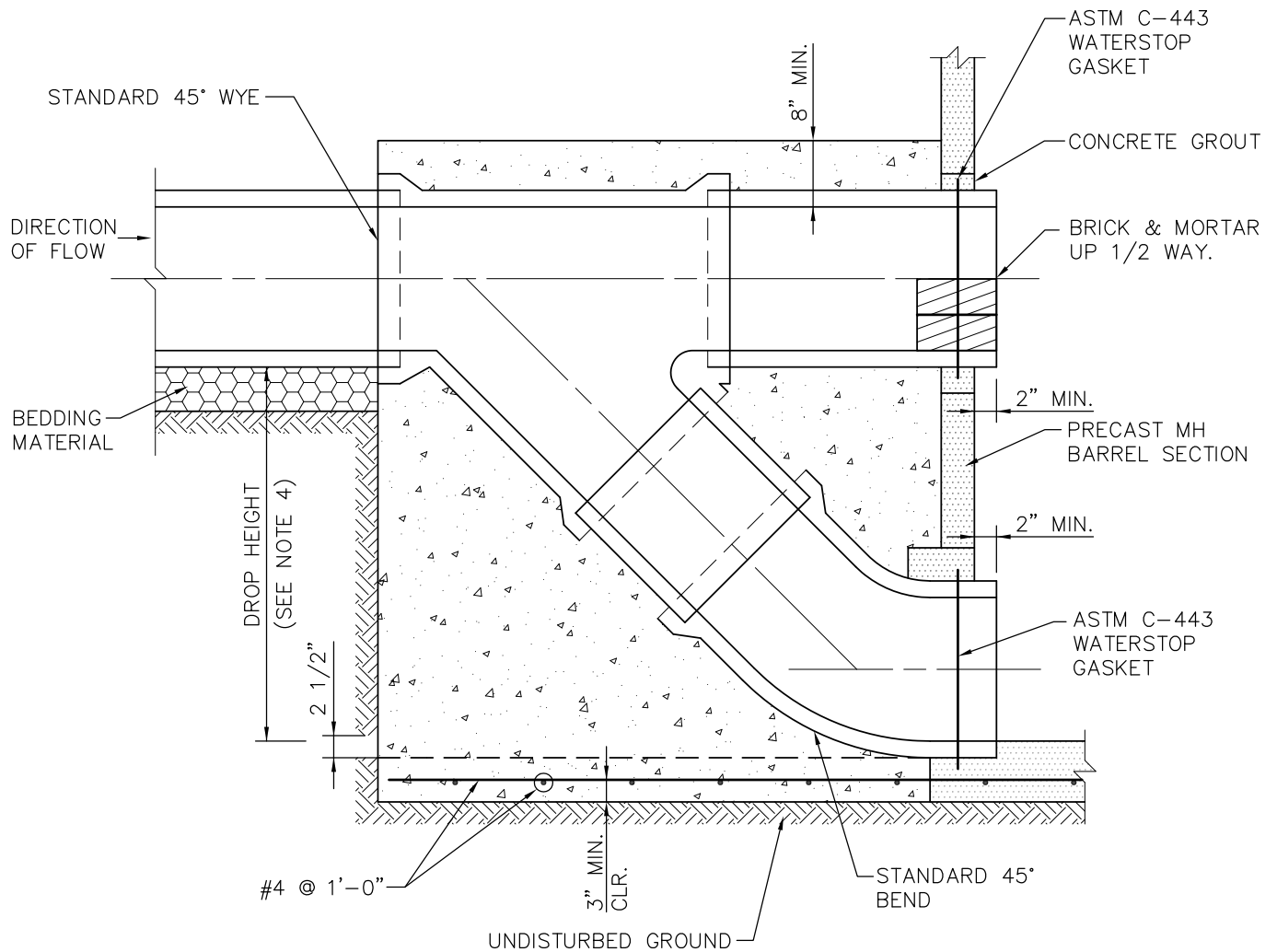
Water & Sanitation District

**OUTSIDE DROP MANHOLE  
FOR PIPE 15" OR SMALLER**

DRAWING NO.: ECCV-8S

DATE: 2-2014

REV. DATE:



**NOTES:**

1. P.V.C. (ASTM F-679 SDR-35) PIPE AND FITTINGS ARE SHOWN.
2. CONCRETE ENCASEMENT SHALL USE TYPE II CEMENT; VIBRATED AND POURED MONOLITHIC WITH MANHOLE BASE. MIN. 8" THICK ALL AROUND PIPE.
3. MAXIMUM ALLOWABLE DROP SHALL BE SUBJECT TO THE REVIEW OF THE DISTRICT.
4. DIAMETER OF DROP PIPE SHALL NOT BE LESS THAN THE LINE DIAMETER.
5. ANY DROP OVER 3'-0" REQUIRES VERTICAL AND HORIZONTAL REINFORCEMENT (#4 @ 1'-6" O.C.-3" CLEAR) IN ADDITION TO THE REINFORCEMENT SHOWN.
6. BOTH PIPE INVERTS SHALL BE AS SPECIFIED ON PLAN AND PROFILE DESIGN.

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**Engineers & Scientists**

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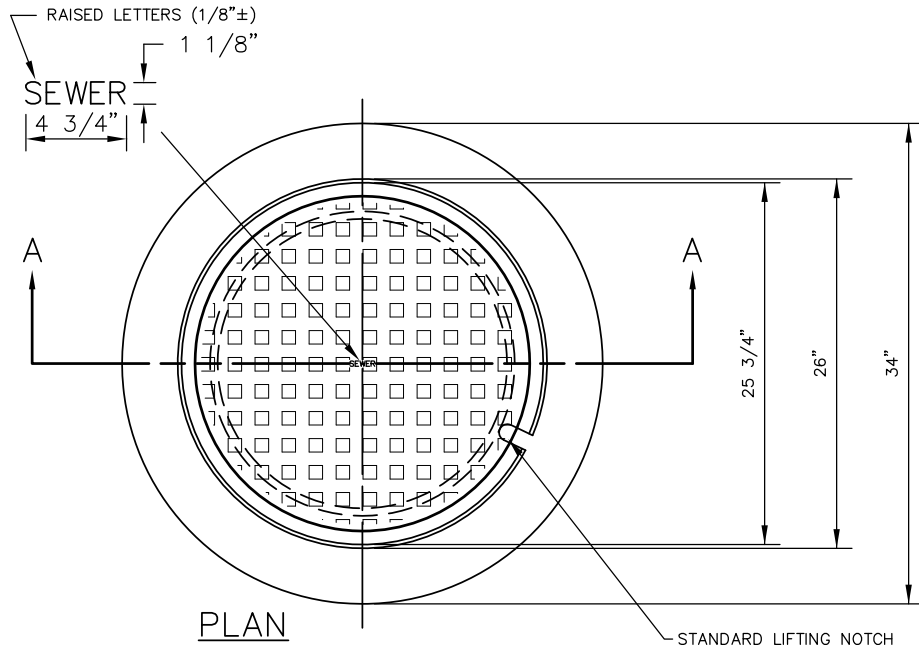


**OUTSIDE DROP MANHOLE  
FOR PIPE 18" OR LARGER**

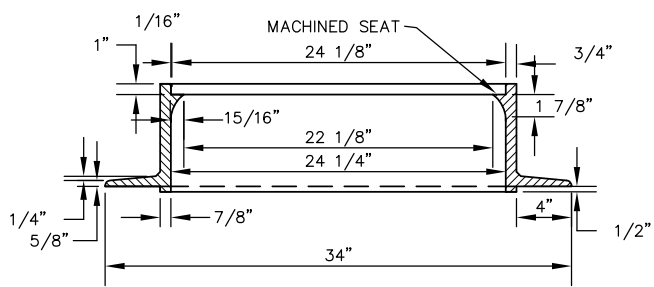
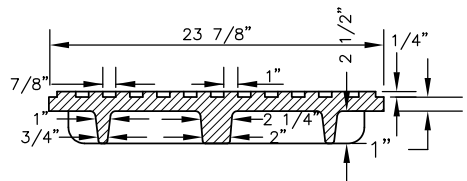
DRAWING NO.: ECCV-9S

DATE: 2-2014

REV. DATE:



PLAN



SECTION A-A

NOTES:

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
  2. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL:
- |               |        |
|---------------|--------|
| MANUFACTURERS | CAT. # |
| NEENAH        | R-1706 |
| DEETER        | 1258   |
3. NO ALUMINUM WILL BE ALLOWED.
  4. NO DISSIMILAR METALS WILL BE ALLOWED.

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**Engineers & Scientists**

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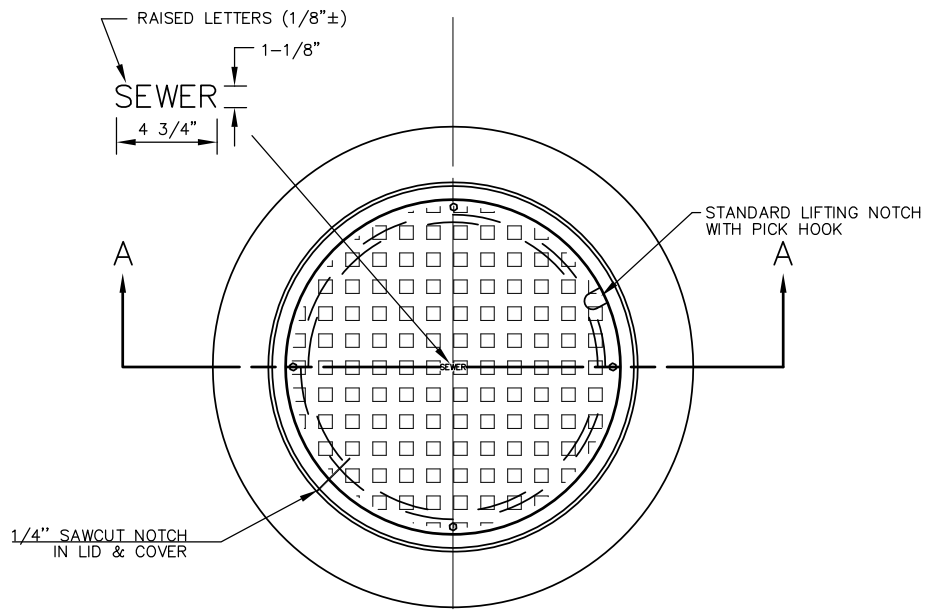
**STANDARD 24" RING AND COVER**

DRAWING NO.: ECCV-10S

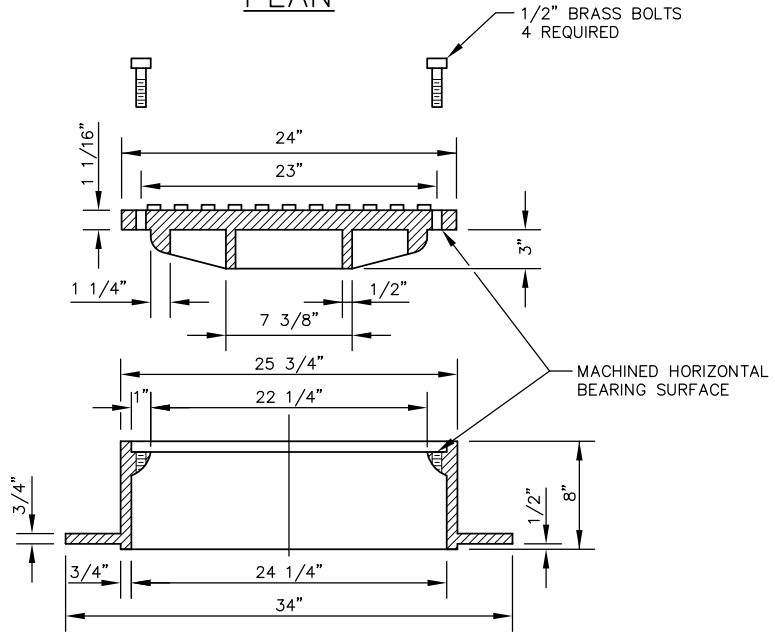
DATE: 2-2014

REV. DATE:





PLAN



SECTION A-A

NOTES:

1. BOLT DOWN MANHOLE COVER SHALL BE USED AS REQUIRED BY DISTRICT.
2. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
3. NO ALUMINUM WILL BE ALLOWED.
4. NO DISSIMILAR METALS WILL BE ALLOWED.
5. SAW CUT 1/4" NOTCH IN LID AND RING TO IDENTIFY BOLT ALIGNMENT.
6. ONLY USED WITH PRIOR PERMISSION OF DISTRICT.
7. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL: (CAST IRON ONLY)
8. COVER SHALL HAVE SELF-CENTERING BOLT HOLES.

MANUFACTURERS	CAT. #
DEETER	1258-B
NEENAH	R-1925

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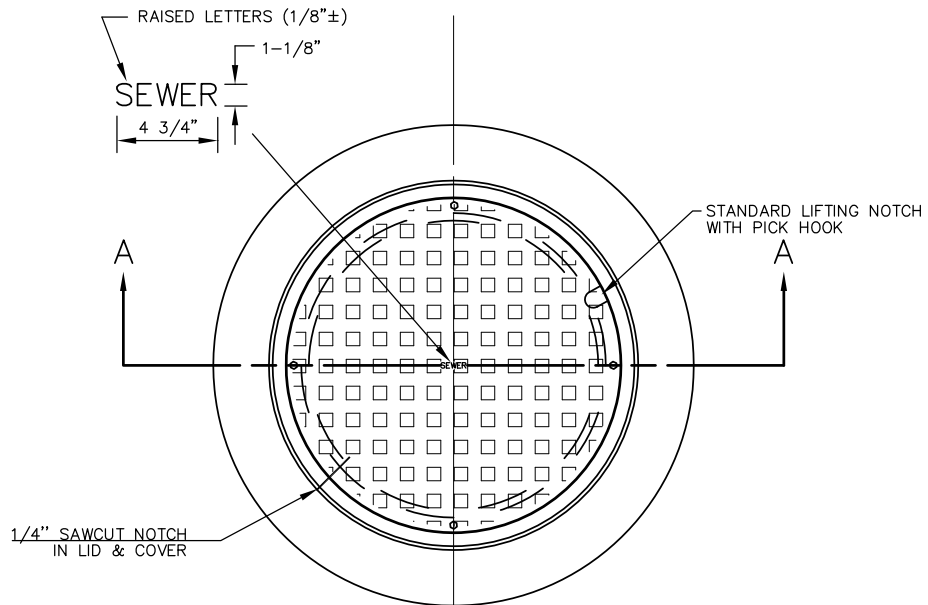


**24" RING AND BOLT DOWN COVER**

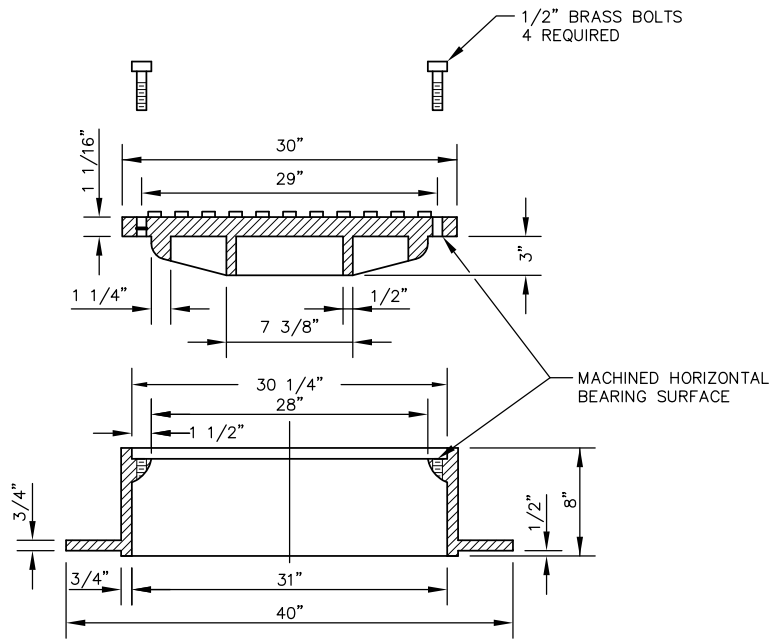
DRAWING NO.: ECCV-115

DATE: 2-2014

REV. DATE:



PLAN



SECTION A-A

NOTES:

1. BOLT DOWN MANHOLE COVER SHALL BE USED AS REQUIRED BY DISTRICT.
2. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
3. NO ALUMINUM WILL BE ALLOWED.
4. NO DISSIMILAR METALS WILL BE ALLOWED.
5. SAW CUT 1/4" NOTCH IN LID AND RING TO IDENTIFY BOLT ALIGNMENT.
6. ONLY USED WITH PRIOR PERMISSION OF DISTRICT.
7. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL: (CAST IRON ONLY)
8. COVER SHALL HAVE SELF-CENTERING BOLT HOLES.

