D. Conduit

1. All exposed/above ground conduit shall be rigid aluminum (¾" minimum) only. Stub-ups from underground to 6" above grade including the 90-degree bends shall be PVC coated aluminum conduit or shall be aluminum conduit wrapped in corrosion tape. No steel galvanized rigid, EMT, or IMC conduit shall be used.
2. Underground conduit shall be Sch 40 PVC (1" minimum) and shall be installed with detectable red tape and backfilled with sand.
3. For flexible conduit, use Type LFNC flexible seal tight conduit for ¾" minimum to 2" sizes (½"LFNC flex will be allowed for instruments with ½" threaded hub entries, all other flex shall be ¾" or larger). Use aluminum core liquid tight flexible metal conduit for sizes 2 ½" and larger. Maximum length of flex conduit shall be 24". All connectors shall be aluminum. No smurf tube shall be used.
4. Conduit fittings, not including couplings and connectors, shall be Form 7 sand cast aluminum with aluminum covers and 316SS screws. Snap-on covers are not permitted. Couplings and connectors shall be aluminum.
5. Use aluminum Myers hubs, grounding type, with insulated throats for all exterior enclosure entries or wet locations.
6. Use UNY and UNF aluminum unions. Galvanized unions are not permitted.
7. Use aluminum seal-off fittings where required by NEC, seal with 3M-2123 re-enterable sealing compound.
8. Use Noalox or other comparable anti-oxidizing agent on all conduit threads.
9. Field bending of conduit shall be accomplished using the appropriate tools. Flame bending is not allowed.

E. Grounding

1. Engineer to design site grounding system to include fencing, electrical rack, generator, RTU, antenna, etc. Resistance to ground for site grounding shall be 5 Ohms or less. Testing report shall be provided at project close out.
2. A separate grounding conductor is required for every raceway, including electrical and I&C. Minimum size is 10 AWG.
3. A grounding grid shall be used throughout sites in accordance with NEC 250.4.
4. All motor tails shall be grounded by grounding rings. All motor tails shall be grounded to grid for lightning protection.
5. Megger test load and line conductors of all power circuits and submit test reports.

F. Conductors

1. All MCC control wiring shall be UL-508 compliant, flexible 41 strand tinned copper, size 14 AWG minimum, 600V insulation, Type MTW for MCCs.
2. All other conductors shall be stranded copper XHHW-2.
3. Phase colored insulation is required for all conductors.
4. A separate neutral conductor is required for every 120VAC or 277VAC circuit.
5. Coordinate sizes of components to accommodate voltage drop. Coordinate direct buried cable with other trades to mitigate conflicts. Coordinate with

equipment installed by other trades to provide suitable terminations for equipment installed by others.

6. Color code conductors using integrally colored insulation. Use the following conventions (listed in phase A, B, C, Neutral order). Maintain consistent color coding throughout the project:
   a) 480Y/277 V, 3-Phase: brown, purple, yellow, gray.
   b) 208Y/120 V, 3-Phase: black, red, blue, white.
   c) 240/120 V, 3-Phase High Leg Delta: black, orange, blue, white.
   d) 120/240 V, 1-Phase: black, red, white.
   e) Grounding in all systems shall be green.
7. Label wiring with yellow heat shrink type markers with black machine printing. Cloth wire wrap shall be permitted in the field.

PART 3 - INSTRUMENTATION AND CONTROLS

A. General

1. Provide Power Quality Meter (PQM) in its own separate enclosure on load side of service or on load side of main disconnect. A PQM shall be used at locations with 400A services or larger.
2. All equipment shall be designed to automatically reset after power outages.
3. All panels shall be tested in accordance with NFPA 70.
4. Provide LED strip lighting with door switch inside control panels of the enclosure size is greater than or equal to 30" wide and greater than or equal to 12" deep.
5. Pump controllers shall be provided by the pump manufacturer. Provide an OIT touch screen for local system monitoring and adjustment of setpoints. Mount the OIT on the exterior door of the pump control panel with a hinged UV protective cover, if exterior, by Shade Aide or CCSUD approved equal. Furnish a spare pump controller, backup programming CD, and one spare I/O module of each type.
6. All PLCs shall be of the same communication type; each with 10% minimum spare I/O, all mapped to the top end. This applies to the entire site and all equipment.
7. At a minimum, the following points shall be monitored in the control room(s):
   a) Pump run status for each pump.
   b) Pump auto status for each pump.
   c) Common fault for each pump (seal fail, over temp, fail to start, motor overload).
   d) Generator runs.
   e) Generator fault.
   f) Generator low fuel alarm.
   g) Power fail.
   h) ATS position.
   i) High float.
   j) Low float.

k) System in backup.
l) PQM ampacities.
m) Daily pump run time hour meters (display on control room screens, reset daily at noon).
n) Intrusion alarms (pump control panel and RTU).
o) Submersible transmitter level.
p) Communications fail.

8. RTU backup power supply shall be a 24V battery system with trickle charger. The battery system shall have sufficient capacity to power the RTU for a minimum duration of four (4) hours.
9. All control panels shall not be penetrated through the top of panels.
10. All enclosures shall be NEMA 4X 316SS with external mounting lugs and lockable 3-point latch system. Mount all enclosures on aluminum struts.
11. All control panel wiring shall be flexible 41 strand tinned copper, size 14 AWG minimum, 600V insulation, Type SIS for control panels, and color coded as follows:
    a) AC controls Red
    b) DC controls Blue
    c) DC (+) power Red
    d) DC (-) power Black
    e) AC hot Black
    f) AC neutral White
12. All 4-20mA signal wire shall be 18 AWG twisted shielded.
13. The contractor shall maintain service to existing wastewater systems at all times during construction. Any work involving power outages, bypass pumping, pump and haul, or any other interruption of flow must be performed between 8:00am and 5:00pm excluding weekends and holidays. All necessary temporary power, bypass pumping, pump and haul, temporary plugs, etc., shall be furnished ad performed by the contractor. Coordinate and schedule any such activities with CCSUD at least two (2) weeks in advance.

PART 4 - SCADA

A. General

1. All sites shall have a SCADA system, appropriate for the applicable service area with the ability to connect to CCSUD's existing SCADA platform.
2. Panels shall be provided by Neltronics (Stan Nelke).
3. Coordinate with CCSUD and Neltronics Staff to determine service area, site specific requirements, and appropriate radio. SCADA system shall be designed and installed in accordance with CCSUD standards. All SCADA points inside the pump control panel shall be landed on terminal strips mounted on the backplane.

PART 5 - LIFT STATIONS

A. General

1. All lift stations shall have a SCADA system, appropriate for the applicable service area.
2. Wet well junction box shall be NEMA 4X 316SS with external mounting lugs and lockable 3-point latch system. Mount all enclosures on vertical strut.
3. Equipment control panel shall have an aluminum dead-front inner door. Panels shall be tested in accordance with NFPA 70.
4. Lift station pump controllers and pump control panels shall be provided by the pump manufacturer. Provide an OIT on the touch screen for local systems monitoring and adjustment of setpoints. Mount the OIT on the exterior door of the pump control panel with a hinged UV protective cover by Shade Aide, or CCSUD approved equal. Furnish a spare pump controller, backup programming CD, and one spare I/O module of each type.
5. For lift stations located at a plant site, pump controllers shall be connected to the plant main RTU via serial MODBUS connection.
6. All PLCs shall be of the same communication type; each with 10% minimum spare I/O, all mapped to the top end. This applies to the entire site and all equipment.
7. The primary level control shall be a Dwyer Model PBLTX (0-15psi) submersible level transmitter. Provide stilling well for transmitter. Provide staggered lead/lag/standby pump operation and first on/first off alternation. Backup level control shall be two floats. Provide one high level float and one low level float. Both floats, when either is activated, shall disengage primary transmitter control and provide alarms to SCADA and provide local horn and beacon alarms. High floats shall provide alarms and turn all pumps on. Low float shall provide alarms and turn all pumps off, regardless of HOA position. Pumps shall remain in backup control until manually reset locally. System in backup alarm shall latch in until manually reset locally; including horn, beacon, and SCADA.
8. All floats shall have one NO and one NC set of contacts.
9. Provide start delay relay timers for each pump to stagger starts in hand and auto, primary and backup control modes, regardless of power source whether normal or emergency.

PART 6 - EMERGENCY GENERATOR

A. General

1. Provide a permanent emergency generator and an automatic transfer switch at each necessary location. All site requirements shall be confirmed with CCSUD.
2. Provide Zenith transfer switch, automatic (ATS) or manual (MTS) with programmable exerciser (with and without load), mounted on vertical strut or housekeeping pad, external mounting lugs, and lockable 3-point latch system. Substitutions are not allowed. All automatic transfer switches (ATS) shall be delayed transition type. ATS Hand/Off/Auto Switch: Provide HOA switch that allows the ATS to switch to source 2 (emergency power) via "hand" position

and operate facility under generator power. The switch shall remain in "hand" until the user manually selects a different position. The intent of the HOA is to allow the user to test the generator under facility load or manually engage the generator if desired, without having to operate the normal power circuit breaker feeding the ATS.