MANUFACTURES	
DEETER	CAT. #
NEENAH	1197-B
	R-1798

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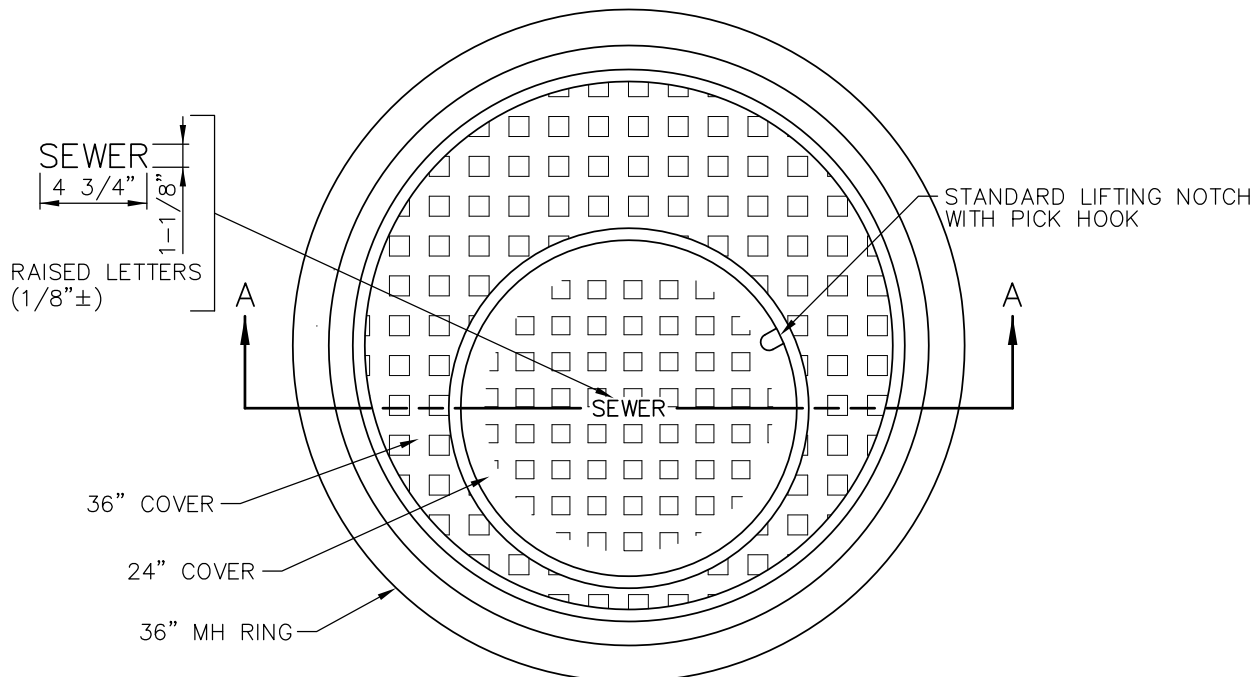
Water & Sanitation District

**30" RING AND COVER  
 (BOLT DOWN ONLY)**

DRAWING NO.: ECCV-12S

DATE: 2-2014

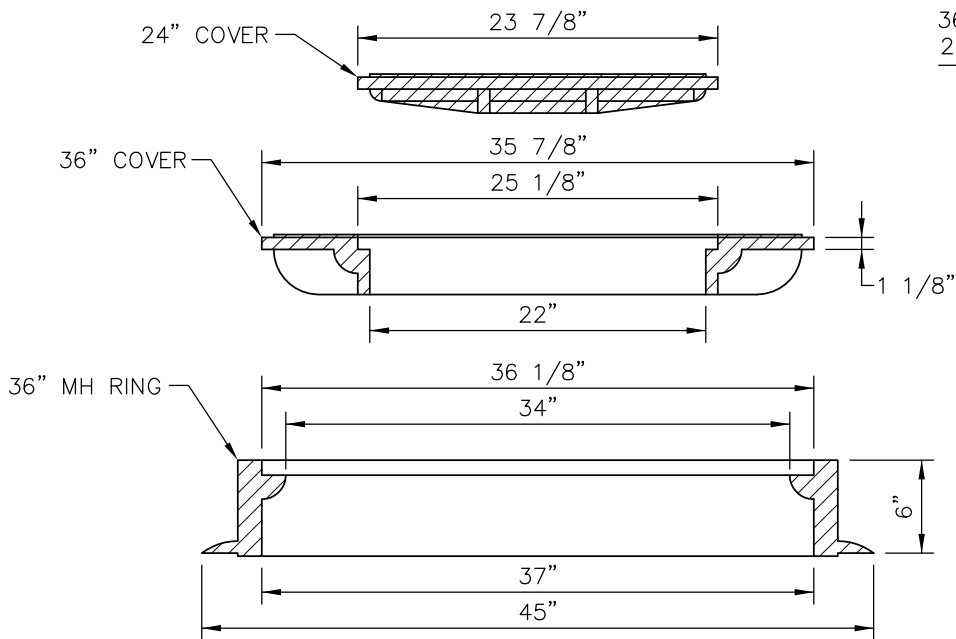
REV. DATE:



PLAN

NOMINAL WEIGHT

RING=280#  
 36" COVER=250#  
 24" COVER=165#  
 TOTAL=695#



SECTION A-A

NOTES:

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25).
2. NO ALUMINUM WILL BE ALLOWED.
3. NO DISSIMILAR METALS WILL BE ALLOWED.
4. OFFSET LID IS PREFERRED BY THE DISTRICT. CENTERED LID ON APPROVAL ONLY BY THE DISTRICT.

5. CASTINGS SHALL BE AS SPECIFIED BELOW OR EQUAL:  
 MANUFACTURER NEENAH CAT. NO. R-1741-D

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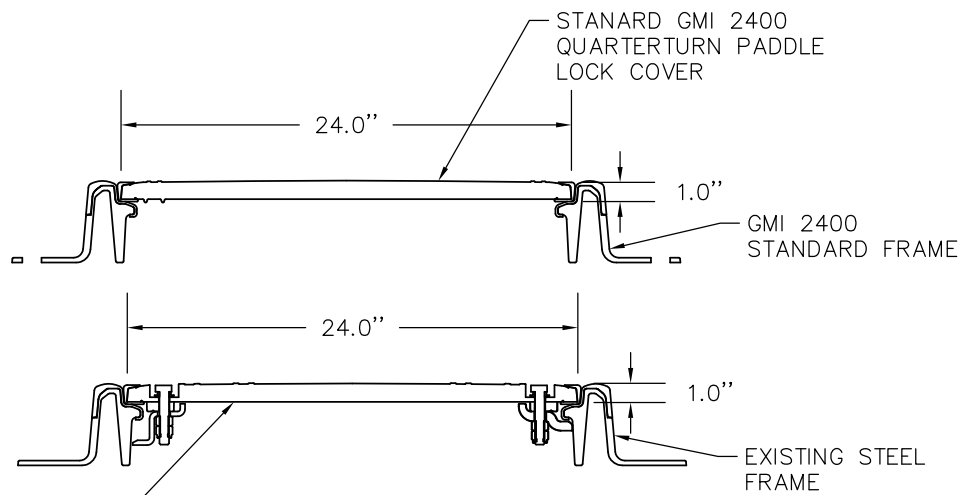
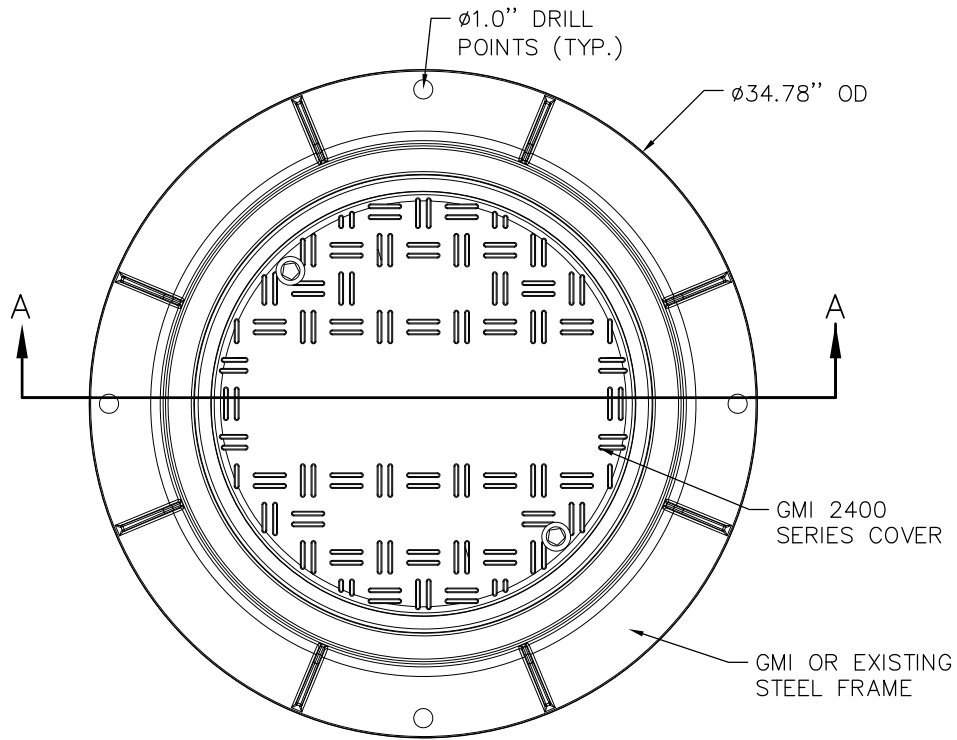


**36" X 24" DOUBLE  
 RING AND COVER**

DRAWING NO.: ECCV-13S

DATE: 2-2014

REV. DATE:



RETRO-FIT GMI 2400  
 QUARTERTURN PADDLE  
 LOCK COVER

SECTION A-A

NOTES:

1. COMPOSITE IS PREFERRED FOR BOLT DOWN LIDS.  
 CAST IRON MAY ONLY BE USED WITH PRIOR  
 PERMISSION OF DISTRICT.

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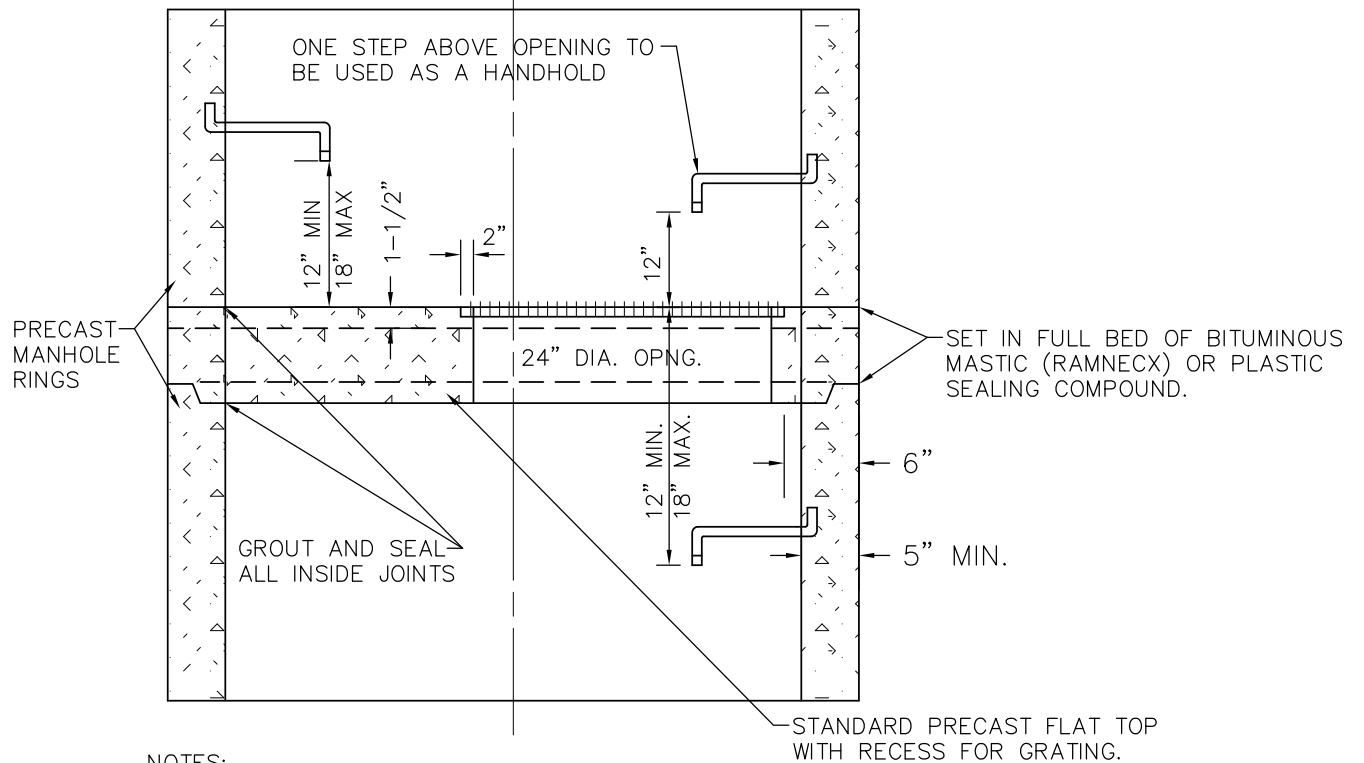
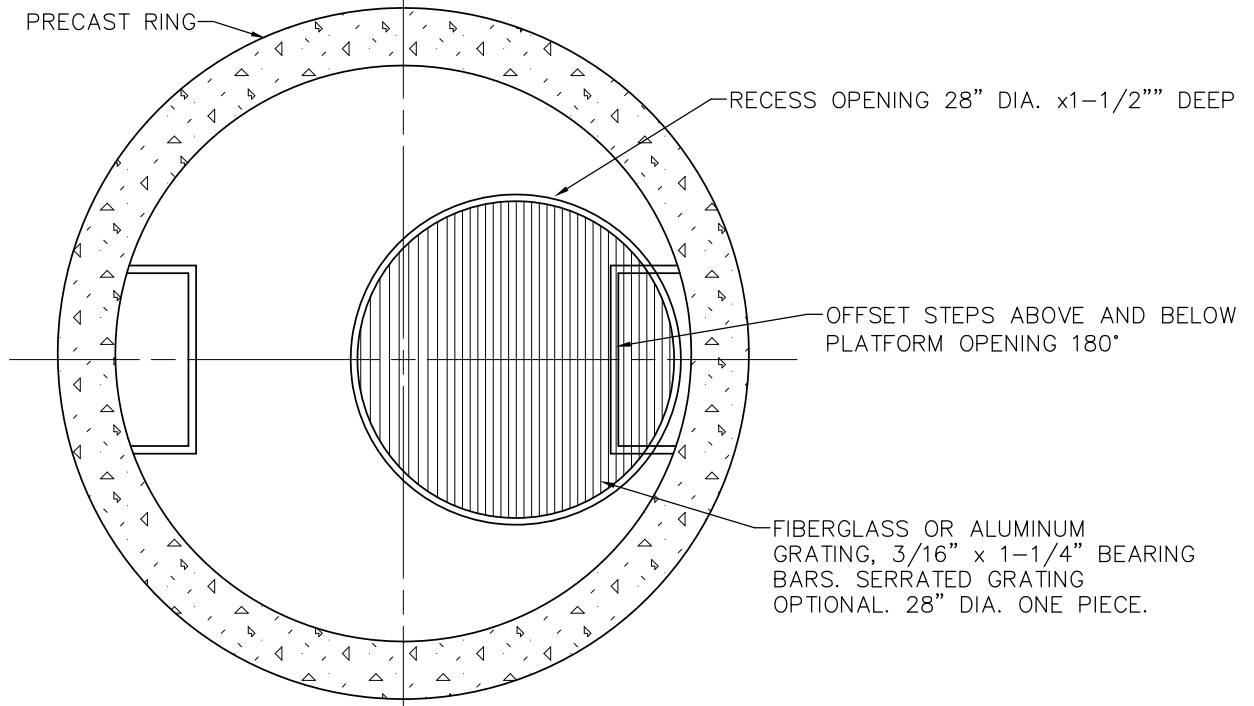
Water & Sanitation District

**COMPOSITE LOCK DOWN  
 RING AND COVER**

DRAWING NO.: ECCV-14S

DATE: 2-2014

REV. DATE:



**NOTES:**

1. USE ONLY WHEN APPROVED BY THE DISTRICT.
2. VERTICALLY CENTER FLATTOP PLATFORM BETWEEN RING AND COVER AND MANHOLE INVERT.

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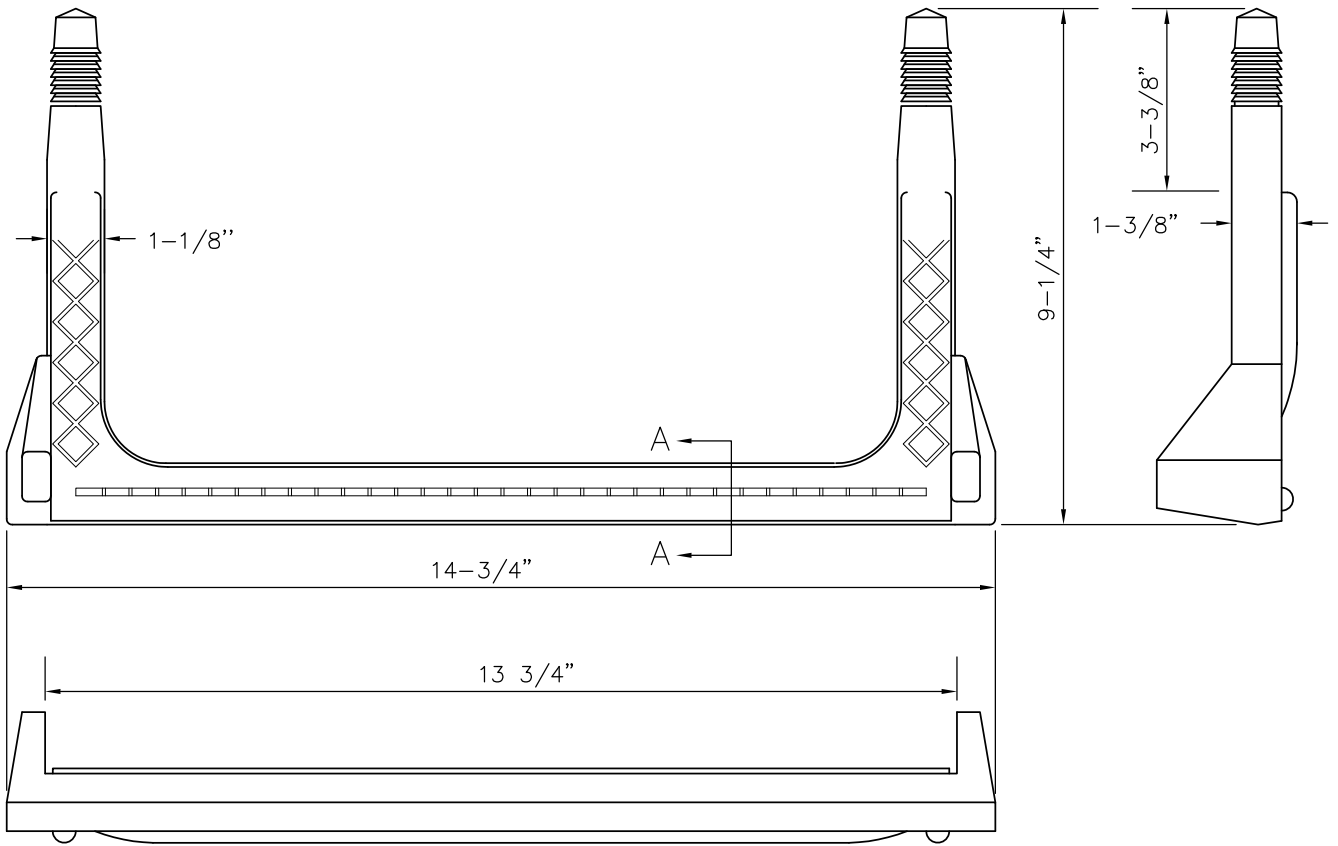
 **ECCV**  
 Water & Sanitation District

**INTERMEDIATE  
 PLATFORM DETAIL**

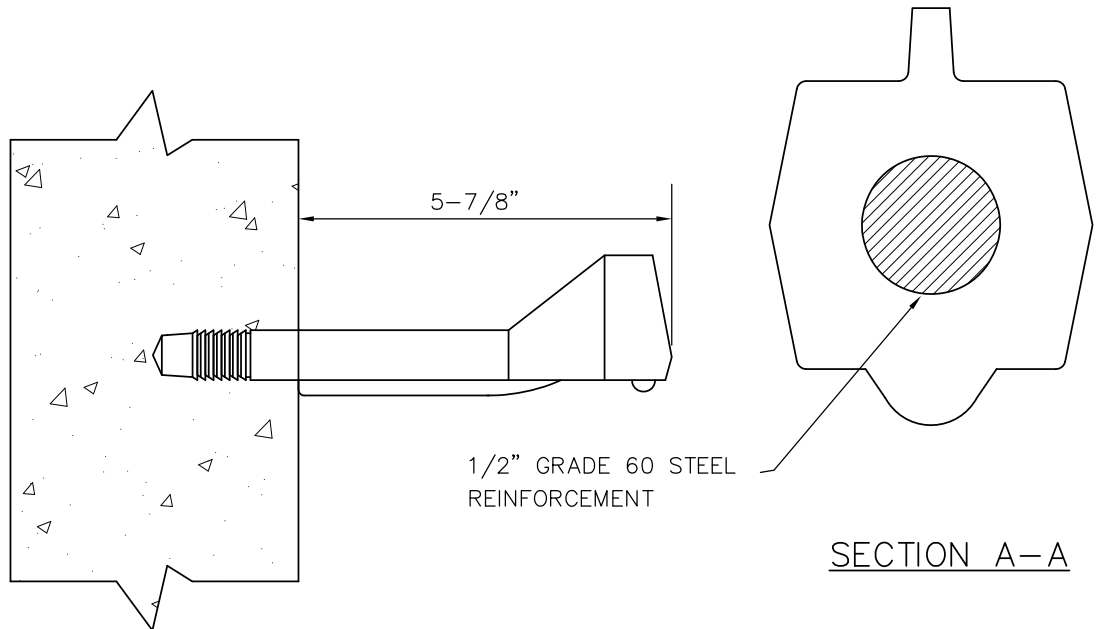
DRAWING NO.: ECCV-15S

DATE: 2-2014

REV. DATE:



COPOLYMER POLYPROPYLENE PLASTIC



NOTES:

1. AS MANUFACTURED BY M.A. INDUSTRIES. PART NO. PS2-PF.
2. IT SHALL BE THE CONTRACTORS RESPONSIBILITY TO REPLACE TOP STEPS AS NECESSARY WITH MODEL NO. PS2-PF-HH (SEE COMPACT COMPOSITE STEP) IF 20" OF CLEARANCE CANNOT BE MAINTAINED.

**Kennedy/Jenks Consultants**  
**Engineers & Scientists**

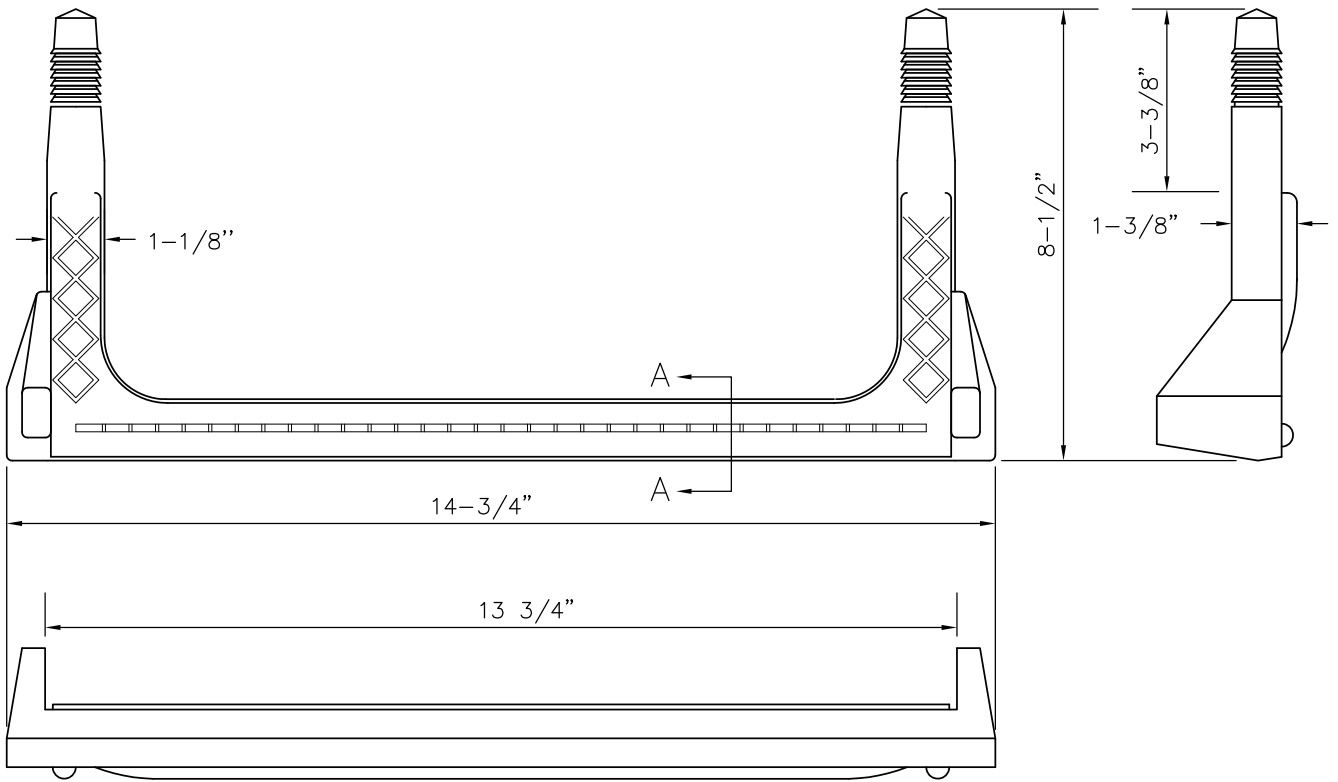
143 Union Boulevard, Suite 600 Lakewood, CO 80228  
P: 303.985.3636 F: 303.985.3800

 **ECCV**  
Water & Sanitation District  
**COMPOSITE STEP**

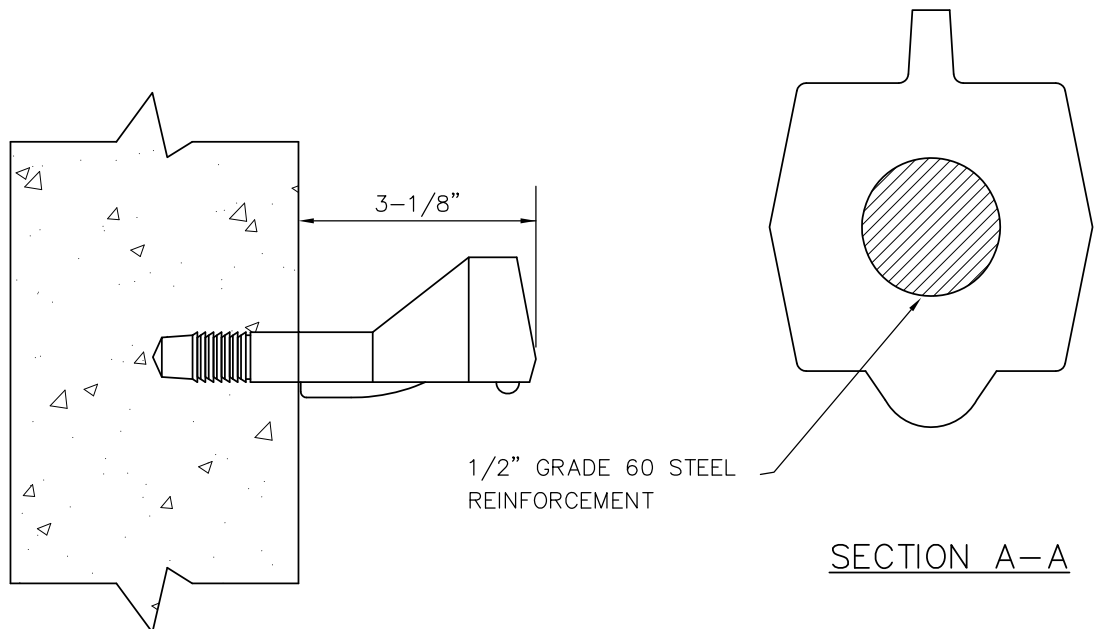
DRAWING NO.: ECCV-16S

DATE: 2-2014

REV. DATE:



COPOLYMER POLYPROPYLENE PLASTIC



NOTES:

1. AS MANUFACTURED BY M.A. INDUSTRIES. PART NO. PS2-PF-HH.
2. THIS STEP SHALL BE USED WHENEVER 20 INCHES OF CLEARANCE CANNOT BE MAINTAINED AT THE TOP STEP, USING THE COMPOSITE STEP DETAIL. MEASUREMENTS SHALL BE TAKEN FROM THE FACE OF THE STEP TO THE INNER WALL OF THE MANHOLE.

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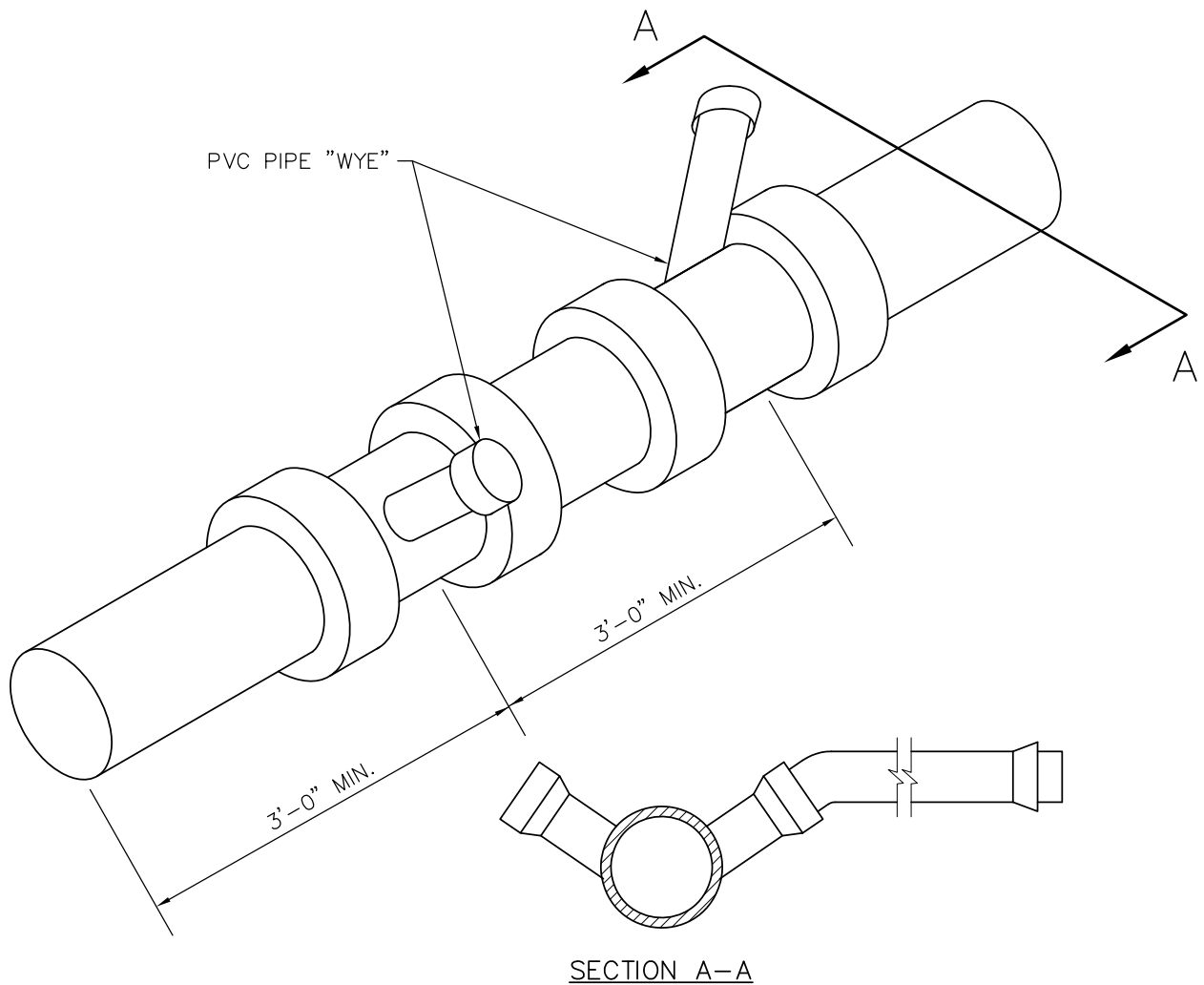


**COMPACT COMPOSITE STEP**

DRAWING NO.: ECCV-17S

DATE: 2-2014

REV. DATE:



NOTE  
 TAPS IN STAGGERED CONFIGURATION AT  
 10 O'CLOCK OR  
 2 O'CLOCK POSITION

NOTES:

1. SANITARY SEWER SERVICE TAPS SHALL BE LOCATED ON THE MAIN AT THE 2 O'CLOCK OR 10 O'CLOCK POSITION.
2. THE MINIMUM DISTANCE BETWEEN ANY TWO CONSECUTIVE FITTINGS SHALL BE 3 FEET, MEASURED BETWEEN FITTING CENTERLINES.
3. SANITARY SEWER SERVICE TAPS SHALL NOT BE MADE WITHIN 3 FEET OF A PIPE JOINT, OR 5 FEET FROM EDGE OF MANHOLE BASE.
4. A MAXIMUM OF FOUR SERVICE TAPS ARE ALLOWED PER 20 FOOT LENGTH OF PIPE.
5. ALL SANITARY SEWER TAPS SHALL USE "WYE" STYLE FITTINGS. TEES ARE NOT ALLOWED.
6. SERVICE CONNECTIONS TO MANHOLES SHALL BE PERFORMED IN ACCORDANCE WITH THE "SERVICE CONNECTION TO DEAD-END MANHOLE" CONSTRUCTION DETAIL.