3. Generator shall be manufactured by Cummins. Manufacturer substitutions are allowed only with written approval from CCSUD. Size generator to operate the facility at 100% capacity with 20% maximum voltage drop and 10% frequency dip for any motor starting conditions. Max loading 90% of rated capacity.
4. Provide diesel powered generator. Fuel capacity shall be 24 hours minimum at 100% generator load rating. Maximum storage for fuel calculations shall be 90% of tank capacity.
5. Level of sound shall be 60 to 80 d(B)A maximum measured at full load at 7 meters with provided steel sound attenuation enclosure.
6. Generator shall have a battery charger and dry contacts for all alarms. Generator and ATS alarms shall be monitored via Modbus to SCADA.
7. Generators shall be equipped with a low fuel alarm.
8. Generator shall be mounted on a cast-in-place reinforced concrete pad with perimeter beam. Concrete pad shall allow for a 3-foot working clearance (minimum) around entire generator.
9. Perform onsite load bank testing in accordance with NFPA 110:
   a) Perform cold start block test at 100% load.
   b) Perform 4-hour load bank testing, 2-hours of which shall be at 100% load.
   c) Perform 1.5-hours facility/plant load testing.
   d) Refill fuel tank to 90% capacity upon completion of testing.
10. All testing shall be performed by the contractor and witnessed by CCSUD. Test equipment must be calibrated annually.
11. Contractor shall perform operational demonstration testing. Contractor shall startup, test, and verify all equipment is operational prior to scheduling CCSUD to witness demonstration testing. Operator training shall be conducted on a separate day after demonstration testing. Contractor shall coordinate schedule with CCSUD at least two (2) weeks in advance. Demonstration testing shall include HOA and generator testing from supply 1 to supply 2 for a minimum duration of 30 minutes and then back to supply 1.

PART 7 - SUBMITTALS

A. Construction submittals shall be provided for CCSUD/Engineer review prior to purchase of materials.

B. Provide electronic backup copies of programming for PLCs, pump controllers, HMI and other controls.

C. Provide two (2) hard copies and one (1) electronic copy of the O&M Manual.

END OF SECTION

Item 164
Seeding for Erosion Control

1. DESCRIPTION

Provide and install temporary or permanent seeding for erosion control as shown on the plans or as directed.

2. MATERIALS

2.1. **Seed**. Provide seed from the previous season's crop meeting the requirements of the Texas Seed Law, including the testing and labeling for pure live seed (PLS = Purity × Germination). Furnish seed of the designated species, in labeled unopened bags or containers to the Engineer before planting. Use within 12 mo. from the date of the analysis. When Buffalograss is specified, use seed that is treated with KNO_3 (potassium nitrate) to overcome dormancy.

Use Tables 1–4 to determine the appropriate seed mix and rates as specified on the plans. If a plant species is not available by the producers, the other plant species in the recommended seed mixture will be increased proportionally by the PLS/acre of the missing plant species.

Table 1
Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
1 (Paris) Feb. 1–May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass Little Bluestem (Native) Illinois Bundleflower	0.3 3.2 1.8 1.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Weeping Lovegrass (Ermelo) Partridge Pea	0.3 1.5 6.0 0.6 0.8 1.0
2 (Ft. Worth) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Purple Prairie Clover (Cuero) Engelmann Daisy (Eldorado) Illinois Bundleflower Awnless Bushsunflower (Plateau)	1.0 1.0 1.0 0.4 0.2 0.8 0.6 0.75 1.3 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Slender Grama (Dilley) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover	1.0 0.2 0.2 0.4 1.0 0.2 0.2 0.6 0.8 0.75 0.3
3 (Wichita Falls) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Blue Grama (Hachita) Western Wheatgrass (Barton) Galleta Grass (Viva) Engelmann Daisy (Eldorado) Awnless Bushsunflower (Plateau)	0.6 1.0 1.0 0.4 0.2 0.8 0.4 1.2 0.6 0.75 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover (Cuero)	1.0 0.2 0.2 0.4 0.2 0.2 0.6 0.8 0.75 0.3
4 (Amarillo) Feb. 15–May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Buffalograss (Texoka) Illinois Bundleflower	0.3 3.6 1.2 1.6 1.0	Green Sprangletop Weeping Lovegrass (Ermelo) Blue Grama (Hachita) Sand Dropseed (Borden Co.) Sand Bluestem Purple Prairie Clover	0.3 0.8 1.0 0.3 1.8 0.5

Table 1 (continued)

Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
5 (Lubbock) Feb. 15–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka) Illinois Bundleflower	0.3 3.6 1.2 1.6 1.0	Green Sprangletop Weeping Lovegrass (Ermelo) Blue Grama (Hachita) Sand Dropseed (Borden Co.) Sand Bluestem Purple Prairie Clover	0.3 0.8 1.0 0.3 1.8 0.5
6 (Odessa) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Blue Grama (Hachita) Galleta Grass (Viva) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Alkali Sacaton (Saltalk) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Whiplash Pappusgrass (Webb) Arizona Cottontop (La Salle)	1.0 1.0 0.4 0.6 0.2 0.6 0.2 0.2 0.1 0.6 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Blue Grama (Hachita) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Indian Ricegrass (Rim Rock) Sand Bluestem (Cottle County) Little Bluestem (Pastura) Purple Prairie Clover (Cuero)	1.0 0.2 0.4 0.4 0.2 0.2 1.6 1.2 0.8 0.3
7 (San Angelo) Feb. 1–May 1	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Blue Grama (Hachita) Western Wheatgrass (Barton) Galleta Grass (Viva) Engelmann Daisy (Eldorado) Illinois Bundleflower (Sabine)	1.0 1.0 1.0 0.4 0.2 0.4 0.4 1.2 0.6 0.75 1.0	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Sand Bluestem (Cottle County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover (Cuero)	1.0 0.2 0.2 0.4 0.2 0.2 1.2 0.6 0.8 0.75 0.3
8 (Abilene) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Blue Grama (Hachita) Western Wheatgrass (Barton) Galleta Grass (Viva) Engelmann Daisy (Eldorado) Illinois Bundleflower (Sabine)	1.0 1.0 1.0 0.4 0.2 0.4 0.4 1.2 0.6 0.75 1.0	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Sand Bluestem (Cottle County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover (Cuero)	1.0 0.2 0.2 0.4 0.2 0.2 1.2 0.6 0.8 0.75 0.3
9 (Waco) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Purple Prairie Clover (Cuero) Engelmann Daisy (Eldorado) Illinois Bundleflower Awnless Bushsunflower (Plateau)	1.0 1.0 1.0 0.4 0.2 0.8 0.6 0.75 1.3 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Slender Grama (Dilley) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover	1.0 0.2 0.2 0.4 1.0 0.2 0.2 0.6 0.8 0.75 0.3
10 (Tyler) Feb. 1–May 15	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sideoats Grama (Haskell) Illinois Bundleflower	0.3 1.8 9.0 2.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Weeping Lovegrass (Ermelo) Sand Lovegrass Lance-Leaf Coreopsis	0.3 1.8 9.0 0.5 0.5 1.0
11 (Lufkin) Feb. 1–May 15	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sideoats Grama (Haskell) Illinois Bundleflower	0.3 1.8 9.0 2.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 9.0 0.5 1.0

Table 1 (continued)

Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
12 (Houston) Jan. 15–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Little Bluestem (Native) Illinois Bundleflower	0.3 2.1 3.2 1.4 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Weeping Lovegrass (Ermelo) Lance-Leaf Coreopsis	0.3 2.4 10.5 1.0 1.0
13 (Yoakum) Jan. 15–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) Canada Wildrye (Lavaca) Illinois Bundleflower (Sabine) Purple Prairie Clover (Cuero)	1.0 1.0 1.5 1.0 0.3 0.2 0.2 2.0 1.3 0.6	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Purple Prairie Clover (Cuero) Partridge Pea (Comanche) Englemann Daisy (Eldorado)	1.0 0.4 1.0 0.8 0.2 0.6 0.6 1.0
14 (Austin) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Purple Prairie Clover (Cuero) Engelmann Daisy (Eldorado) Illinois Bundleflower (Sabine) Awnless Bushsunflower (Plateau)	1.0 1.0 1.0 0.4 0.2 0.8 0.6 0.75 1.3 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Slender Grama (Dilley) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover	1.0 0.2 0.2 0.4 1.0 0.2 0.2 0.6 0.8 0.75 0.3
15 (San Antonio) Feb. 1–May 1	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhoades Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
16 (Corpus Christi) Jan. 1–May 1	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhodes Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
17 (Bryan) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Little Bluestem (Native) Illinois Bundleflower	0.3 1.5 3.6 1.7 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Weeping Lovegrass (Ermelo) Sand Lovegrass Lance-Leaf Coreopsis	0.3 1.5 7.5 0.6 0.6 1.0

Table 1 (continued)