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Water & Sanitation District

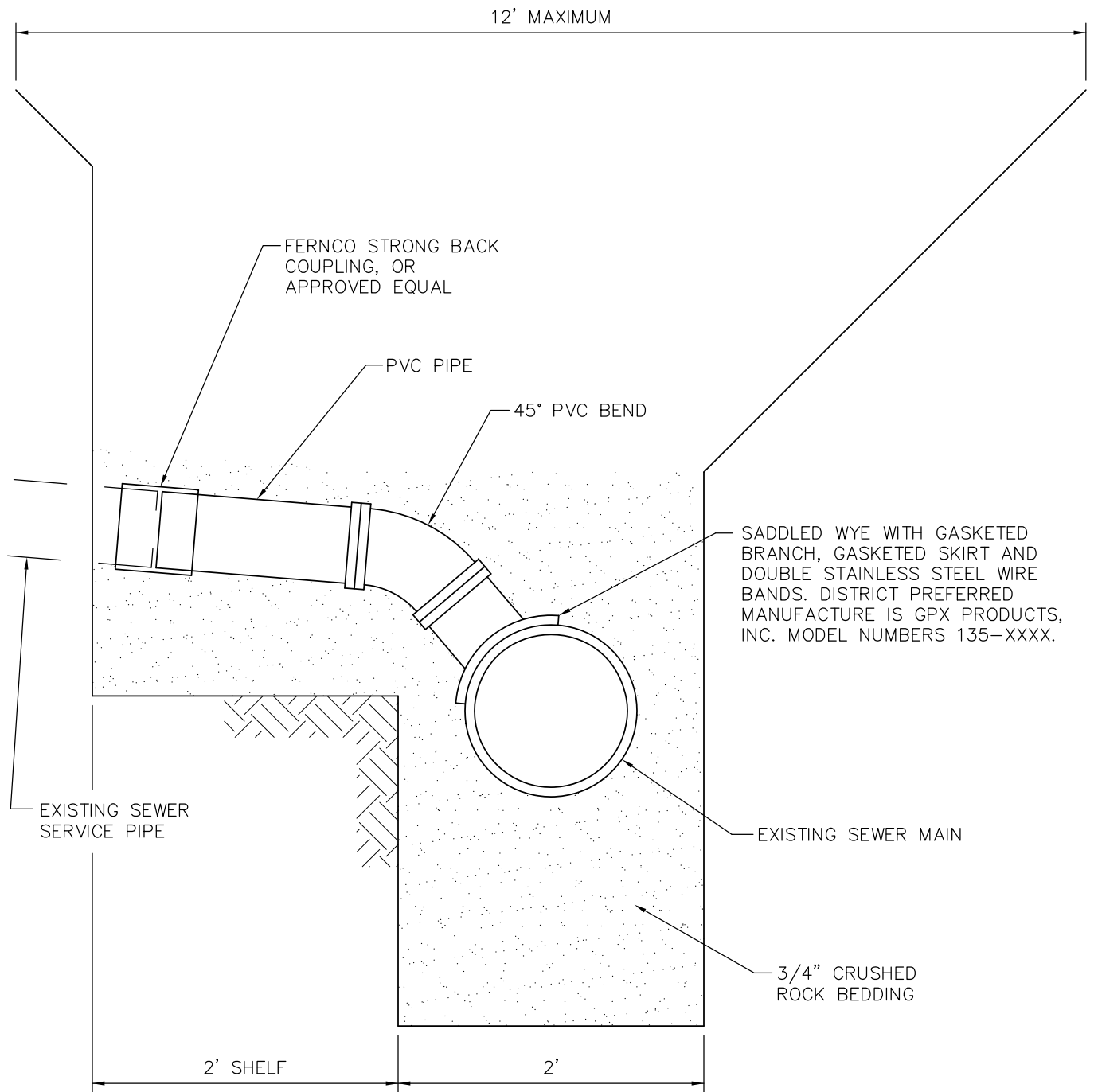
**SERVICE CONNECTION TO  
 NEW CONSTRUCTION**

DRAWING NO.: ECCV-18S

DATE: 2-2014

REV. DATE:





NOTES:

1. MAXIMUM TRENCH WIDTH AT SERVICE CONNECTIONS IS 12 FEET.
2. ONLY USED WITH PRIOR PERMISSION OF DISTRICT.

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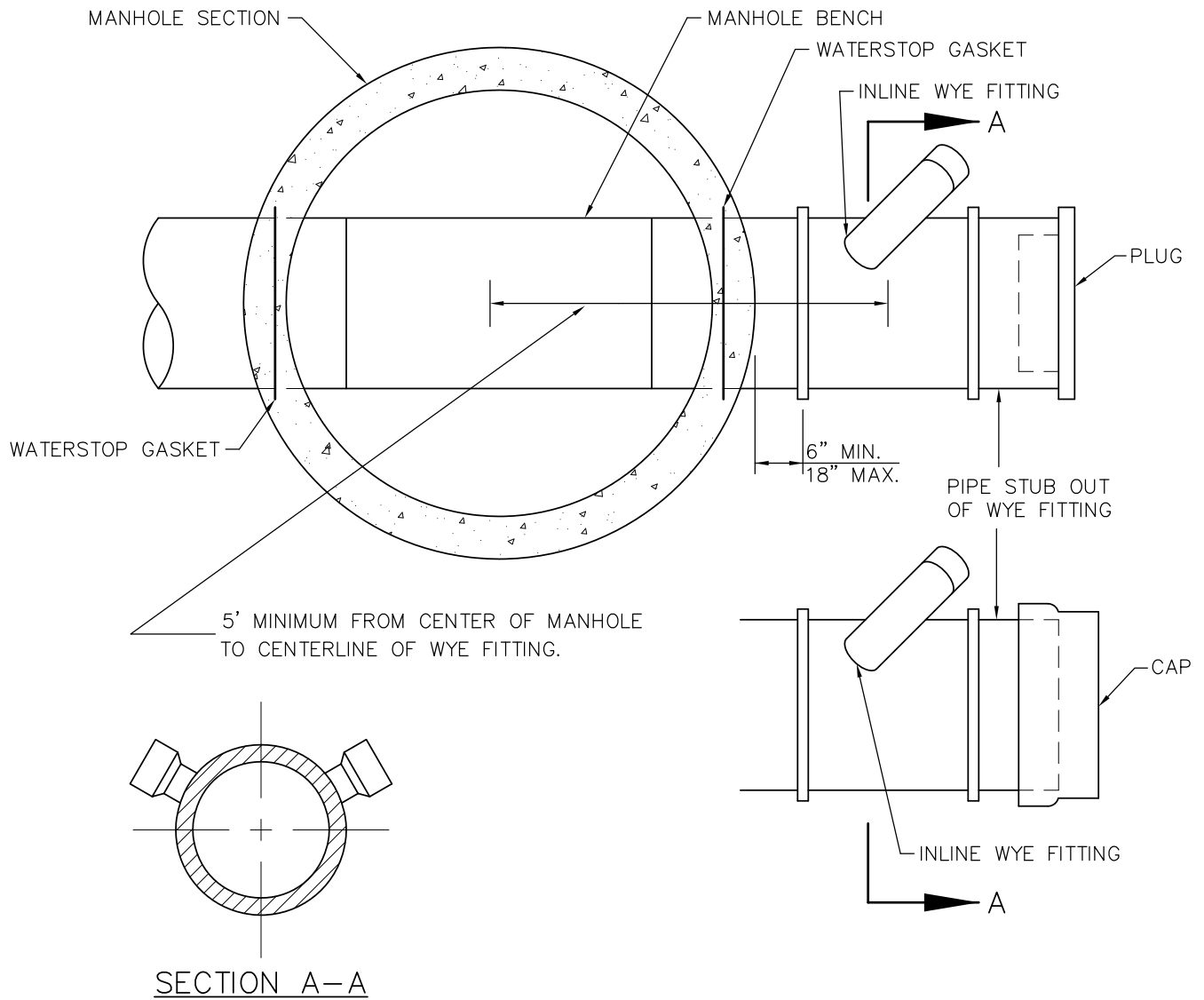


**SEWER SERVICE CONNECTION  
 TO EXISTING SEWER MAIN**

DRAWING NO.: ECCV-19S

DATE: 2-2014

REV. DATE:



NOTE:  
TAPS IN STAGGERED  
CONFIGURATION AT  
10 O'CLOCK OR  
2 O'CLOCK POSITION.

NOTES:

1. ONLY ONE SERVICE CONNECTION IS ALLOWED PER MANHOLE.
2. USE IN CONJUNCTION WITH THE STANDARD MANHOLE DETAIL.
3. SLOPE OUT OF MANHOLE TO WYE FITTING IS TO BE AT LEAST 0.5%

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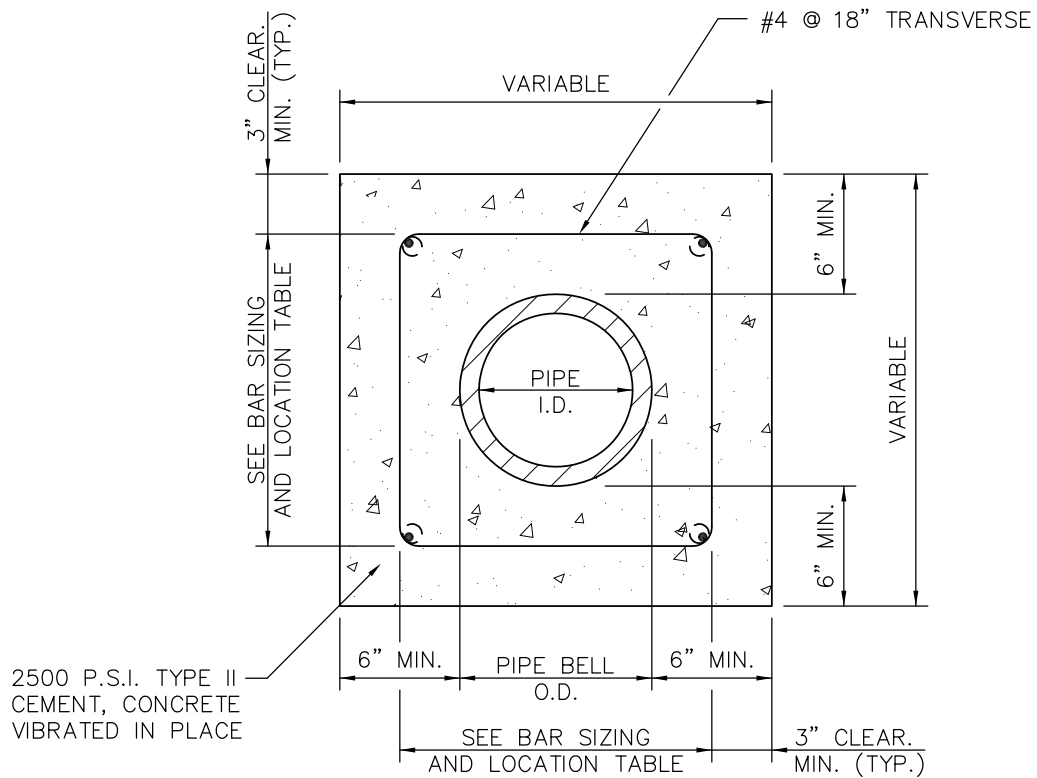
Water & Sanitation District

**SERVICE CONNECTION TO  
DEAD-END MANHOLE**

DRAWING NO.: ECCV-20S

DATE: 2-2014

REV. DATE:



### REINFORCEMENT STEEL

PIPE I.D.	LONGITUDINAL BARS – LOCATION		
6 IN.	4-NO. 4 BARS	1 EACH	CORNER
8 IN.	4-NO. 4 BARS	1 EACH	CORNER
10 IN.	8-NO. 4 BARS	3 EACH	SIDE
12 IN.	8-NO. 4 BARS	3 EACH	SIDE
15 IN.	8-NO. 4 BARS	3 EACH	SIDE
18 IN.	8-NO. 4 BARS	3 EACH	SIDE
21 IN.	12-NO. 4 BARS	4 EACH	SIDE
24 IN.	12-NO. 4 BARS	4 EACH	SIDE
27 IN.	12-NO. 4 BARS	4 EACH	SIDE
30 IN.	12-NO. 4 BARS	4 EACH	SIDE
33 IN.	12-NO. 4 BARS	4 EACH	SIDE
36 IN.	16-NO. 4 BARS	5 EACH	SIDE

**NOTE:**

THE DISTRICT SHALL REVIEW THIS DETAIL FOR USE ON A CASE BY CASE BASIS. SPECIAL ENCASEMENTS MAY BE REQUIRED AT CREEK CROSSINGS AND CONDUIT CROSSINGS.

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Water & Sanitation District

### CONCRETE ENCASEMENT

DRAWING NO.: ECCV-21S

DATE: 2-2014

REV. DATE:

2 ROWS OF GREEN REFLECTIVE TAPE 1" WIDE EACH WITH 1" GAP

3" DIA. STEEL POST PAINTED YELLOW, FILLED WITH CONCRETE

M.H. OBJECT (MANHOLE)

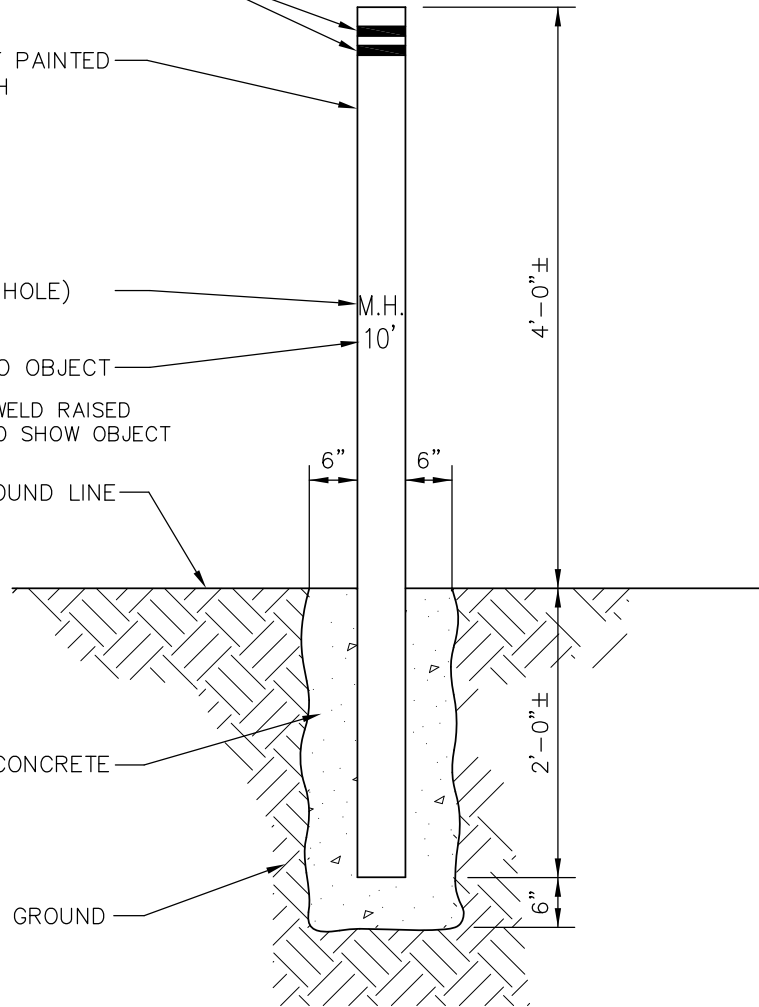
10' DISTANCE TO OBJECT

2" STAMPED LETTERS OR WELD RAISED BLACK CAPITAL LETTERS TO SHOW OBJECT AND DISTANCE TO OBJECT.

GROUND LINE

CONCRETE

UNDISTURBED GROUND



**NOTE:**

1. MARKER POSTS SHALL BE INSTALLED AT THE LOCATIONS INDICATED ON THE SIGNED CONSTRUCTION PLANS AND AT ANY OTHER LOCATIONS REQUIRED BY THE DISTRICT DURING CONSTRUCTION.