Permanent Rural Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
18 (Dallas) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Purple Prairie Clover (Cuero) Engelmann Daisy (Eldorado) Illinois Bundleflower Awnless Bushsunflower (Plateau)	1.0 1.0 1.0 0.4 0.2 0.8 0.6 0.75 1.3 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Slender Grama (Dilley) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover	1.0 0.2 0.2 0.4 1.0 0.2 0.2 0.6 0.8 0.75 0.3
19 (Atlanta) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Illinois Bundleflower	0.3 2.4 4.5 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 7.5 0.6 1.0
20 (Beaumont) Jan. 15–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell) Illinois Bundleflower	0.3 2.7 4.1 1.0	Green Sprangletop Bermudagrass Bahiagrass (Pensacola) Sand Lovegrass Lance-Leaf Coreopsis	0.3 2.1 7.5 0.6 1.0
21 (Pharr) Jan. 15–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhoades Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
22 (Laredo) Jan. 15–May 1	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Texas Grama (Atascosa) Slender Grama (Dilley) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Halls Panicum (Oso) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Hooded Windmillgrass (Mariah) Arizona Cottontop (La Salle)	1.0 1.0 1.0 1.0 0.2 0.6 0.2 0.2 0.1 0.2 0.2	Green Sprangletop (Van Horn) Slender Grama (Dilley) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Plains Bristlegrass (Catarina Blend) Hooded Windmillgrass (Mariah) Multi-flowered False Rhoades Grass (Hidalgo) Arizona Cottontop (La Salle)	1.0 2.0 0.6 0.4 0.6 0.2 0.3 0.1 0.2
23 (Brownwood) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (Haskell) Texas Grama (Atascosa) Hairy Grama (Chaparral) Shortspike Windmillgrass (Welder) Little Bluestem (OK Select) Blue Grama (Hachita) Western Wheatgrass (Barton) Galleta Grass (Viva) Engelmann Daisy (Eldorado) Awnless Bushsunflower (Plateau)	0.6 1.0 1.0 0.4 0.2 0.8 0.4 1.2 0.6 0.75 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Shortspike Windmillgrass (Welder) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Partridge Pea (Comanche) Little Bluestem (OK Select) Englemann Daisy (Eldorado) Purple Prairie Clover (Cuero)	1.0 0.2 0.2 0.4 0.2 0.2 0.6 0.8 0.75 0.3

Table 2 (continued)
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
24 (El Paso) Feb. 1–May 15	Green Sprangletop (Van Horn) Sideoats Grama (South Texas) Blue Grama (Hachita) Galleta Grass (Viva) Shortspike Windmillgrass (Welder) Pink Pappusgrass (Maverick) Alkali Sacaton (Saltalk) Plains Bristlegrass (Catarina Blend) False Rhodes Grass (Kinney) Whiplash Pappusgrass (Webb) Arizona Cottontop (La Salle)	1.0 1.0 0.4 0.6 0.2 0.6 0.2 0.2 0.1 0.6 0.2	Green Sprangletop (Van Horn) Hooded Windmillgrass (Mariah) Blue Grama (Hachita) Hairy Grama (Chaparral) Sand Lovegrass (Mason) Sand Dropseed (Borden County) Indian Ricegrass (Rim Rock) Sand Bluestem (Cottle County) Little Bluestem (Pastura) Purple Prairie Clover (Cuero)	1.0 0.2 0.4 0.4 0.2 0.2 1.6 1.2 0.8 0.3
25 (Childress) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Western Wheatgrass Galleta Illinois Bundleflower	0.3 2.7 0.9 2.1 1.6 1.0	Green Sprangletop Weeping Lovegrass (Ermelo) Sand Dropseed (Borden Co.) Sand Lovegrass Purple Prairie Clover	0.3 1.2 0.5 0.8 0.5

Table 2
Permanent Urban Seed Mix

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
1 (Paris) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
2 (Ft. Worth) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Sand Dropseed (Borden Co.)	0.3 3.6 2.1 0.3
3 (Wichita Falls) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Buffalograss (Texoka)	0.3 4.5 1.8 1.6	Green Sprangletop Sideoats Grama (El Reno) Bermudagrass Sand Dropseed (Borden Co.)	0.3 3.6 1.8 0.4
4 (Amarillo) Feb. 15–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Sand Dropseed (Borden Co.) Buffalograss (Texoka)	0.3 2.7 0.9 0.4 1.6
5 (Lubbock) Feb. 15–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Sand Dropseed (Borden Co.) Buffalograss (Texoka)	0.3 2.7 0.9 0.4 1.6
6 (Odessa) Feb. 1–May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sideoats Grama (Haskell) Sand Dropseed (Borden Co.) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 2.7 0.4 0.9 1.6
7 (San Angelo) Feb. 1–May 1	Green Sprangletop Sideoats Grama (Haskell) Buffalograss (Texoka)	0.3 7.2 1.6	Green Sprangletop Sideoats Grama (Haskell) Sand Dropseed (Borden Co.) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.2 0.3 0.9 1.6
8 (Abilene) Feb. 1–May 15	Green Sprangletop Sideoats Grama (Haskell) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sand Dropseed (Borden Co.) Sideoats Grama (Haskell) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 0.3 3.6 0.8 1.6
9 (Waco) Feb. 1–May 15	Green Sprangletop Bermudagrass Buffalograss (Texoka) Sideoats Grama (Haskell)	0.3 1.8 1.6 4.5	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4

District and Planting Dates	Clay Soils Species and Rates (lb. PLS/acre)		Sandy Soils Species and Rates (lb. PLS/acre)	
10 (Tyler) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
11 (Lufkin) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
12 (Houston) Jan. 15–May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass	0.3 4.5 2.4	Green Sprangletop Bermudagrass	0.3 5.4
13 (Yoakum) Jan. 15–May 15	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass	0.3 4.5 2.4	Green Sprangletop Bermudagrass	0.3 5.4
14 (Austin) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (South Texas) Buffalograss (Texoka)	0.3 2.4 3.6 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
15 (San Antonio) Feb. 1–May 1	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
16 (Corpus Christi) Jan. 1–May 1	Green Sprangletop Sideoats Grama (South Texas) Bermudagrass Buffalograss (Texoka)	0.3 3.6 2.4 1.6	Green Sprangletop Bermudagrass Buffalograss (Texoka)	0.3 4.8 1.6
17 (Bryan) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
18 (Dallas) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Buffalograss (Texoka) Bermudagrass	0.3 3.6 1.6 2.4	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
19 (Atlanta) Feb. 1–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
20 (Beaumont) Jan. 15–May 15	Green Sprangletop Bermudagrass Sideoats Grama (Haskell)	0.3 2.4 4.5	Green Sprangletop Bermudagrass	0.3 5.4
21 (Pharr) Jan. 15–May 15	Green Sprangletop Sideoats Grama (South Texas) Buffalograss (Texoka) Bermudagrass	0.3 3.6 1.6 2.4	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
22 (Laredo) Jan. 15–May 1	Green Sprangletop Sideoats Grama (South Texas) Buffalograss (Texoka) Bermudagrass	0.3 4.5 1.6 1.8	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed	0.3 1.6 3.6 0.4
23 (Brownwood) Feb. 1–May 15	Green Sprangletop Sideoats Grama (Haskell) Bermudagrass Blue Grama (Hachita)	0.3 3.6 1.2 0.9	Green Sprangletop Buffalograss (Texoka) Bermudagrass Sand Dropseed (Borden Co.)	0.3 1.6 3.6 0.4
24 (El Paso) Feb. 1–May 15	Green Sprangletop Sideoats Grama (South Texas) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Buffalograss (Texoka) Sand Dropseed (Borden Co.) Blue Grama (Hachita)	0.3 1.6 0.4 1.8
25 (Childress) Feb. 1–May 15	Green Sprangletop Sideoats Grama (El Reno) Blue Grama (Hachita) Buffalograss (Texoka)	0.3 3.6 1.2 1.6	Green Sprangletop Sand Dropseed (Borden Co.) Buffalograss (Texoka) Bermudagrass	0.3 0.4 1.6 1.8

Table 3
Temporary Cool Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)	
Paris (1), Amarillo (4), Lubbock (5), Dallas (18)	September 1–November 30	Tall Fescue Western Wheatgrass Wheat (Red, Winter)	4.5 5.6 34
Odessa (6), San Angelo (7), El Paso (24)	September 1–November 30	Western Wheatgrass Wheat (Red, Winter)	8.4 50
Waco (9), Tyler (10), Lufkin (11), Austin (14), San Antonio (15), Bryan (17), Atlanta (19)	September 1–November 30	Tall Fescue Oats Wheat	4.5 24 34
Houston (12), Yoakum (13), Corpus Christi (16), Beaumont (20), Pharr (21), Laredo (22)	September 1–November 30	Oats	72
Ft. Worth (2), Wichita Falls (3), Abilene (8), Brownwood (23), Childress (25)	September 1–November 30	Tall Fescue Western Wheatgrass Cereal Rye	4.5 5.6 34

Table 4
Temporary Warm Season Seeding

Districts	Dates	Seed Mix and Rates (lb. PLS/acre)	
All	May 1–August 31	Foxtail Millet	34

2.2. **Fertilizer**. Use fertilizer in conformance with Article 166.2., "Materials."