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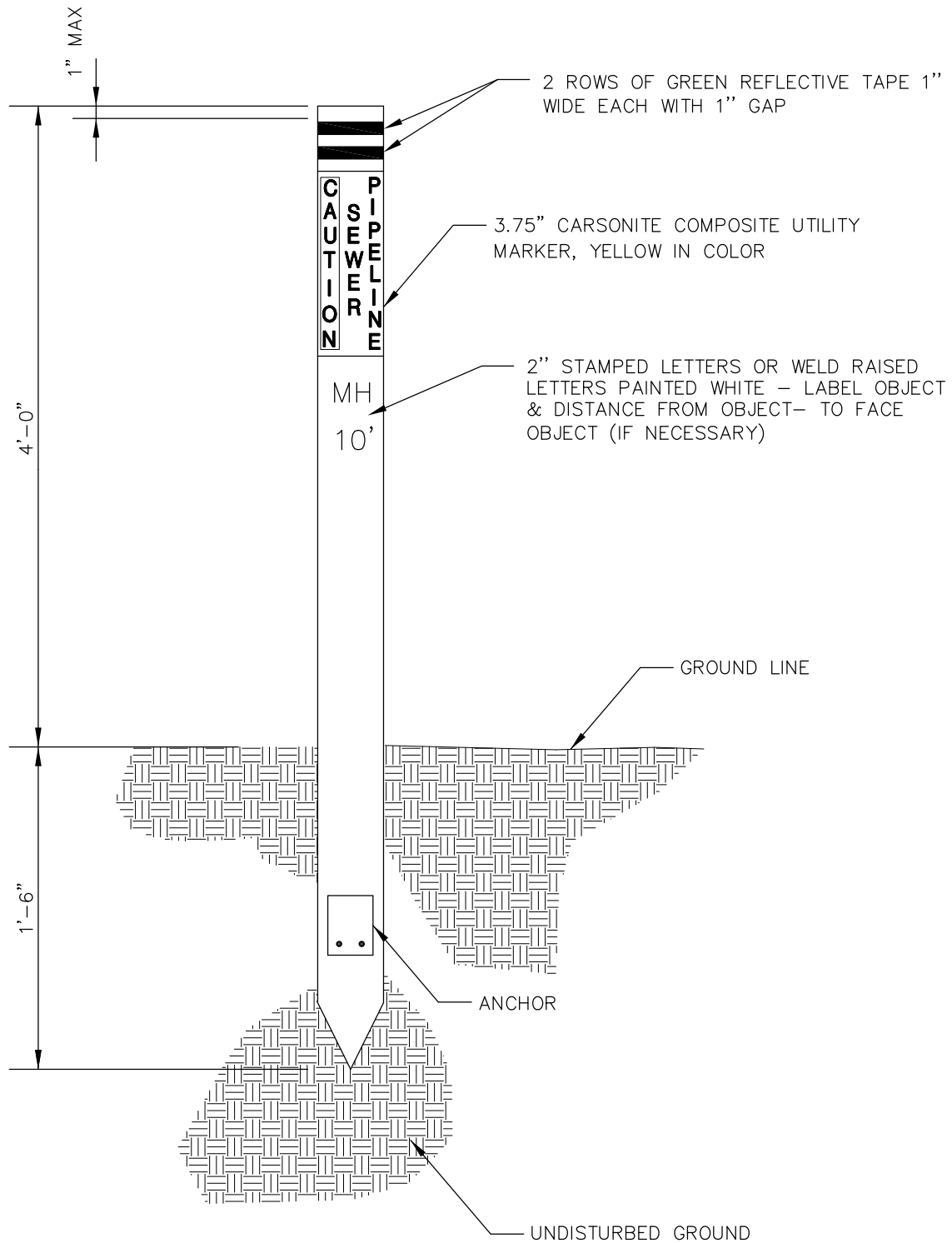
 **ECCV**  
Water & Sanitation District

**STANDARD STEEL  
MARKER POST**

DRAWING NO.: ECCV-22S

DATE: 2-2014

REV. DATE:



**NOTE:**

1. MARKER POSTS SHALL BE INSTALLED AT THE LOCATIONS INDICATED ON THE SIGNED CONSTRUCTION PLANS AND AT ANY OTHER LOCATIONS REQUIRED BY THE DISTRICT DURING CONSTRUCTION.

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**Engineers & Scientists**

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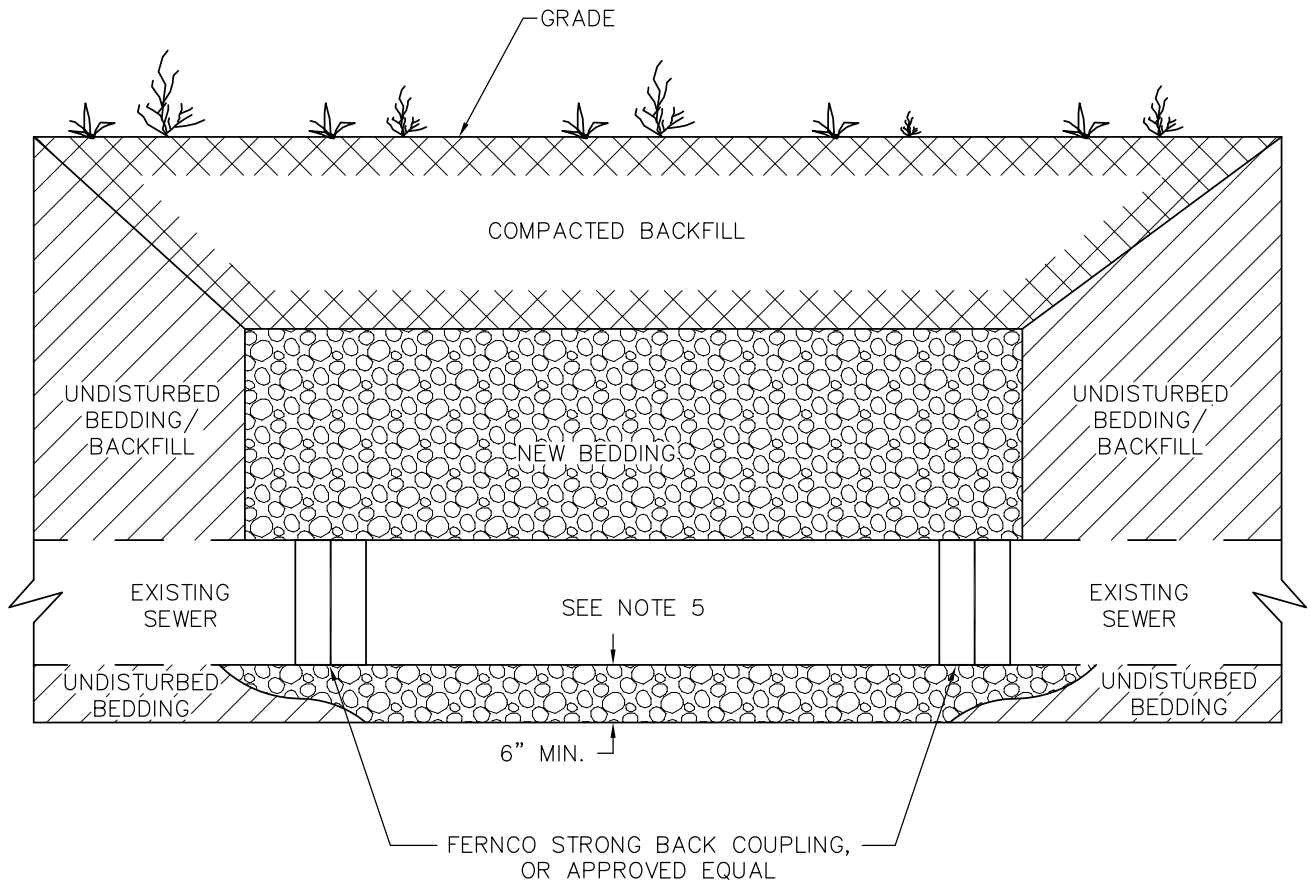


**CARSONITE MARKER  
POST DETAIL**

DRAWING NO.: ECCV-23S

DATE: 2-2014

REV. DATE:



**NOTES:**

1. WHEN SANITARY SEWER LINES ARE DAMAGED, THE DISTRICT SHALL BE NOTIFIED IMMEDIATELY BY THE CONTRACTOR.
2. THE CONTRACTOR SHALL PROVIDE BYPASS PUMPING UNTIL THE REPAIR IS CONSTRUCTED, REVIEWED, AND APPROVED BY THE DISTRICT.
3. SANITARY SEWER LINE REPAIRS SHALL NOT BE BACKFILLED UNTIL THEY ARE REVIEWED BY THE DISTRICT.
4. THIS DETAIL SHALL BE USED IN CONJUNCTION WITH THE STANDARD BEDDING DETAIL.
5. THE MAIN REPAIR SHALL USE PVC PIPE OF A CLASS AT LEAST EQUAL TO THE EXISTING PIPE, BUT IN NO CASE LESS THAN THE FOLLOWING MINIMUM CLASS. FOR LINES 15-INCHES IN DIAMETER OR LESS, ASTM SDR 35, FOR LINES 18-INCHES IN DIAMETER OR LARGER, ASTM F679. THE DISTRICT MAY REQUIRE OTHER MATERIALS AND REPAIR TECHNIQUES ON A CASE BY CASE BASIS. THE NEW PIPE SHALL BE CONNECTED TO THE EXISTING MAIN USING WATERTIGHT FLEXIBLE COUPLINGS MEETING ASTM C-425 BANDED WITH TWO SERIES 300 STAINLESS STEEL BANDS AND EACH COUPLING SHALL BE ENCASED IN CONCRETE.

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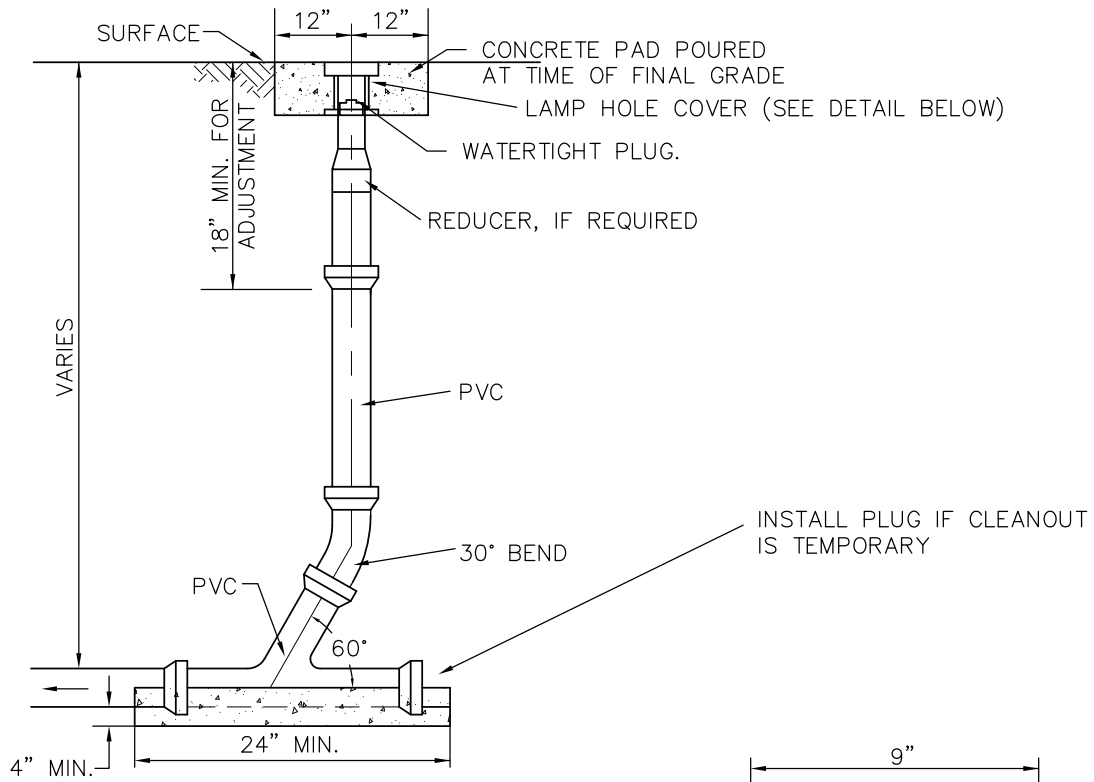


**SANITARY SEWER  
LINE REPAIR**

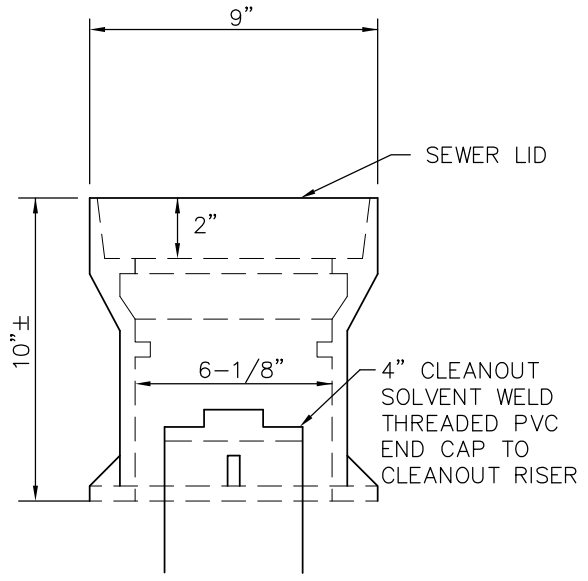
DRAWING NO.: ECCV-24S

DATE: 2-2014

REV. DATE:



PLAN VIEW



COVER DETAIL

- NOTES:**
1. COVER SHALL HAVE A LOCKING LID MARKED "SEWER".
  2. TYLER SERIES 6855 SLIP TYPE TOP SECTION, D & L SUPPLY SERIES M-8056 OR EQUAL.
  3. CLEANOUT LIDS FOR RESIDENTIAL SHALL NOT BE SET IN CONCRETE.

FOR SERVICES ONLY  
NOT ALLOWED ON DISTRICT LINES

**Kennedy/Jenks Consultants**  
**Engineers & Scientists**

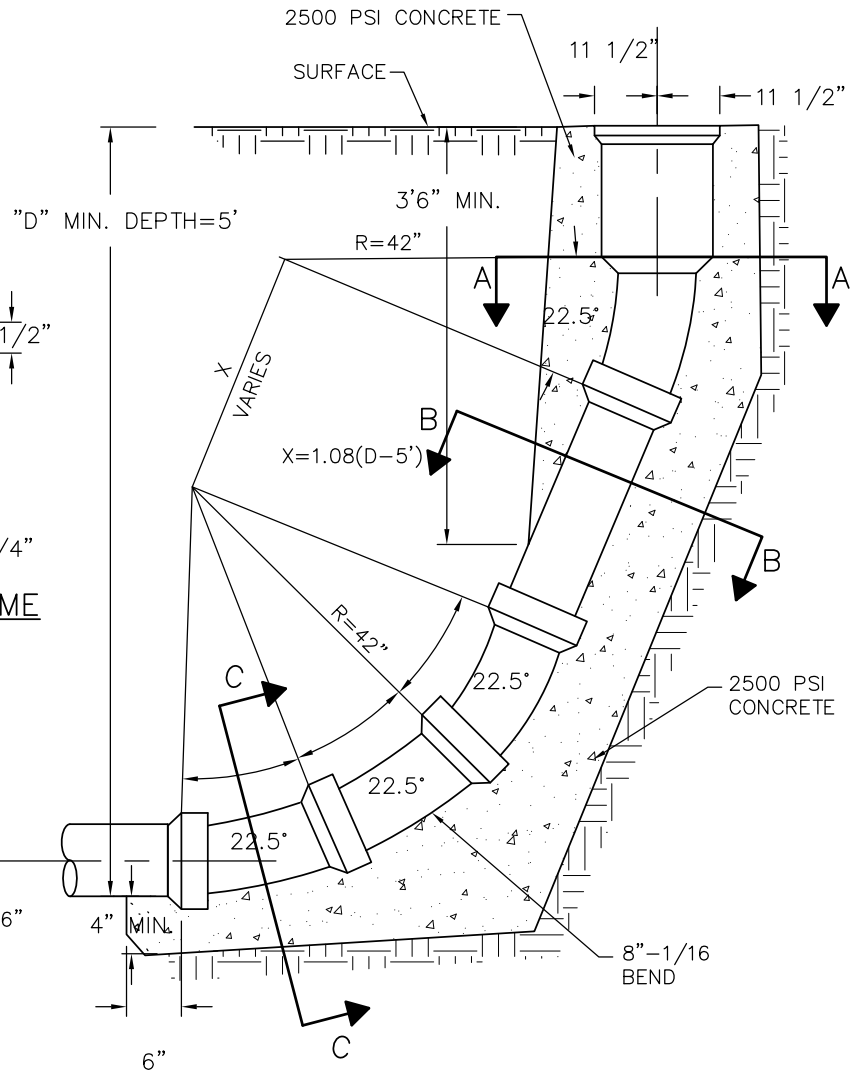
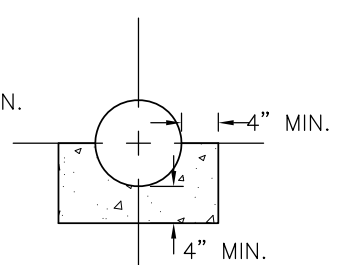
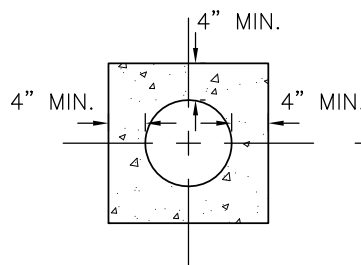
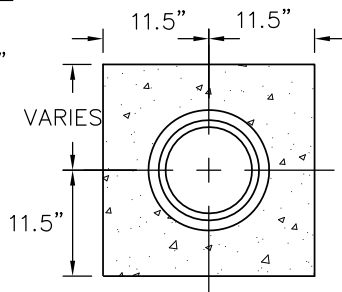
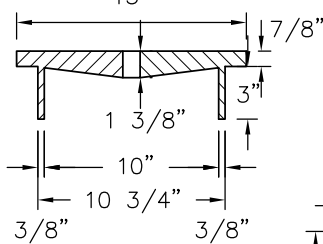
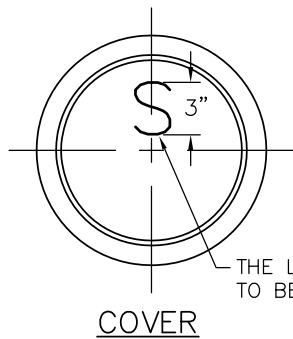
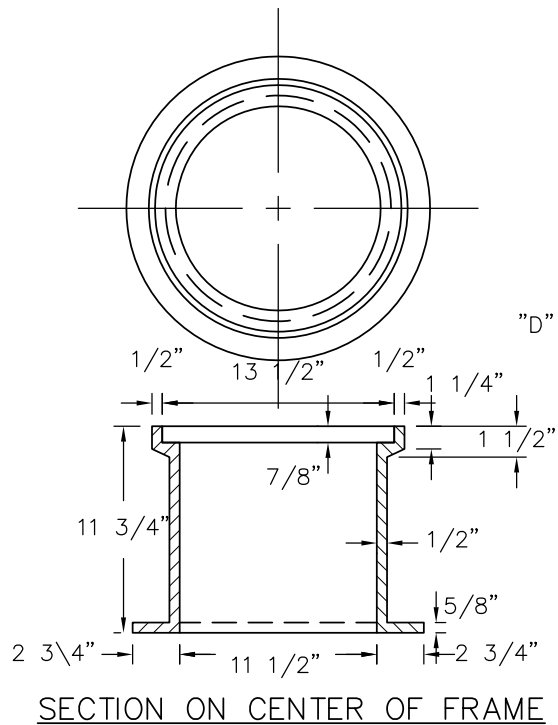
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 **ECCV**  
Water & Sanitation District  
**CLEANOUT DETAIL**

DRAWING NO.: ECCV-25S

DATE: 2-2014

REV. DATE:



FOR SERVICES ONLY  
NOT ALLOWED ON DISTRICT LINES

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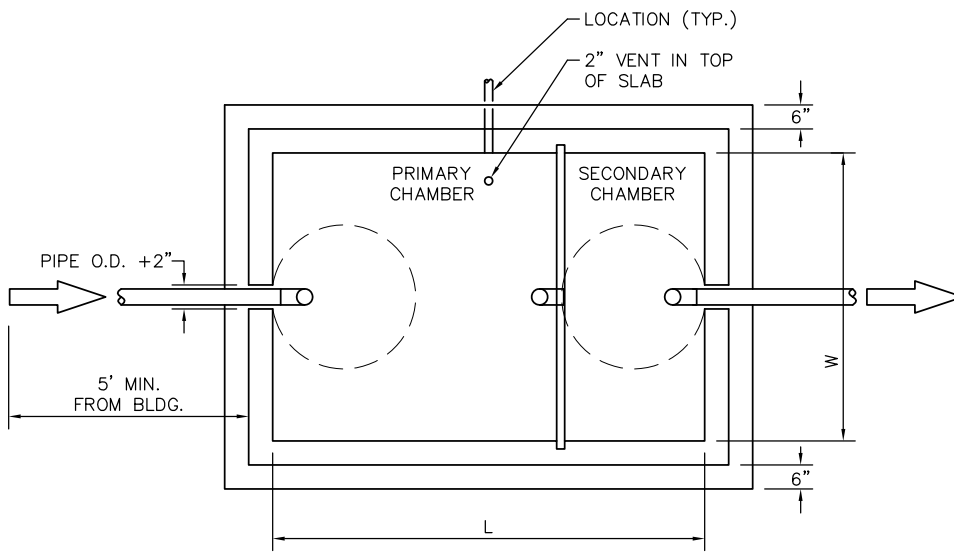
 **ECCV**  
Water & Sanitation District  
**DEAD-END  
CLEANOUT DETAIL**

DRAWING NO.: ECCV-26S

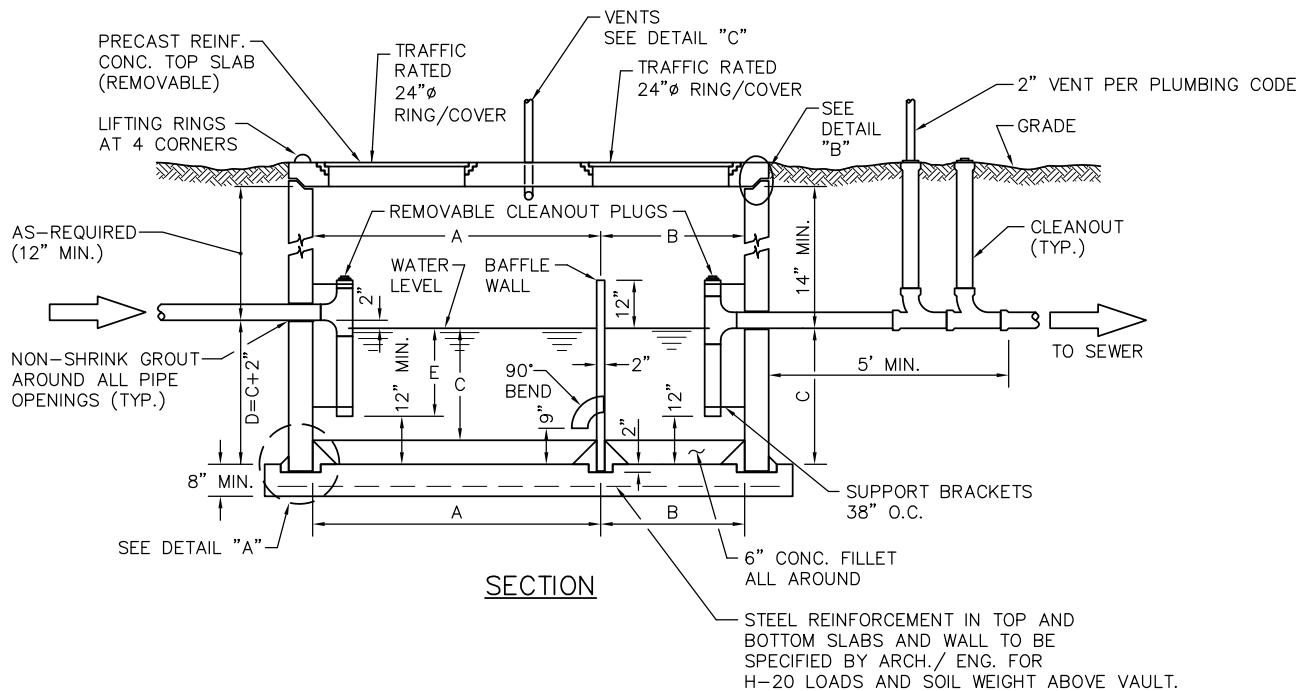
DATE: 2-2014

REV. DATE:

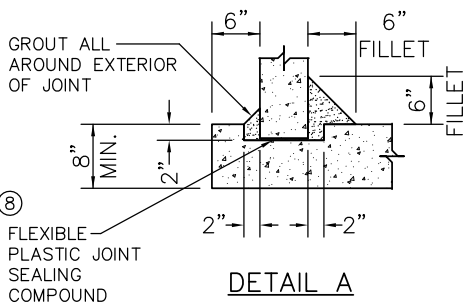




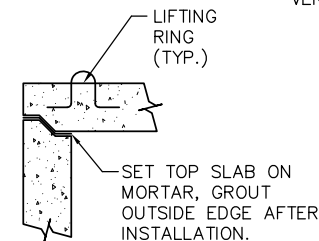
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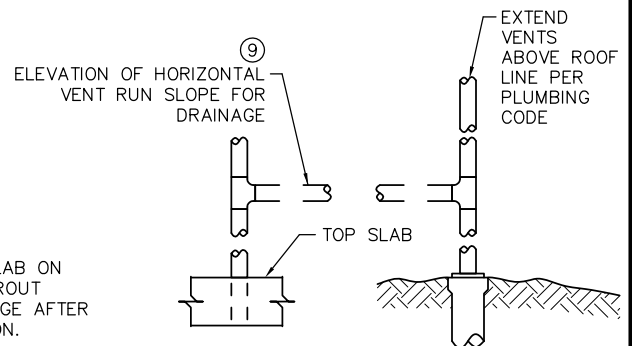
SECTION



DETAIL A



DETAIL B



DETAIL C

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**ECCV**  
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**LOW AND HIGH RATE COMMERCIAL  
 GREASE INTERCEPTOR (1 OF 2)**

DRAWING NO.: ECCV-27S

DATE: 2-2014

REV. DATE:

## TYPE "A" LOW RATE

### CAPACITY CHART

	RATE OF FLOW (G.P.M.)						APPROX. TOTAL WTR. CAP.		GREASE CAP. (CU. FT. APPROX.)	DIMENSIONS TWO COMPARTMENT TANK (INCHES)						
	5	10	25	50	75	100	CU.FT.	GAL.		W	L	A	B	C	D	E
APPROX. RETENTION TIME (MINUTES)	100	90	32	16	11	8	107	800	41	48	96	64	32	40	42	23
	230	114	46	23	15	11	153	1145	57	72	108	72	36	34	36	19
	300	150	60	30	20	15	200	1500	77	72	120	80	40	40	42	23

NOTE: (A-1) MINIMUM ALLOWABLE RETENTION TIME FOR TYPE "A" INTERCEPTOR = 3 MINUTES.

(A-2) MINIMUM ALLOWABLE TOTAL WATER CAPACITY FOR TYPE "A" INTERCEPTOR = 300 GALLONS.

## TYPE "B" HIGH RATE

### CAPACITY CHART

		APPROX. WATER SURFACE AREA				APPROX. WATER CAPACITY/FT. DEPTH			
PRIMARY CHAMBER		44 SQ. FT.				330 GAL./FT.			
SECOND. CHAMBER		20 SQ. FT.				150 GAL./FT.			
TOTAL		64 SQ. FT.				480 GAL./FT.			

	RATE OF FLOW (G.P.M.)				APPROX. TOTAL WTR. CAP.	GREASE CAP. (CU. FT. APPROX.)	DIMENSIONS (INCHES)		
	25	50	75	100	(GALLONS)	(CU. FT.)	C	D	E
APPROX. RETENTION TIME (MINUTES)	64	32	21	16	1600	84	40	42	23
	72	36	24	18	1840	103	46	48	28
	84	42	28	21	2080	117	52	54	32
	100	50	34	25	2560	150	64	68	41
	120	60	40	30	3040	183	76	78	50
	122	66	44	33	3280	202	82	84	55
	140	70	47	35	3520	216	88	90	59

NOTE: (B-1) MINIMUM ACCEPTABLE RETENTION TIME FOR TYPE "B" INTERCEPTOR = 15 MINUTES.

(B-2) MINIMUM ALLOWABLE TOTAL WATER CAPACITY FOR TYPE "B" INTERCEPTOR = 1500 GALLONS.

(B-3) A=8'-0", B=4'-0", W=6'-0" (TYP.).

#### GENERAL NOTES:

1. THESE STANDARD DETAILS SHALL ONLY BE CONSTRUED TO SHOW CONCEPTUAL AND STANDARD DIMENSIONAL REQUIREMENTS FOR GREASE INTERCEPTOR AND SHALL NOT BE USED FOR CONSTRUCTION. THE ARCHITECT/ENGINEER SHALL FURNISH STRUCTURAL DESIGN CRITERIA, HYDRAULIC LOADING, VOLUME & RETENTION TIME REQUIREMENTS AND DETAILED CONSTRUCTION DRAWINGS, INCLUDING SITE PLAN FOR APPROVAL PRIOR TO CONSTRUCTION.
2. SECONDARY TANK HAS VOLUME EQUAL TO 1/3 OF TOTAL CAPACITY.
3. ALL PIPE AND FITTINGS TO BE CAST IRON SOIL PIPE (XH) EXCEPT WHERE NOTED OTHERWISE AND SHALL BE 4" MINIMUM DIAMETER.
4. WELLS, BOTTOM AND TOP SLAB TO BE REINFORCED THROUGHOUT. ADDITIONAL DIAGONAL REINFORCING TOP AND BOTTOM IS REQUIRED AROUND ACCESS OPENINGS. ALL REBAR SHALL HAVE A 3" MINIMUM COVER TO FACE OF CONCRETE.
5. THICKNESS OF WALLS, BOTTOM AND TOP SLAB TO BE DETERMINED FROM STRUCTURAL LOADING REQUIREMENTS BY ARCHITECT/ENGINEER. CAST-IN- PLACE BOTTOM SLAB SHALL NOT BE LESS THAN 8" THICK.
6. INLET AND OUTLET PIPE SIZES SHALL BE DETERMINED BY ARCHITECT/ ENGINEER BUT SHALL NOT BE LESS THAN 4" DIAMETER (OUTLET PIPE INVERT TO BE 2" LOWER THAN INLET).
7. REINFORCED CONCRETE BOTTOM SLAB SHOWN. (MAY BE INTEGRALLY CAST WITH PRE-CAST WALL SECTIONS AT CONTRACTOR'S OPTION).
8. ALL JOINTS IN PRE-CAST SECTIONS TO BE SEALED WITH FLEXIBLE PLASTIC JOINT SEALING COMPOUND TO FED. SPEC. S-SS-C0210 (EXCEPT TOP SLAB).
9. VENT PIPE MATERIALS AND LOCATION SHALL BE IN ACCORDANCE WITH PLUMBING CODE.
10. ROUND OR CIRCULAR GREASE INTERCEPTOR WILL REQUIRE SPECIAL DESIGN AND APPROVAL.
11. PRE-CAST CONCRETE SHAPES ARE SHOWN: CAST-IN-PLACE CONCRETE STRUCTURE IS OPTIONAL.
12. PRE-CAST REINFORCED CONCRETE SECTIONS SHALL BE IN ACCORDANCE WITH ASTM-C-478.
13. DESIGN CRITERIA:  

(MINIMUM) UNIT WEIGHT OF "SOIL"	120 PCF
EQUIVALENT FLUID PRESSURE	30 PCF
LIVELOADS (IF APPLICABLE)	AASHTO H=20
CONCRETE STRENGTH (F'c)(TYPE II CEMENT)	4000 PSI

TOP SLAB MAY BE ONE PIECE OF MULTIPLE SEGMENT CONSTRUCTION AT CONTRACTOR'S OPTION.
14. SUPPORT BRACKETS AND CLEAN-OUT PLUGS SHALL BE BRASS.
15. TOP SLAB IS NOT SHOWN IN PLAN VIEW.
16. OTHER VARIOUS COMBINATIONS OF TANK DIMENSIONS MAY BE SUBMITTED FOR APPROVAL, PROVIDED THAT ANY ALTERNATE DESIGN SHALL HAVE THE SAME BASIC PROPORTIONAL DIMENSIONS, COMPARABLE VOLUMES AND FUNCTIONAL CAPABILITIES AS THESE STANDARD DETAILS.
17. DRAWINGS ARE NOT TO SCALE.