2.3. **Vegetative Watering**. Use water that is clean and free of industrial wastes and other substances harmful to the growth of vegetation.

2.4. **Mulch**.

2.4.1. **Straw or Hay Mulch**. Use straw or hay mulch in conformance with Section 162.2.5., "Mulch."

2.4.2. **Cellulose Fiber Mulch**. Use only cellulose fiber mulches that are on the Approved Products List, *Erosion Control Approved Products*. (http://www.txdot.gov/business/resources/erosion-control.html) Submit one full set of manufacturer's literature for the selected material. Keep mulch dry until applied. Do not use molded or rotted material.

2.5. **Tacking Methods**. Use a tacking agent applied in accordance with the manufacturer's recommendations or a crimping method on all straw or hay mulch operations. Use tacking agents as approved or as specified on the plans.

3. CONSTRUCTION

Cultivate the area to a depth of 4 in. before placing the seed unless otherwise directed. Use approved equipment to vertically track the seedbed as shown on the plans or as directed. Cultivate the seedbed to a depth of 4 in. or mow the area before placement of the permanent seed when performing permanent seeding after an established temporary seeding. Plant the seed specified and mulch, if required, after the area has been completed to lines and grades as shown on the plans.

3.1. **Broadcast Seeding**. Distribute the seed or seed mixture uniformly over the areas shown on the plans using hand or mechanical distribution or hydro-seeding on top of the soil unless otherwise directed. Apply the mixture to the area to be seeded within 30 min. of placement of components in the equipment when seed and water are to be distributed as a slurry during hydro-seeding. Roll the planted area with a light roller or other suitable equipment. Roll sloped areas along the contour of the slopes.

3.2. **Straw or Hay Mulch Seeding**. Plant seed according to Section 164.3.1., "Broadcast Seeding." Apply straw or hay mulch uniformly over the seeded area immediately after planting the seed or seed mixture. Apply

straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

3.3. **Cellulose Fiber Mulch Seeding**. Plant seed in accordance with Section 164.3.1., "Broadcast Seeding." Apply cellulose fiber mulch uniformly over the seeded area immediately after planting the seed or seed mixture at the following rates.

- Sandy soils with slopes of 3:1 or less—2,500 lb. per acre.
- Sandy soils with slopes greater than 3:1—3,000 lb. per acre.
- Clay soils with slopes of 3:1 or less—2,000 lb. per acre.
- Clay soils with slopes greater than 3:1—2,300 lb. per acre.

Cellulose fiber mulch rates are based on dry weight of mulch per acre. Mix cellulose fiber mulch and water to make a slurry and apply uniformly over the seeded area using suitable equipment.

3.4. **Drill Seeding**. Plant seed or seed mixture uniformly over the area shown on the plans at a depth of 1/4 to 1/3 in. using a pasture or rangeland type drill unless otherwise directed. Plant seed along the contour of the slopes.

3.5. **Straw or Hay Mulching**. Apply straw or hay mulch uniformly over the area as shown on the plans. Apply straw mulch at 2 to 2.5 tons per acre. Apply hay mulch at 1.5 to 2 tons per acre. Use a tacking method over the mulched area.

Apply fertilizer in conformance with Article 166.3., "Construction." Seed and fertilizer may be distributed simultaneously during "Broadcast Seeding" operations, provided each component is applied at the specified rate. Apply half of the required fertilizer during the temporary seeding operation and the other half during the permanent seeding operation when temporary and permanent seeding are both specified for the same area.

Water the seeded areas at the rates and frequencies as shown on the plans or as directed.

4. MEASUREMENT

This Item will be measured by the square yard or by the acre.

5. PAYMENT

The work performed and the materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Broadcast Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Broadcast Seeding (Temp)" of warm or cool season specified, "Straw or Hay Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Straw or Hay Mulch Seeding (Temp)" of warm or cool season specified, "Cellulose Fiber Mulch Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Cellulose Fiber Mulch Seeding (Temp)" of warm or cool season specified, "Drill Seeding (Perm)" of the rural or urban seed mixture and sandy or clay soil specified, "Drill Seeding (Temp)" of warm or cool season specified, and "Straw or Hay Mulching." This price is full compensation for furnishing materials, including water for hydro-seeding and hydro-mulching operations, mowing, labor, equipment, tools, supplies, and incidentals. Fertilizer will not be paid for directly but will be subsidiary to this Item. Water for irrigating the seeded area, when specified, will be paid for under Item 168, "Vegetative Watering."

Item 169
Soil Retention Blankets

1. DESCRIPTION

Provide and install soil retention blankets (SRB) as shown on the plans or as directed.

2. MATERIALS

Provide only SRB that meet the requirements of DMS-6370, "Soil Retention Blankets," and are on the Approved Products List, *Erosion Control Approved Products.* (http://www.txdot.gov/business/resources/erosion-control.html) Use material of the following class and type as shown on the plans and provide a copy of the manufacturer's label for the selected product.

2.1. **Class 1: Slope Protection**.

2.1.1. **Type A**. Slopes 3:1 or flatter—clay soils,

2.1.2. **Type B**. Slopes 3:1 or flatter—sandy soils,

2.1.3. **Type C**. Slopes steeper than 3:1—clay soils, and

2.1.4. **Type D**. Slopes steeper than 3:1—sandy soils.

2.2. **Class 2: Flexible Channel Liners**.

2.2.1. **Type E**. Biodegradable materials with shear stress less than 2.0 psf,

2.2.2. **Type F**. Biodegradable materials with shear stress less than 4.0 psf,

2.2.3. **Type G**. Nonbiodegradable materials with shear stress less than 6.0 psf, and

2.2.4. **Type H**. Nonbiodegradable materials with shear stress less than 8.0 lb. psf.

3. CONSTRUCTION

Provide a copy of the manufacturer's installation instructions to the Engineer before placement of the material. Place the SRB within 24 hr. after the seeding or sodding operation, or when directed. Install and anchor the SRB in strict accordance with the recommendations contained within the manufacturer's published literature. Installation includes the repair of ruts, reseeding or resodding, and the removal of rocks, clods, and other foreign materials which may prevent contact of the blanket with the soil.

4. MEASUREMENT

This Item will be measured by the square yard of surface area covered.

5. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Soil Retention Blankets" of the class and type specified. This price is full compensation for equipment, materials, labor, tools, and incidentals.

Item 340
Dense-Graded Hot-Mix Asphalt (Small Quantity)

1. DESCRIPTION

Construct a hot-mix asphalt (HMA) pavement layer composed of a compacted, dense-graded mixture of aggregate and asphalt binder mixed hot in a mixing plant. This specification is intended for small quantity (SQ) HMA projects, typically under 5,000 tons total production.

2. MATERIALS

Furnish uncontaminated materials of uniform quality that meet the requirements of the plans and specifications.

Notify the Engineer of all material sources and before changing any material source or formulation. The Engineer will verify that the specification requirements are met when the Contractor makes a source or formulation change, and may require a new laboratory mixture design, trial batch, or both. The Engineer may sample and test project materials at any time during the project to verify specification compliance in accordance with Item 6, "Control of Materials."

2.1. **Aggregate**. Furnish aggregates from sources that conform to the requirements shown in Table 1 and as specified in this Section. Aggregate requirements in this Section, including those shown in Table 1, may be modified or eliminated when shown on the plans. Additional aggregate requirements may be specified when shown on the plans. Provide aggregate stockpiles that meet the definitions in this Section for coarse, intermediate, or fine aggregate. Aggregate from reclaimed asphalt pavement (RAP) is not required to meet Table 1 requirements unless otherwise shown on the plans. Supply aggregates that meet the definitions in Tex-100-E for crushed gravel or crushed stone. The Engineer will designate the plant or the quarry as the sampling location. Provide samples from materials produced for the project. The Engineer will establish the Surface Aggregate Classification (SAC) and perform Los Angeles abrasion, magnesium sulfate soundness, and Micro-Deval tests. Perform all other aggregate quality tests listed in Table 1. Document all test results on the mixture design report. The Engineer may perform tests on independent or split samples to verify Contractor test results. Stockpile aggregates for each source and type separately. Determine aggregate gradations for mixture design and production testing based on the washed sieve analysis given in Tex-200-F, Part II.

2.1.1. **Coarse Aggregate**. Coarse aggregate stockpiles must have no more than 20% material passing the No. 8 sieve. Aggregates from sources listed in the Department's *Bituminous Rated Source Quality Catalog* (BRSQC) are preapproved for use. Use only the rated values for hot-mix listed in the BRSQC. Rated values for surface treatment (ST) do not apply to coarse aggregate sources used in hot-mix asphalt.

For sources not listed on the Department's BRSQC:

- build an individual stockpile for each material;
- request the Department test the stockpile for specification compliance; and
- once approved, do not add material to the stockpile unless otherwise approved.