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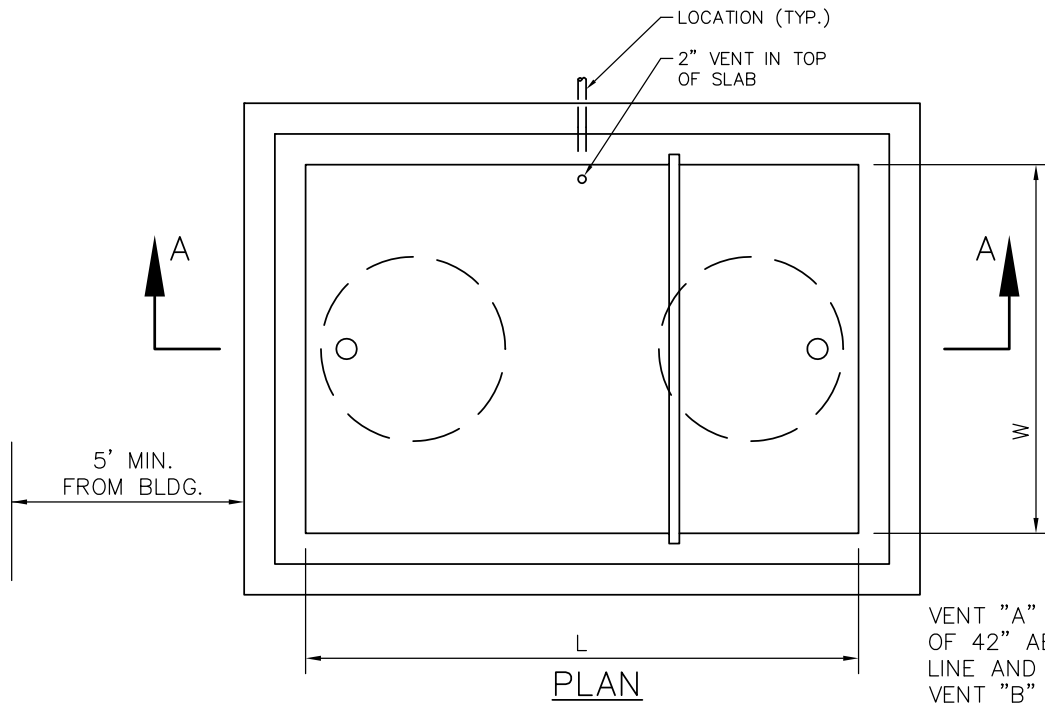


## LOW AND HIGH RATE COMMERCIAL GREASE INTERCEPTOR (2 OF 2)

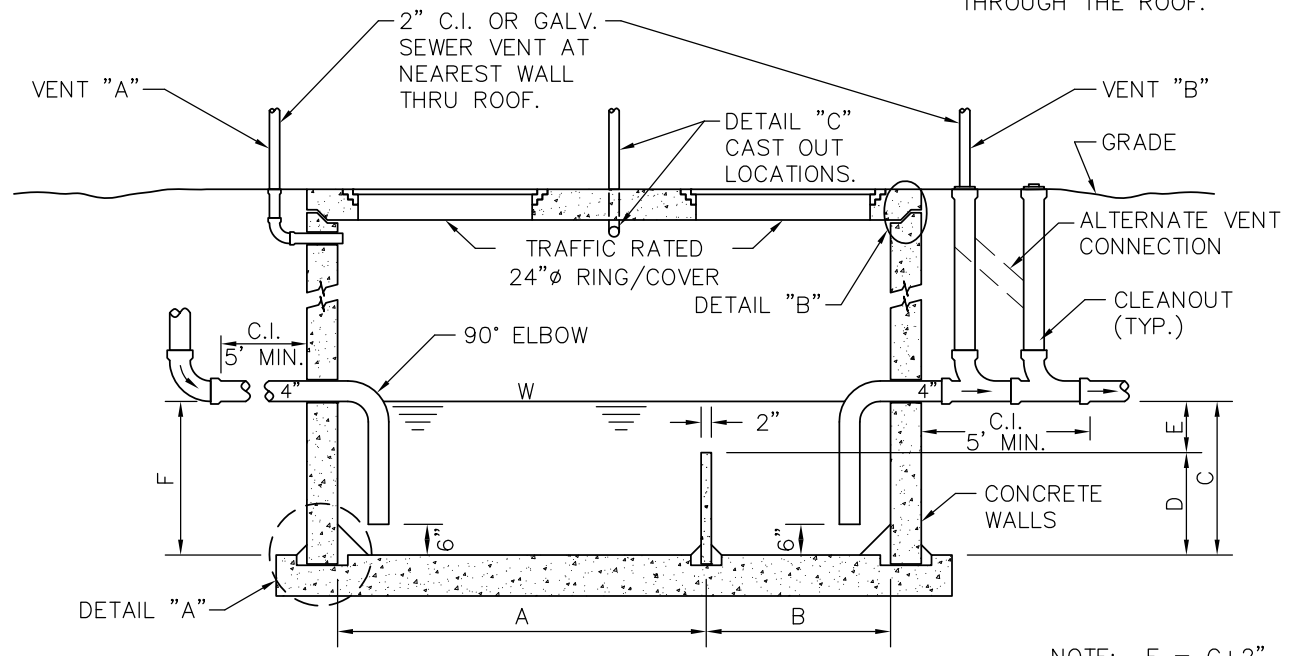
DRAWING NO.: ECCV-28S

DATE: 2-2014

REV. DATE:




VENT "A" MAY RISE A MINIMUM OF 42" ABOVE FIXTURE FLOOD LINE AND MAY COMBINE WITH VENT "B" ABOVE THE 42" LINE TO FORM A SINGLE VENT THROUGH THE ROOF.



NOTE: F = C+2"  
G = D-2"

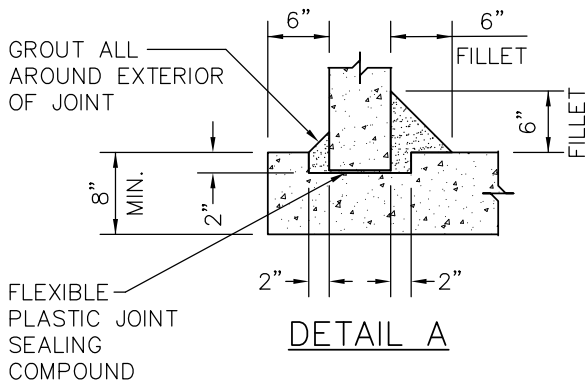
RATED CAPACITY	L	W	A	B	C	D	E
300 GALLON	72"	48"	48"	24"	21"	14"	7"
750 GALLON	96"	48"	64"	32"	38"	25"	13"
1000 GALLON	108"	72"	72"	36"	30"	20"	10"
1500 GALLON	120"	72"	80"	40"	40"	27"	13"

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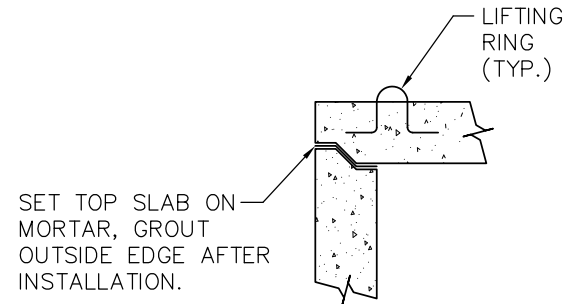

**ECCV**  
 Water & Sanitation District  
**CLASS A COMMERCIAL SAND AND OIL INTERCEPTOR (1 OF 2)**

DRAWING NO.: ECCV-29S

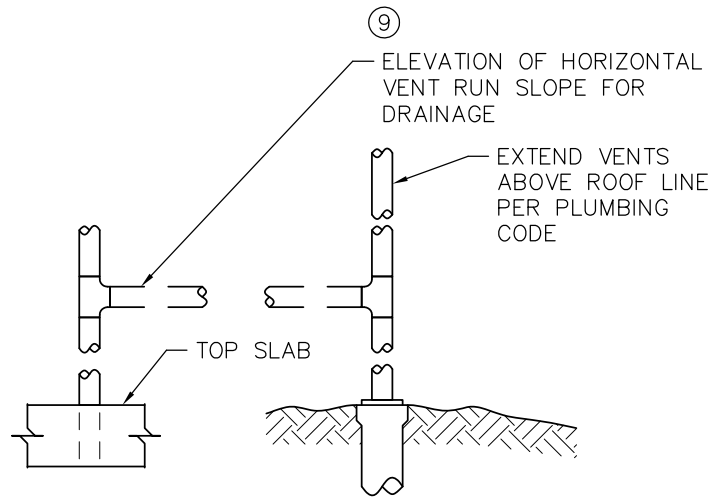
DATE: 2-2014      REV. DATE:



**DETAIL A**



**DETAIL B**



**DETAIL C**

**GENERAL NOTES**

1. THESE ENGINEERING DETAILS SHALL ONLY BE CONSTRUED TO SHOW CONCEPTUAL AND TYPICAL DIMENSION REQUIREMENTS FOR SAND AND OIL INTERCEPTORS AND SHALL NOT BE USED FOR CONSTRUCTION. THE ENGINEER SHALL FURNISH STRUCTURAL DESIGN CRITERIA, HYDRAULIC LOADING REQUIREMENTS AND DETAILED CONSTRUCTION DRAWINGS, INCLUDING SITE PLAN FOR APPROVAL PRIOR TO CONSTRUCTION.
2. ALL PIPE AND FITTINGS TO BE CAST IRON SOIL PIPE EXCEPT WHERE NOTED OTHERWISE AND SHALL BE 4" MINIMUM DIAMETER UNLESS OTHERWISE NOTED.
3. SEPARATE SECTIONS OF CAST IRON SOIL PIPE INSIDE OF TRAP AT INLET AND OUTLET SHALL BE SECURED BY A FLEXIBLE PVC COUPLING, FERNCO SERIES 1056 WITH STAINLESS STEEL CLAMP OR EQUIVALENT.
4. WALLS, BOTTOM, AND TOP SLAB TO BE REINFORCED THROUGHOUT. ADDITIONAL DIAGONAL REINFORCING TOP AND BOTTOM IS REQUIRED AROUND ACCESS OPENINGS. ALL REBAR SHALL HAVE 3" MINIMUM COVER TO FACE OF CONCRETE.
5. THICKNESS OF WALLS, BOTTOM, AND TOP SLAB TO BE DETERMINED FROM STRUCTURAL LOADING REQUIREMENTS BY ENGINEER. BOTTOM SLAB SHALL NOT BE LESS THAN 8" THICK.
6. INLET AND OUTLET PIPE SIZES SHALL BE 4" DIAMETER (OUTLET PIPE INVERT TO BE 2" LOWER THAN INLET).
7. REINFORCED CONCRETE BOTTOM SLAB SHOWN (MAY BE INTEGRALLY CAST WITH PRE-CAST WALL SECTIONS AT CONTRACTOR'S OPTION).
8. ALL JOINTS IN PRECAST SECTIONS. TO BE SEALED WITH FLEXIBLE PLASTIC JOINT SEALING COMPOUND CONFORMING TO FED. SPEC. S-SS-00210 (EXCEPT TOP SLAB).
9. VENT PIPE MATERIALS AND LOCATIONS SHALL BE IN ACCORDANCE WITH PLUMBING CODE.
10. PRECAST CONCRETE SHAPES ARE SHOWN; CAST-IN-PLACE CONCRETE STRUCTURE IS OPTIONAL.
11. PRECAST REINFORCED CONCRETE SECTIONS SHALL BE IN ACCORDANCE WITH ASTM C-478.
12. DESIGN CRITERIA:
 

UNIT WEIGHT OF "SOIL"	120 pcf
EQUIVALENT FLUID PRESSURE	30 pcf
LIVELOADS (IF APPLICABLE)	AASHTO H-20
CONCRETE STRENGTH (F'c) (TYPE 2 CEMENT)	4000 psi

TOP SLAB MAY BE OF ONE PIECE OR MULTIPLE SEGMENT CONSTRUCTION AT CONTRACTOR'S OPTION.
13. CLEAN-OUT PLUGS SHALL BE BRASS.
14. TOP SLAB IS NOT SHOWN IN PLAN VIEWS.
15. OTHER VARIOUS COMBINATIONS OF TANK DIMENSIONS MAY BE SUBMITTED FOR APPROVAL, PROVIDED THAT ANY ALTERNATE DESIGN SHALL HAVE THE SAME BASIC PROPORTIONAL DIMENSIONS, COMPARABLE VOLUMES AND FUNCTIONAL CAPABILITIES AS THESE STANDARD DETAILS.

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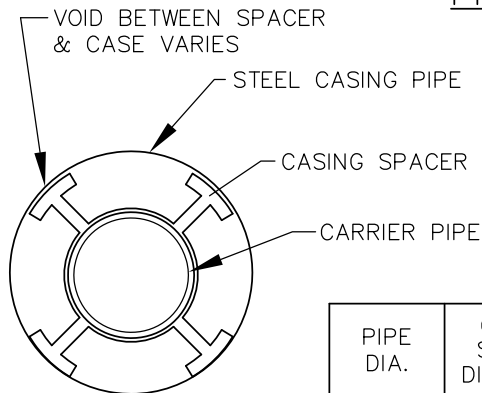
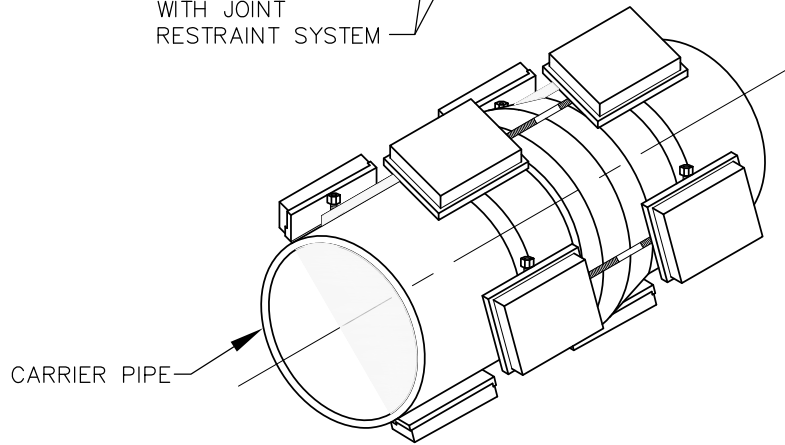
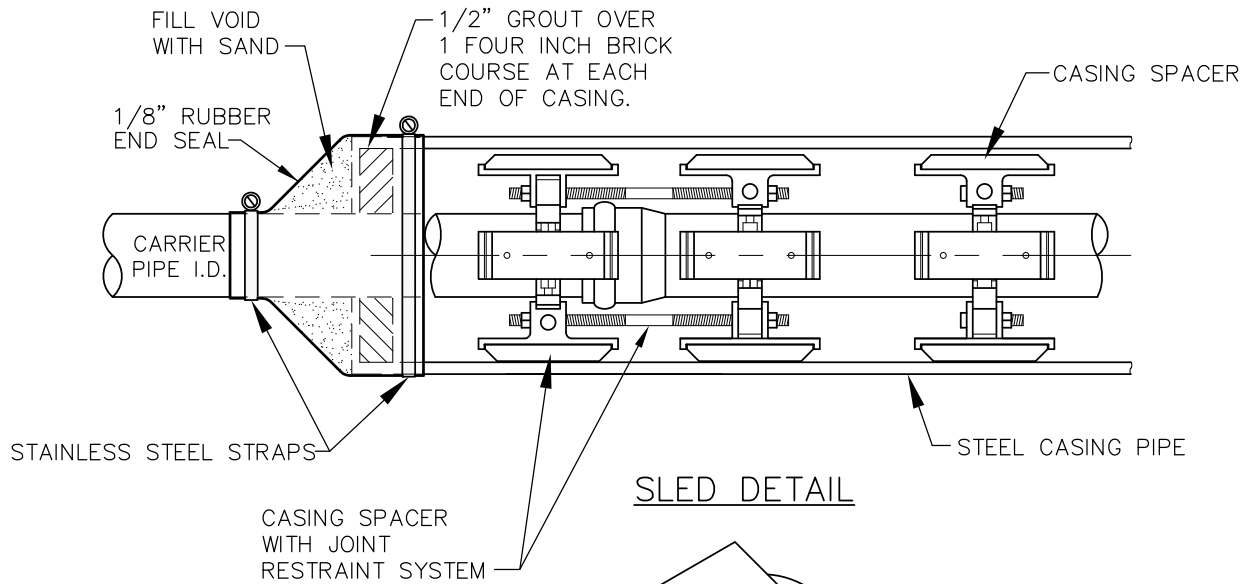


**CLASS A COMMERCIAL SAND AND OIL INTERCEPTOR (2 OF 2)**

DRAWING NO.: ECCV-30S

DATE: 2-2014

REV. DATE:



**NOTES:**

1. CASING SPACERS SHOULD BE INSTALLED WITHIN ONE FOOT OF BELL AND SPIGOT JOINT AND ONE IN CENTER OF PIPE.
2. PROVIDE UNIFLANGE RESTRAINED CASING SPACERS 1300 & 1390 OR EQUAL.