Provide aggregate from non-listed sources only when tested by the Engineer and approved before use. Allow 30 calendar days for the Engineer to sample, test, and report results for non-listed sources.

Provide coarse aggregate with at least the minimum SAC shown on the plans. SAC requirements only apply to aggregates used on the surface of travel lanes. SAC requirements apply to aggregates used on surfaces other than travel lanes when shown on the plans. The SAC for sources on the Department's *Aggregate Quality Monitoring Program* (AQMP) (Tex-499-A) is listed in the BRSQC.

2.1.1.1. **Blending Class A and Class B Aggregates**. Class B aggregate meeting all other requirements in Table 1 may be blended with a Class A aggregate to meet requirements for Class A materials. Ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source when blending Class A and B aggregates to meet a Class A requirement. Blend by volume if the bulk specific gravities of the Class A and B aggregates differ by more than 0.300. Coarse aggregate from RAP and Recycled Asphalt Shingles (RAS) will be considered as Class B aggregate for blending purposes.

The Engineer may perform tests at any time during production, when the Contractor blends Class A and B aggregates to meet a Class A requirement, to ensure that at least 50% by weight, or volume if required, of the material retained on the No. 4 sieve comes from the Class A aggregate source. The Engineer will use the Department's mix design template, when electing to verify conformance, to calculate the percent of Class A aggregate retained on the No. 4 sieve by inputting the bin percentages shown from readouts in the control room at the time of production and stockpile gradations measured at the time of production. The Engineer may determine the gradations based on either washed or dry sieve analysis from samples obtained from individual aggregate cold feed bins or aggregate stockpiles. The Engineer may perform spot checks using the gradations supplied by the Contractor on the mixture design report as an input for the template; however, a failing spot check will require confirmation with a stockpile gradation determined by the Engineer.

2.1.2. **Intermediate Aggregate**. Aggregates not meeting the definition of coarse or fine aggregate will be defined as intermediate aggregate. Supply intermediate aggregates, when used that are free from organic impurities.

The Engineer may test the intermediate aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. Supply intermediate aggregate from coarse aggregate sources, when used that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

2.1.3. **Fine Aggregate**. Fine aggregates consist of manufactured sands, screenings, and field sands. Fine aggregate stockpiles must meet the gradation requirements in Table 2. Supply fine aggregates that are free from organic impurities. The Engineer may test the fine aggregate in accordance with Tex-408-A to verify the material is free from organic impurities. No more than 15% of the total aggregate may be field sand or other uncrushed fine aggregate. Use fine aggregate, with the exception of field sand, from coarse aggregate sources that meet the requirements shown in Table 1 unless otherwise approved.

Test the stockpile if 10% or more of the stockpile is retained on the No. 4 sieve, and verify that it meets the requirements in Table 1 for crushed face count (Tex-460-A) and flat and elongated particles (Tex-280-F).

Table 1
Aggregate Quality Requirements

Property	Test Method	Requirement
Coarse Aggregate		
SAC	Tex-499-A (AQMP)	As shown on the plans
Deleterious material, %, Max	Tex-217-F, Part I	1.5
Decantation, %, Max	Tex-217-F, Part II	1.5
Micro-Deval abrasion, %	Tex-461-A	Note[1]
Los Angeles abrasion, %, Max	Tex-410-A	40
Magnesium sulfate soundness, 5 cycles, %, Max	Tex-411-A	30
Crushed face count,[2] %, Min	Tex-460-A, Part I	85
Flat and elongated particles @ 5:1, %, Max	Tex-280-F	10
Fine Aggregate		
Linear shrinkage, %, Max	Tex-107-E	3
Combined Aggregate[3]		
Sand equivalent, %, Min	Tex-203-F	45

1. Not used for acceptance purposes. Optional test used by the Engineer as an indicator of the need for further investigation.
2. Only applies to crushed gravel.
3. Aggregates, without mineral filler, RAP, RAS, or additives, combined as used in the job-mix formula (JMF).

Table 2
Gradation Requirements for Fine Aggregate

Sieve Size	% Passing by Weight or Volume
3/8"	100
#8	70–100
#200	0–30

2.2. **Mineral Filler**. Mineral filler consists of finely divided mineral matter such as agricultural lime, crusher fines, hydrated lime, or fly ash. Mineral filler is allowed unless otherwise shown on the plans. Use no more than 2% hydrated lime or fly ash unless otherwise shown on the plans. Use no more than 1% hydrated lime if a substitute binder is used unless otherwise shown on the plans or allowed. Test all mineral fillers except hydrated lime and fly ash in accordance with Tex-107-E to ensure specification compliance. The plans may require or disallow specific mineral fillers. Provide mineral filler, when used, that:

- is sufficiently dry, free-flowing, and free from clumps and foreign matter as determined by the Engineer;
- does not exceed 3% linear shrinkage when tested in accordance with Tex-107-E; and
- meets the gradation requirements in Table 3.

Table 3
Gradation Requirements for Mineral Filler

Sieve Size	% Passing by Weight or Volume
#8	100
#200	55–100

2.3. **Baghouse Fines**. Fines collected by the baghouse or other dust-collecting equipment may be reintroduced into the mixing drum.

2.4. **Asphalt Binder**. Furnish the type and grade of performance-graded (PG) asphalt specified on the plans.

2.5. **Tack Coat**. Furnish CSS-1H, SS-1H, or a PG binder with a minimum high-temperature grade of PG 58 for tack coat binder in accordance with Item 300, "Asphalts, Oils, and Emulsions." Specialized or preferred tack coat materials may be allowed or required when shown on the plans. Do not dilute emulsified asphalts at the terminal, in the field, or at any other location before use.

The Engineer will obtain at least one sample of the tack coat binder per project in accordance with Tex-500-C, Part III, and test it to verify compliance with Item 300, "Asphalts, Oils, and Emulsions." The Engineer will obtain the sample from the asphalt distributor immediately before use.

2.6. **Additives**. Use the type and rate of additive specified when shown on the plans. Additives that facilitate mixing, compaction, or improve the quality of the mixture are allowed when approved. Provide the Engineer

with documentation, such as the bill of lading, showing the quantity of additives used in the project unless otherwise directed.

2.6.1. **Lime and Liquid Antistripping Agent**. When lime or a liquid antistripping agent is used, add in accordance with Item 301, "Asphalt Antistripping Agents." Do not add lime directly into the mixing drum of any plant where lime is removed through the exhaust stream unless the plant has a baghouse or dust collection system that reintroduces the lime into the drum.

2.6.2. **Warm Mix Asphalt (WMA)**. Warm Mix Asphalt (WMA) is defined as HMA that is produced within a target temperature discharge range of 215°F and 275°F using approved WMA additives or processes from the Department's MPL.

WMA is allowed for use on all projects and is required when shown on the plans. When WMA is required, the maximum placement or target discharge temperature for WMA will be set at a value below 275°F.

Department-approved WMA additives or processes may be used to facilitate mixing and compaction of HMA produced at target discharge temperatures above 275°F; however, such mixtures will not be defined as WMA.

2.7. **Recycled Materials**. Use of RAP and RAS is permitted unless otherwise shown on the plans. Do not exceed the maximum allowable percentages of RAP and RAS shown in Table 4. The allowable percentages shown in Table 4 may be decreased or increased when shown on the plans. Determine asphalt binder content and gradation of the RAP and RAS stockpiles for mixture design purposes in accordance with Tex-236-F. The Engineer may verify the asphalt binder content of the stockpiles at any time during production. Perform other tests on RAP and RAS when shown on the plans. Asphalt binder from RAP and RAS is designated as recycled asphalt binder. Calculate and ensure that the ratio of the recycled asphalt binder to total binder does not exceed the percentages shown in Table 5 during mixture design and HMA production when RAP or RAS is used. Use a separate cold feed bin for each stockpile of RAP and RAS during HMA production.

Surface, intermediate, and base mixes referenced in Tables 4 and 5 are defined as follows:

- **Surface**. The final HMA lift placed at or near the top of the pavement structure;
- **Intermediate**. Mixtures placed below an HMA surface mix and less than or equal to 8.0 in. from the riding surface; and
- **Base**. Mixtures placed greater than 8.0 in. from the riding surface.

2.7.1. **RAP**. RAP is salvaged, milled, pulverized, broken, or crushed asphalt pavement. Crush or break RAP so that 100% of the particles pass the 2 in. sieve. Fractionated RAP is defined as 2 or more RAP stockpiles, divided into coarse and fine fractions.

Use of Contractor-owned RAP, including HMA plant waste, is permitted unless otherwise shown on the plans. Department-owned RAP stockpiles are available for the Contractor's use when the stockpile locations are shown on the plans. If Department-owned RAP is available for the Contractor's use, the Contractor may use Contractor-owned fractionated RAP and replace it with an equal quantity of Department-owned RAP. This allowance does not apply to a Contractor using unfractionated RAP. Department-owned RAP generated through required work on the Contract is available for the Contractor's use when shown on the plans. Perform any necessary tests to ensure Contractor- or Department-owned RAP is appropriate for use. The Department will not perform any tests or assume any liability for the quality of the Department-owned RAP unless otherwise shown on the plans. The Contractor will retain ownership of RAP generated on the project when shown on the plans.

The coarse RAP stockpile will contain only material retained by processing over a 3/8-in. or 1/2-in. screen unless otherwise approved. The fine RAP stockpile will contain only material passing the 3/8-in. or 1/2-in. screen unless otherwise approved. The Engineer may allow the Contractor to use an alternate to the 3/8-in. or 1/2-in. screen to fractionate the RAP. The maximum percentages of fractionated RAP may be comprised of coarse or fine fractionated RAP or the combination of both coarse and fine fractionated RAP.

Do not use Department- or Contractor-owned RAP contaminated with dirt or other objectionable materials. Do not use Department- or Contractor-owned RAP if the decantation value exceeds 5% and the plasticity index is greater than 8. Test the stockpiled RAP for decantation in accordance with Tex-406-A, Part I. Determine the plasticity index in accordance with Tex-106-E if the decantation value exceeds 5%. The decantation and plasticity index requirements do not apply to RAP samples with asphalt removed by extraction or ignition.

Do not intermingle Contractor-owned RAP stockpiles with Department-owned RAP stockpiles. Remove unused Contractor-owned RAP material from the project site upon completion of the project. Return unused Department-owned RAP to the designated stockpile location.

Table 4
Maximum Allowable Amounts of RAP[1]

Maximum Allowable Fractionated RAP[2] (%)			Maximum Allowable Unfractionated RAP[3] (%)		
Surface	Intermediate	Base	Surface	Intermediate	Base
20.0	30.0	40.0	10.0	10.0	10.0

1. Must also meet the recycled binder to total binder ratio shown in Table 5.
2. Up to 5% RAS may be used separately or as a replacement for fractionated RAP.
3. Unfractionated RAP may not be combined with fractionated RAP or RAS.

2.7.2. **RAS**. Use of post-manufactured RAS or post-consumer RAS (tear-offs) is permitted unless otherwise shown on the plans. Up to 5% RAS may be used separately or as a replacement for fractionated RAP in accordance with Table 4 and Table 5. RAS is defined as processed asphalt shingle material from manufacturing of asphalt roofing shingles or from re-roofing residential structures. Post-manufactured RAS is processed manufacturer's shingle scrap by-product. Post-consumer RAS is processed shingle scrap removed from residential structures. Comply with all regulatory requirements stipulated for RAS by the TCEQ. RAS may be used separately or in conjunction with RAP.

Process the RAS by ambient grinding or granulating such that 100% of the particles pass the 3/8 in. sieve when tested in accordance with Tex-200-F, Part I. Perform a sieve analysis on processed RAS material before extraction (or ignition) of the asphalt binder.

Add sand meeting the requirements of Table 1 and Table 2 or fine RAP to RAS stockpiles if needed to keep the processed material workable. Any stockpile that contains RAS will be considered a RAS stockpile and be limited to no more than 5.0% of the HMA mixture in accordance with Table 4.

Certify compliance of the RAS with DMS-11000, "Evaluating and Using Nonhazardous Recyclable Materials Guidelines." Treat RAS as an established nonhazardous recyclable material if it has not come into contact with any hazardous materials. Use RAS from shingle sources on the Department's MPL. Remove substantially all materials before use that are not part of the shingle, such as wood, paper, metal, plastic, and felt paper. Determine the deleterious content of RAS material for mixture design purposes in accordance with Tex-217-F, Part III. Do not use RAS if deleterious materials are more than 0.5% of the stockpiled RAS unless otherwise approved. Submit a sample for approval before submitting the mixture design. The Department will perform the testing for deleterious material of RAS to determine specification compliance.

2.8. **Substitute Binders**. Unless otherwise shown on the plans, the Contractor may use a substitute PG binder listed in Table 5 instead of the PG binder originally specified, if the substitute PG binder and mixture made with the substitute PG binder meet the following:

- the substitute binder meets the specification requirements for the substitute binder grade in accordance with Section 300.2.10., "Performance-Graded Binders;" and
- the mixture has less than 10.0 mm of rutting on the Hamburg Wheel test (Tex-242-F) after the number of passes required for the originally specified binder. Use of substitute PG binders may only be allowed at the discretion of the Engineer if the Hamburg Wheel test results are between 10.0 mm and 12.5 mm.

Table 5
Allowable Substitute PG Binders and Maximum Recycled Binder Ratios

Originally Specified PG Binder	Allowable Substitute PG Binder	Maximum Ratio of Recycled Binder[1] to Total Binder (%)		
		Surface	Intermediate	Base
HMA				
76-22[2]	70-22 or 64-22	20.0	20.0	20.0
	70-28 or 64-28	30.0	35.0	40.0
70-22[2]	64-22	20.0	20.0	20.0
	64-28 or 58-28	30.0	35.0	40.0
64-22[2]	58-28	30.0	35.0	40.0
76-28[2]	70-28 or 64-28	20.0	20.0	20.0
	64-34	30.0	35.0	40.0
70-28[2]	64-28 or 58-28	20.0	20.0	20.0
	64-34 or 58-34	30.0	35.0	40.0
64-28[2]	58-28	20.0	20.0	20.0
	58-34	30.0	35.0	40.0
WMA[3]				
76-22[2]	70-22 or 64-22	30.0	35.0	40.0
70-22[2]	64-22 or 58-28	30.0	35.0	40.0
64-22[4]	58-28	30.0	35.0	40.0
76-28[2]	70-28 or 64-28	30.0	35.0	40.0
70-28[2]	64-28 or 58-28	30.0	35.0	40.0
64-28[4]	58-28	30.0	35.0	40.0

1. Combined recycled binder from RAP and RAS.
2. Use no more than 20.0% recycled binder when using this originally specified PG binder.
3. WMA as defined in Section 340.2.6.2., "Warm Mix Asphalt (WMA)."
4. When used with WMA, this originally specified PG binder is allowed for use at the maximum recycled binder ratios shown in this table.

3. EQUIPMENT

Provide required or necessary equipment in accordance with Item 320, "Equipment for Asphalt Concrete Pavement."

4. CONSTRUCTION

Produce, haul, place, and compact the specified paving mixture. In addition to tests required by the specification, Contractors may perform other QC tests as deemed necessary. At any time during the project, the Engineer may perform production and placement tests as deemed necessary in accordance with Item 5, "Control of the Work." Schedule and participate in a pre-paving meeting with the Engineer on or before the first day of paving unless otherwise directed.

4.1. **Certification**. Personnel certified by the Department-approved hot-mix asphalt certification program must conduct all mixture designs, sampling, and testing in accordance with Table 6. Supply the Engineer with a list of certified personnel and copies of their current certificates before beginning production and when personnel changes are made. Provide a mixture design developed and signed by a Level 2 certified specialist.

Table 6
Test Methods, Test Responsibility, and Minimum Certification Levels

Test Description	Test Method	Contractor	Engineer	Level[1]
1. Aggregate and Recycled Material Testing				
Sampling	Tex-221-F	✓	✓	1A
Dry sieve	Tex-200-F, Part I	✓	✓	1A
Washed sieve	Tex-200-F, Part II	✓	✓	1A
Deleterious material	Tex-217-F, Parts I & III	✓	✓	1A
Decantation	Tex-217-F, Part II	✓	✓	1A
Los Angeles abrasion	Tex-410-A		✓	TxDOT
Magnesium sulfate soundness	Tex-411-A		✓	TxDOT
Micro-Deval abrasion	Tex-461-A		✓	2
Crushed face count	Tex-460-A	✓	✓	2
Flat and elongated particles	Tex-280-F	✓	✓	2
Linear shrinkage	Tex-107-E	✓	✓	2
Sand equivalent	Tex-203-F	✓	✓	2
Organic impurities	Tex-408-A	✓	✓	2
2. Asphalt Binder & Tack Coat Sampling				
Asphalt binder sampling	Tex-500-C, Part II	✓	✓	1A/1B
Tack coat sampling	Tex-500-C, Part III	✓	✓	1A/1B
3. Mix Design & Verification				
Design and JMF changes	Tex-204-F	✓	✓	2
Mixing	Tex-205-F	✓	✓	2
Molding (TGC)	Tex-206-F	✓	✓	1A
Molding (SGC)	Tex-241-F	✓	✓	1A
Laboratory-molded density	Tex-207-F	✓	✓	1A
VMA[2] (calculation only)	Tex-204-F	✓	✓	2
Rice gravity	Tex-227-F	✓	✓	1A
Ignition oven correction factors[3]	Tex-236-F	✓	✓	2
Indirect tensile strength	Tex-226-F	✓	✓	2
Hamburg Wheel test	Tex-242-F	✓	✓	2
Boil test	Tex-530-C	✓	✓	1A
4. Production Testing				
Mixture sampling	Tex-222-F	✓	✓	1A
Molding (TGC)	Tex-206-F		✓	1A
Molding (SGC)	Tex-241-F		✓	1A
Laboratory-molded density	Tex-207-F		✓	1A
VMA[2] (calculation only)	Tex-204-F		✓	1A
Rice gravity	Tex-227-F		✓	1A
Gradation & asphalt binder content[3]	Tex-236-F		✓	1A
Moisture content	Tex-212-F		✓	1A
Hamburg Wheel test	Tex-242-F		✓	2
Boil test	Tex-530-C		✓	1A
5. Placement Testing				
Trimming roadway cores	Tex-207-F	✓	✓	1A/1B
In-place air voids	Tex-207-F		✓	1A/1B
Establish rolling pattern	Tex-207-F	✓		1B
Ride quality measurement	Tex-1001-S	✓	✓	Note[4]

1. Level 1A, 1B, and 2 are certification levels provided by the Hot Mix Asphalt Center certification program.
2. Voids in mineral aggregates.
3. Refer to Section 340.4.8.3., "Production Testing," for exceptions to using an ignition oven.
4. Profiler and operator are required to be certified at the Texas A&M Transportation Institute facility when Surface Test Type B is specified.