PIPE DIA.	CASING SPACER DIMENSION	CASING O.D.	PIPE WALL THICKNESS
6"	13.375"	16"	0.375"
8"	17.125"	18"	0.375"
12"	21.875"	24"	0.375"
16"	28.375"	30"	0.375"
24"	38.250"	40"	0.375"

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**RESTRAINED CASING SPACERS**

DRAWING NO.: ECCV-31S

DATE: 2-2014

REV. DATE:



## APPENDIX B

### **SANITARY SEWER SYSTEM PLAN REQUIREMENTS CHECK LIST**

#### **GENERAL REQUIREMENTS**

1. Correct sheet size (24" x 36").
2. Vicinity Map.
3. Location Map.
4. Index to drawings.
5. List of quantities.
6. List of agencies, including surveyor, soils engineer and all involved agencies for the project.
7. General notes. (Refer to Appendix.)
8. Professional Engineer, State of Colorado, seal and signature on every sheet.
9. North arrow on vicinity map, location map and each plan view.
10. Title block on each sheet.
11. Bench mark, including U.S.G.S. datum, location, elevation and monument type.
12. Street alignment, existing and proposed, shown on overall plan.
13. Street names.
14. Horizontal curve data for street centerline and all curbs shown on plan, or recorded plat included in plan set.
15. Street grades, existing and proposed shown on profile.
16. Typical street cross-section(s).
17. Street addresses for all lots and/or buildings indicated on plan, or address plat included in plan set.
18. Lot and block numbers.
19. Property, easement and tract lines shown on plan.
20. Private improvements identified.
21. Existing improvements identified.
22. Match lines and sheet references called out in plan and profile.
23. Street cross-pans shown.
24. Center line of drainage channel(s) shown.
25. 100-year flood plain limits shown.
26. Recorded plat and address plat submitted.
27. Project in conformance with overall sanitary sewer master plan.
28. Submit final plans in electronic format as .pdf or ACAD with final plans for acceptance/signing.

## **SANITARY SEWER REQUIREMENTS**

### A. General

1. Sewer line horizontal alignment generally 10' south and west of street centerline; 3' min. from flow line; 10' min. from R.O.W. line.
2. All sewer lines shown in both plan and profile.
3. Manning formula hydraulic data including O, V, D, d/D, S and n, indicated at connection(s) to existing system. Number and type of units and per unit average and peak flows.
4. Sewer easement drawings and legal descriptions submitted with Professional Land Surveyor, State of Colorado, seal and signature affixed.
5. Sanitary sewer system notes included (refer to attached).
6. Sanitary sewer system details included.
7. Service wye locations, including size, manhole reach, lot or building number, stationing from nearest downstream manhole, right of left side connection looking upstream and the invert of the main at wyes and plugs shown in tabular form on the plans.

### B. Sewer Plan View

1. Scale: 1" = 50' minimum
2. Pipe size and material called out.
3. Bearings and linear footage between manholes called out along sewer reach.
4. Outside angles between sewer reaches called out at manholes. (deflection angle)
5. Sewer lines dimensioned from street centerline or property line, and from other utilities, curb and gutter and other obstructions.
6. Connection(s) to existing system shown on plan and tied to property corner or section corner.
7. Manholes properly numbered on plan.
8. Directional flow arrows shown.
9. Service line connections shown (service lines within easements not allowed).
10. Easements must be an "Out lot" or contained on one property.
11. At least a 10' workable easement margin on each side of the sewer line.
12. Manhole markers included for sewer line outside of paved R.O.W.
13. Match lines and sheet references.
14. All utility improvements, including water lines and storm sewer, shown on plans.

### C. Sewer Profile View

1. Scales: 1" = 50' (horizontal)  
1" = 5' (vertical)
2. Manholes properly numbered and stationed.
3. Pipe size, linear footage and grade called out between manholes.
4. Sewer line grades checked.
5. 1 % minimum slope on dead-end mains.
6. Invert elevations for all entering and exiting pipes, rim elevations, cuts and drop inverts called out at the manholes.
7. Sewer service table or other notations showing lot number, station from downstream manhole, invert of sewer main at service and left or right side service included.



8. Inside manhole drop between inverts of highest entering pipe and lowest existing pipe not to exceed 1-1/2."
9. Connections to existing system shown on profile.
10. Crossings with other utilities shown on profile (1-1/2' minimum edge-to-edge separation)
11. Match lines and sheet references.
12. Dead end manholes should have a full invert through the manhole. Either note the requirement or call for an "Invert IN" to note this.

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## APPENDIX C

### East Cherry Creek Valley Water and Sanitation District

#### GENERAL NOTES FOR SANITARY SEWER SYSTEM PLANS

1. All sanitary sewer system plans and construction shall conform with the current East Cherry Creek Valley Water and Sanitation District Specifications and shall be subject to construction observation by District personnel or representatives. Copies of the District's Specifications may be obtained from the District. The Owner, his Engineer or Contractor, shall schedule a preconstruction meeting with the District at least 48 hours prior to the start of construction. Accepted construction plans, reviewed and signed by the District Manager and District Engineer, will be distributed at the preconstruction meeting. No construction will be permitted until all easements are signed and recorded and the preconstruction meeting has been held.
2. The Contractor shall be responsible for the protection of all utility lines whether shown on the plans or not. The Contractor shall coordinate his activities with the affected utility companies and shall notify the Utility Notification Center, phone number: 303-534-6700, 48 hours prior to starting construction.
3. The pipe for sanitary sewer mains shall be in accordance with ASTM D-3034 SDR 35 PVC pipe in paved R-O-W's and easements, and AWWA C 900, Class 150 in unpaved easements.
4. Contractor shall have in his possession at all times one (1) signed copy of plans approved by the District Manager and the District Engineer.
5. As-built drawings as required in the specifications are to be submitted by the Contractor prior to probationary acceptance of the construction.
6. The Contractor shall be responsible for removing and replacing any existing signs, structures, fences, etc., encountered on the job and restoring them to their original condition.
7. Probationary acceptance of the new sanitary sewer mains will not be considered until all requirements for acceptance have been met, including
  - a. Testing results
  - b. Sanitary sewer trench compaction test results, and,
  - c. Record drawings.
8. The sanitary sewer system will be tested in accordance with the District Specifications.
  - a. Lamp 100% of the new system,
  - b. Low pressure air test 100% of the new system
  - c. Deflection test 33% of the new system for depths < 15 ft. and 100% for
    - i. depths  $\geq$  15 ft.

9. Manhole rims shall be set at an elevation relative to the pavement, in accordance with the appropriate City, County or State Highway Department Standards. Whether or not the manhole is in a paved or unpaved area, a minimum of four-inches (4") of concrete riser rings shall be used to adjust rim elevations to final grade. The maximum acceptable vertical adjustment utilizing riser rings is twelve inches (12").
10. Existing pipe at the point of connection shall not be "broken out" and no service connections will be made until the new system is tested and accepted.
11. It shall be the Design Engineer's responsibility to resolve construction problems with the District due to changed conditions encountered by the Contractor during the progress of any portion of the proposed work. If, in the opinion of the District, proposed alterations to the signed construction plans involves significant changes to the character of the work, or to the future contiguous public or private improvements, the Design Engineer shall be responsible for submitting revised plans to the District for review prior to any further construction related to that portion of the work.
12. The Contractor agrees that he shall assume sole and complete responsibility for job site conditions during the course of construction of the project, including safety of all persons and property; that this requirement shall apply continuously, and not be limited to normal working hours; and that the Contractor shall defend, indemnify and hold harmless from any and all liability, real or alleged, in connection with the performance or work on this project, excepting for liability arising from the sole negligence of the Owner, the Engineer, or the County.
13. The Contractor shall verify existing manhole inverts at proposed points of connection, prior to construction staking.
14. The Contractor shall take care to properly shape all manhole inverts and benches in accordance with District Specifications. Manhole inverts shall be constructed with a smooth trowel finish, and benches finished with a light broom, non-skid finish.
15. The District, its representative, and/or the District Engineer, is not a guarantor of the construction Contractors' obligations and performance of contract.
16. Observations of work in progress and on-site visits are not to be construed as a guarantee by the District or District Engineer, of the Contractors' performance.
17. The District and/or District Engineer, is not responsible for safety in, on, or about the Project site, nor for compliance by the appropriate party of any regulations relating thereto.
18. The District and/or District Engineer, exercises no control of the safety or adequacy of any equipment, building components, scaffolding, forms, or any other work aids used in or about the project, or in the superintending of the same.
19. All new mains must be jetted prior to probation and may be required again prior to final conveyance and acceptance by the District. Costs of jetting will be the

- responsibility of the Owner. The Contractor will be responsible for all pumping associated with the line jetting.
20. Underdrain systems are not part of the District's Sanitary Sewer System and are not to be designed, reviewed, accepted, or subject to construction observation or maintenance by the District.
  21. The Contractor shall be responsible for removing any groundwater encountered during the construction of any portion of this project. Groundwater shall be pumped, piped, removed, and disposed of in a manner which does not cause flooding of existing streets nor erosion
  22. The Owner is responsible for all costs associated with plan review and construction observation.
  23. The Constrictor shall provide the required insurance certificates to the District before beginning construction.

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**APPENDIX D**

**SAMPLE EASEMENT DEED**

THIS EASEMENT DEED is made this \_\_\_\_ day of \_\_\_\_\_, 2014, between \_\_\_\_\_ (“Grantor”), whose address is \_\_\_\_\_ and East Cherry Creek Valley Water and Sanitation District, a quasi-municipal corporation (“Grantee”), whose address is 6201 South Gun Club Road, Aurora, Colorado 80016.

**WITNESSETH:**

WHEREAS, Grantor is the owner of certain real property located in the County of Arapahoe, State of Colorado; and

WHEREAS, Grantee is desirous of constructing and maintaining within its boundaries, or accepting after construction by the Grantor, water and sanitary sewer facilities and lines (“Utility Facilities”) across the real property of Grantor.

NOW, THEREFORE, in consideration of the sum of One Dollar (\$1.00) and other good and valuable consideration, paid by Grantee, the receipt of which is hereby acknowledged by Grantor, Grantor hereby grants, bargains, sells and conveys to Grantee, its successors and assigns, a non-exclusive and perpetual easement for the construction, maintenance, removal, and replacement of Utility Facilities of such size as is desired by Grantee, over the real property located in the County of Arapahoe, State of Colorado, more particularly described and substantially depicted on Exhibit A (the “Easement Property”).

The parties further covenant and agree as follows:

1. Grantor hereby grants to Grantee, its successors and assigns, a perpetual, non-exclusive easement over, under, across, above and through the Easement Property for the purpose of constructing, laying, operating, maintaining, repairing, replacing, removing and enlarging the Utility Facilities. The Utility Facilities shall mean one or more water and/or sanitary sewer pipeline(s) or facilities and all necessary underground, surface, and above-ground facilities and appurtenances thereto necessary or desirable for the transmission of water and/or sewage, including, but not limited to, mains, manholes, conduits, valves, valve marker signs, vaults, ventilators, electric or other control systems, cable, wires and connections, including telephone wiring.

2. Grantee shall have and exercise the perpetual right of ingress and egress in, to, over, through and across the Easement Property for any purpose necessary or desirable for the full enjoyment of the rights granted to Grantee under this Easement Deed.

3. Grantor shall not construct or place any structure or building, street light, power pole, permanent sign, or temporary or permanent mailbox on any part of the Easement Property. Grantor may plant grass and sod and install street surfacing, curbs and gutters on the Easement Property. Any structure, building, street light, power pole,

fence, signage or temporary or permanent mailbox located on the Easement Property or any shrub, tree, woody plant, nursery stock or other crops located on the Easement Property may be removed by Grantee at any time without liability for damages arising therefrom.

4. Grantor, at Grantor's expense, shall be solely responsible for the maintenance of the surface of the Easement Property, including any street surfacing, curbs, gutters, and landscaping within said Easement Property, except that after the initial construction by the Grantee and also in the event the Grantee performs any maintenance or repair of the Utility Facilities resulting in the disturbance of the surface of the ground, the Grantee agrees for a period of one year to maintain the surface elevation and quality of the soil by correcting any settling or subsiding that may occur as a result of such work done by Grantee. After that one year period Grantor shall be responsible for the restoration of the general surface of the ground and the maintenance of the surface elevation and quality of the soil.

5. Grantor retains the right to the use and occupancy of the Easement Property insofar as such use and occupancy is consistent with and does not impair any right of the Grantee herein contained and except as herein otherwise provided.

6. Other public utilities may be installed in the Easement Property so long as those utilities do not interfere with the Grantee's rights herein granted. All subsequent public utilities within the Easement Property, crossing any Utility Facilities, must cross at approximately right angles, and any and all said utilities which parallel the Utility Facilities must be located at least ten (10) feet from any pipeline located in the Easement Property. All surface and subsurface uses of the Easement Property for other utility or easement purposes must be approved in writing by the Grantee prior to installation.

7. Grantor covenants and warrants that Grantee's Utility Facilities shall have the right of subjacent and lateral support on the Easement Property to whatever extent is necessary or desirable for the full, complete and undisturbed enjoyment of the rights granted to Grantee. Except as set forth herein, the Grantor shall take no action which in the opinion of the Grantee would impair the necessary earth cover over, or the lateral or subjacent support of any water or sewer pipeline and appurtenance within the Easement Property. Only upon obtaining the written permission of the Grantee may the earth cover over any pipeline be modified. Permission of the Grantee will not normally be granted for a modification of the earth cover over any water lines resulting in less than four and one half (4 ½) feet of earth cover nor more than ten (10) feet of earth cover measured vertically from the top of any pipeline. In the event of any modification of support or earth cover undertaken by the Grantor it shall be upon the terms which provide for the reimbursement to the Grantee of the cost of any alterations to any pipeline made necessary by the change.

8. Grantee shall have and may properly exercise rights in the Easement Property in order to insure to Grantee a dominant easement for the exercise of Grantee's functions. The exercise of any rights in the Easement Property other than those specifically retained by Grantor is within the sound discretion of Grantee. Grantee agrees to permit and authorize such other uses of the Easement Property, not reserved in Grantor, as will not impair Grantee's dominant rights, upon such reasonable terms, limitations and conditions as Grantee shall find reasonably necessary to protect its



dominant right of occupancy of the Easement Property without undue or unnecessary injury to or impairment of the estate retained by Grantor.

9. In the event that Grantee shall abandon the rights granted to it hereunder, all right, title and interest hereunder of Grantee shall cease and terminate, and Grantor shall hold the Easement Property, as the same may then be, free from the rights of Grantee so abandoned and shall own all materials and structures of Grantee so abandoned, provided that Grantee shall have a reasonable period of time after said abandonment in which to remove any or all Utility Facilities from the Easement Property. In the event the easement is abandoned by Grantee, Grantor shall have the right, at its sole option, to require Grantee to remove or neutralize any improvements constructed in the Easement Property by Grantee. However, nothing herein shall be construed as working a forfeiture or abandonment of any interest derived hereunder and not owned by Grantee at the time of the abandonment of Grantee's rights.

10. Grantor covenants and agrees to and with Grantee, that Grantor is well seized of the Easement Property, has good, sure, perfect, absolute and indefeasible estate of inheritance in law, in fee simple, subject to matters of record and has full right, title and authority to grant the within easement, and that this Easement Deed is effective to grant and convey to Grantee the easement rights described herein. Grantor further covenants, agrees, and warrants the Easement Property in the quiet and peaceable possession of Grantee against all and every person or persons lawfully claiming or to claim the whole or any part thereof and to indemnify, defend and hold Grantee harmless from any adverse claim to the title of the Easement Property.

11. Each and every one of the benefits and burdens of this Easement Deed shall inure to and be binding upon the respective legal representatives, heirs, executors, administrators, successors and assigns of the parties hereto.

12. Unless special provisions are attached hereto, the above and foregoing constitutes the whole agreement between the parties and no additional or different oral representations, promises or agreements shall be binding on any of the parties hereto with respect to the subject matter of this instrument. To the extent that any special provisions attached hereto are in conflict with any other special provisions hereof, such special provisions shall control and supersede any other term or provisions hereof.

IN WITNESS WHEREOF, the Grantor has executed this Deed on the date set forth above.

GRANTOR: \_\_\_\_\_

By: \_\_\_\_\_

Title: \_\_\_\_\_

STATE OF COLORADO )  
 ) ss.  
COUNTY OF ARAPAHOE )

The foregoing instrument was acknowledged before me this \_\_\_\_ day of \_\_\_\_\_, 20\_\_\_\_, by \_\_\_\_\_ as \_\_\_\_\_, of \_\_\_\_\_.



CONSENT AND SUBORDINATION AGREEMENT

\_\_\_\_\_ (Lender), is the holder of the note secured by a deed of trust dated \_\_\_\_\_, 20\_\_, recorded at Reception Number \_\_\_\_\_ of the real estate records of \_\_\_\_\_ County, Colorado (the Deed of Trust) on certain real property located in the County of Arapahoe, State of Colorado (the Property), and hereby consents to the easement granted to East Cherry Creek Valley Water and Sanitation District pursuant to an Easement Agreement (the Easement Agreement) dated \_\_\_\_\_, 20\_\_ and Lender hereby subordinates its interest in the Property to the Easement Agreement with the same force and effect as though the Easement Agreement were entered into and recorded prior to the execution and recordation of the Deed of Trust.

EXECUTED this \_\_\_\_\_ day of \_\_\_\_\_, 20\_\_.

(Name of Lender)

By: \_\_\_\_\_

Name:  
\_\_\_\_\_

Title: \_\_\_\_\_

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