4.2. **Reporting, Testing, and Responsibilities**. Use Department-provided templates to record and calculate all test data pertaining to the mixture design. The Engineer will use Department templates for any production and placement testing. Obtain the current version of the templates at http://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/forms/site-manager.html or from the Engineer.

The maximum allowable time for the Engineer to exchange test data with the Contractor is as given in Table 7 unless otherwise approved. The Engineer will immediately report to the Contractor any test result that requires suspension of production or placement or that fails to meet the specification requirements.

Subsequent mix placed after test results are available to the Contractor, which require suspension of operations, may be considered unauthorized work. Unauthorized work will be accepted or rejected at the discretion of the Engineer in accordance with Article 5.3., "Conformity with Plans, Specifications, and Special Provisions."

Table 7
Reporting Schedule

Description	Reported By	Reported To	To Be Reported Within
Production Testing			
Gradation	Engineer	Contractor	1 working day of completion of the test
Asphalt binder content			
Laboratory-molded density			
VMA (calculation)			
Hamburg Wheel test			
Moisture content			
Boil test			
Binder tests			
Placement Testing			
In-place air voids	Engineer	Contractor	1 working day of completion of the test[1]

1. 2 days are allowed if cores cannot be dried to constant weight within 1 day.

4.3. **Mixture Design**.

4.3.1. **Design Requirements**. The Contractor may design the mixture using a Texas Gyratory Compactor (TGC) or a Superpave Gyratory Compactor (SGC) unless otherwise shown on the plans. Use the dense-graded design procedure provided in Tex-204-F. Design the mixture to meet the requirements listed in Tables 1, 2, 3, 4, 5, 8, 9, and 10.

4.3.1.1. **Target Laboratory-Molded Density When The TGC Is Used**. Design the mixture at a 96.5% target laboratory-molded density. Increase the target laboratory-molded density to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.

4.3.1.2. **Design Number of Gyrations (Ndesign) When The SGC Is Used**. Design the mixture at 50 gyrations (Ndesign). Use a target laboratory-molded density of 96.0% to design the mixture; however, adjustments can be made to the Ndesign value as noted in Table 9. The Ndesign level may be reduced to no less than 35 gyrations at the Contractor's discretion.

Use an approved laboratory from the Department's MPL to perform the Hamburg Wheel test in accordance with Tex-242-F, and provide results with the mixture design, or provide the laboratory mixture and request that the Department perform the Hamburg Wheel test. The Engineer will be allowed 10 working days to provide the Contractor with Hamburg Wheel test results on the laboratory mixture design.

The Engineer will provide the mixture design when shown on the plans. The Contractor may submit a new mixture design at any time during the project. The Engineer will verify and approve all mixture designs (JMF1) before the Contractor can begin production.

Provide the Engineer with a mixture design report using the Department-provided template. Include the following items in the report:

- the combined aggregate gradation, source, specific gravity, and percent of each material used;
- asphalt binder content and aggregate gradation of RAP and RAS stockpiles;
- the target laboratory-molded density (or Ndesign level when using the SGC);
- results of all applicable tests;

- the mixing and molding temperatures;
- the signature of the Level 2 person or persons that performed the design;
- the date the mixture design was performed; and
- a unique identification number for the mixture design.

Table 8
Master Gradation Limits (% Passing by Weight or Volume) and VMA Requirements

Sieve Size	A Coarse Base	B Fine Base	C Coarse Surface	D Fine Surface	F Fine Mixture
2"	100.0[1]	–	–	–	–
1-1/2"	98.0–100.0	100.0[1]	–	–	–
1"	78.0–94.0	98.0–100.0	100.0[1]	–	–
3/4"	64.0–85.0	84.0–98.0	95.0–100.0	100.0[1]	–
1/2"	50.0–70.0	–	–	98.0–100.0	100.0[1]
3/8"	–	60.0–80.0	70.0–85.0	85.0–100.0	98.0–100.0
#4	30.0–50.0	40.0–60.0	43.0–63.0	50.0–70.0	70.0–90.0
#8	22.0–36.0	29.0–43.0	32.0–44.0	35.0–46.0	38.0–48.0
#30	8.0–23.0	13.0–28.0	14.0–28.0	15.0–29.0	12.0–27.0
#50	3.0–19.0	6.0–20.0	7.0–21.0	7.0–20.0	6.0–19.0
#200	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0	2.0–7.0
Design VMA, % Minimum					
–	12.0	13.0	14.0	15.0	16.0
Production (Plant-Produced) VMA, % Minimum					
–	11.5	12.5	13.5	14.5	15.5

1. Defined as maximum sieve size. No tolerance allowed.

Table 9
Laboratory Mixture Design Properties

Mixture Property	Test Method	Requirement
Target laboratory-molded density, % (TGC)	Tex-207-F	96.5[1]
Design gyrations (Ndesign for SGC)	Tex-241-F	50[2]
Indirect tensile strength (dry), psi	Tex-226-F	85–200[3]
Boil test[4]	Tex-530-C	–

1. Increase to 97.0% or 97.5% at the Contractor's discretion or when shown on the plans or specification.
2. Adjust within a range of 35–100 gyrations when shown on the plans or specification or when mutually agreed between the Engineer and Contractor.
3. The Engineer may allow the IDT strength to exceed 200 psi if the corresponding Hamburg Wheel rut depth is greater than 3.0 mm and less than 12.5 mm.
4. Used to establish baseline for comparison to production results. May be waived when approved.

Table 10
Hamburg Wheel Test Requirements

High-Temperature Binder Grade	Test Method	Minimum # of Passes @ 12.5 mm[1] Rut Depth, Tested @ 50°C
PG 64 or lower	Tex-242-F	10,000[2]
PG 70		15,000[3]
PG 76 or higher		20,000

1. When the rut depth at the required minimum number of passes is less than 3 mm, the Engineer may require the Contractor to increase the target laboratory-molded density (TGC) by 0.5% to no more than 97.5% or lower the Ndesign level (SGC) to no less than 35 gyrations.
2. May be decreased to no less than 5,000 passes when shown on the plans.
3. May be decreased to no less than 10,000 passes when shown on the plans.

4.3.2. **Job-Mix Formula Approval**. The job-mix formula (JMF) is the combined aggregate gradation, target laboratory-molded density (or Ndesign level), and target asphalt percentage used to establish target values for hot-mix production. JMF1 is the original laboratory mixture design used to produce the trial batch. When

WMA is used, JMF1 may be designed and submitted to the Engineer without including the WMA additive. When WMA is used, document the additive or process used and recommended rate on the JMF1 submittal. Furnish a mix design report (JMF1) with representative samples of all component materials and request approval to produce the trial batch. Provide approximately 10,000 g of the design mixture and request that the Department perform the Hamburg Wheel test if opting to have the Department perform the test. The Engineer will verify JMF1 based on plant-produced mixture from the trial batch unless otherwise determined. The Engineer may accept an existing mixture design previously used on a Department project and may waive the trial batch to verify JMF1. Provide split samples of the mixtures and blank samples used to determine the ignition oven correction factors. The Engineer will determine the aggregate and asphalt correction factors from the ignition oven used for production testing in accordance with Tex-236-F.

The Engineer will use a TGC calibrated in accordance with Tex-914-K in molding production samples. Provide an SGC at the Engineer's field laboratory for use in molding production samples if the SGC is used to design the mix.

The Engineer may perform Tex-530-C and retain the tested sample for comparison purposes during production. The Engineer may waive the requirement for the boil test.

4.3.3. **JMF Adjustments**. If JMF adjustments are necessary to achieve the specified requirements, the adjusted JMF must:

- be provided to the Engineer in writing before the start of a new lot;
- be numbered in sequence to the previous JMF;
- meet the mixture requirements in Table 4 and Table 5;
- meet the master gradation limits shown in Table 8; and
- be within the operational tolerances of the current JMF listed in Table 11.

The Engineer may adjust the asphalt binder content to maintain desirable laboratory density near the optimum value while achieving other mix requirements.

Table 11
Operational Tolerances

Description	Test Method	Allowable Difference Between Trial Batch and JMF1 Target	Allowable Difference from Current JMF Target
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F	Must be within master grading limits in Table 8	±5.0[1,2]
Individual % retained for sieves smaller than #8 and larger than #200			±3.0[1,2]
% passing the #200 sieve			±2.0[1,2]
Asphalt binder content, %	Tex-236-F	±0.5	±0.3[2]
Laboratory-molded density, %	Tex-207-F	±1.0	±1.0
VMA, %, min	Tex-204-F	Note[3]	Note[3]

1. When within these tolerances, mixture production gradations may fall outside the master grading limits; however, the % passing the #200 will be considered out of tolerance when outside the master grading limits.
2. Only applies to mixture produced for Lot 1 and higher.
3. Mixture is required to meet Table 8 requirements.

4.4. **Production Operations**. Perform a new trial batch when the plant or plant location is changed. Take corrective action and receive approval to proceed after any production suspension for noncompliance to the specification. Submit a new mix design and perform a new trial batch when the asphalt binder content of:

- any RAP stockpile used in the mix is more than 0.5% higher than the value shown on the mixture design report; or
- RAS stockpile used in the mix is more than 2.0% higher than the value shown on the mixture design report.

4.4.1. **Storage and Heating of Materials**. Do not heat the asphalt binder above the temperatures specified in Item 300, "Asphalts, Oils, and Emulsions," or outside the manufacturer's recommended values. Provide the Engineer with daily records of asphalt binder and hot-mix asphalt discharge temperatures (in legible and

discernible increments) in accordance with Item 320, "Equipment for Asphalt Concrete Pavement," unless otherwise directed. Do not store mixture for a period long enough to affect the quality of the mixture, nor in any case longer than 12 hr. unless otherwise approved.

4.4.2. **Mixing and Discharge of Materials**. Notify the Engineer of the target discharge temperature and produce the mixture within 25°F of the target. Monitor the temperature of the material in the truck before shipping to ensure that it does not exceed 350°F (or 275°F for WMA) and is not lower than 215°F. The Department will not pay for or allow placement of any mixture produced above 350°F.

Produce WMA within the target discharge temperature range of 215°F and 275°F when WMA is required. Take corrective action any time the discharge temperature of the WMA exceeds the target discharge range. The Engineer may suspend production operations if the Contractor's corrective action is not successful at controlling the production temperature within the target discharge range. Note that when WMA is produced, it may be necessary to adjust burners to ensure complete combustion such that no burner fuel residue remains in the mixture.

Control the mixing time and temperature so that substantially all moisture is removed from the mixture before discharging from the plant. The Engineer may determine the moisture content by oven-drying in accordance with Tex-212-F, Part II, and verify that the mixture contains no more than 0.2% of moisture by weight. The Engineer will obtain the sample immediately after discharging the mixture into the truck, and will perform the test promptly.

4.5. **Hauling Operations**. Clean all truck beds before use to ensure that mixture is not contaminated. Use a release agent shown on the Department's MPL to coat the inside bed of the truck when necessary.

Use equipment for hauling as defined in Section 340.4.6.3.2., "Hauling Equipment." Use other hauling equipment only when allowed.

4.6. **Placement Operations**. Collect haul tickets from each load of mixture delivered to the project and provide the Department's copy to the Engineer approximately every hour, or as directed. Use a hand-held thermal camera or infrared thermometer to measure and record the internal temperature of the mixture as discharged from the truck or Material Transfer Device (MTD) before or as the mix enters the paver and an approximate station number or GPS coordinates on each ticket unless otherwise directed. Calculate the daily yield and cumulative yield for the specified lift and provide to the Engineer at the end of paving operations for each day unless otherwise directed. The Engineer may suspend production if the Contractor fails to produce and provide haul tickets and yield calculations by the end of paving operations for each day.

Prepare the surface by removing raised pavement markers and objectionable material such as moisture, dirt, sand, leaves, and other loose impediments from the surface before placing mixture. Remove vegetation from pavement edges. Place the mixture to meet the typical section requirements and produce a smooth, finished surface with a uniform appearance and texture. Offset longitudinal joints of successive courses of hot-mix by at least 6 in. Place mixture so that longitudinal joints on the surface course coincide with lane lines, or as directed. Ensure that all finished surfaces will drain properly.

Place the mixture at the rate or thickness shown on the plans. The Engineer will use the guidelines in Table 12 to determine the compacted lift thickness of each layer when multiple lifts are required. The thickness determined is based on the rate of 110 lb./sq. yd. for each inch of pavement unless otherwise shown on the plans.

Table 12
Compacted Lift Thickness and Required Core Height

Mixture Type	Compacted Lift Thickness Guidelines		Minimum Untrimmed Core Height (in.) Eligible for Testing
	Minimum (in.)	Maximum (in.)	
A	3.00	6.00	2.00
B	2.50	5.00	1.75
C	2.00	4.00	1.50
D	1.50	3.00	1.25
F	1.25	2.50	1.25

4.6.1. **Weather Conditions**. Place mixture when the roadway surface temperature is at or above 60°F unless otherwise approved. Measure the roadway surface temperature with a hand-held thermal camera or infrared thermometer. The Engineer may allow mixture placement to begin before the roadway surface reaches the required temperature if conditions are such that the roadway surface will reach the required temperature within 2 hr. of beginning placement operations. Place mixtures only when weather conditions and moisture conditions of the roadway surface are suitable as determined by the Engineer. The Engineer may restrict the Contractor from paving if the ambient temperature is likely to drop below 32°F within 12 hr. of paving.

4.6.2. **Tack Coat**. Clean the surface before placing the tack coat. The Engineer will set the rate between 0.04 and 0.10 gal. of residual asphalt per square yard of surface area. Apply a uniform tack coat at the specified rate unless otherwise directed. Apply the tack coat in a uniform manner to avoid streaks and other irregular patterns. Apply a thin, uniform tack coat to all contact surfaces of curbs, structures, and all joints. Allow adequate time for emulsion to break completely before placing any material. Prevent splattering of tack coat when placed adjacent to curb, gutter, and structures. Roll the tack coat with a pneumatic-tire roller to remove streaks and other irregular patterns when directed.

4.6.3. **Lay-Down Operations**.

4.6.3.1. **Windrow Operations**. Operate windrow pickup equipment so that when hot-mix is placed in windrows substantially all the mixture deposited on the roadbed is picked up and loaded into the paver.

4.6.3.2. **Hauling Equipment**. Use belly dumps, live bottom, or end dump trucks to haul and transfer mixture; however, with exception of paving miscellaneous areas, end dump trucks are only allowed when used in conjunction with an MTD with remixing capability unless otherwise allowed.

4.6.3.3. **Screed Heaters**. Turn off screed heaters, to prevent overheating of the mat, if the paver stops for more than 5 min.

4.7. **Compaction**. Compact the pavement uniformly to contain between 3.8% and 8.5% in-place air voids.

Furnish the type, size, and number of rollers required for compaction as approved. Use a pneumatic-tire roller to seal the surface unless excessive pickup of fines occurs. Use additional rollers as required to remove any roller marks. Use only water or an approved release agent on rollers, tamps, and other compaction equipment unless otherwise directed.

Use the control strip method shown in Tex-207-F, Part IV, on the first day of production to establish the rolling pattern that will produce the desired in-place air voids unless otherwise directed.

Use tamps to thoroughly compact the edges of the pavement along curbs, headers, and similar structures and in locations that will not allow thorough compaction with rollers. The Engineer may require rolling with a trench roller on widened areas, in trenches, and in other limited areas.

Complete all compaction operations before the pavement temperature drops below 160°F unless otherwise allowed. The Engineer may allow compaction with a light finish roller operated in static mode for pavement temperatures below 160°F.

Allow the compacted pavement to cool to 160°F or lower before opening to traffic unless otherwise directed. Sprinkle the finished mat with water or limewater, when directed, to expedite opening the roadway to traffic.

4.8. **Production Acceptance**.

4.8.1. **Production Lot**. Each day of production is defined as a production lot. Lots will be sequentially numbered and correspond to each new day of production. Note that lots are not subdivided into sublots for this specification.

4.8.2. **Production Sampling**.

4.8.2.1. **Mixture Sampling**. The Engineer may obtain mixture samples in accordance with Tex-222-F at any time during production.

4.8.2.2. **Asphalt Binder Sampling**. The Engineer may obtain or require the Contractor to obtain 1 qt. samples of the asphalt binder at any time during production from a port located immediately upstream from the mixing drum or pug mill in accordance with Tex-500-C, Part II. The Engineer may test any of the asphalt binder samples to verify compliance with Item 300, "Asphalts, Oils, and Emulsions."

4.8.3. **Production Testing**. The Engineer will test at the frequency listed in the Department's *Guide Schedule of Sampling and Testing* and this specification. The Engineer may suspend production if production tests do not meet specifications or are not within operational tolerances listed in Table 11. Take immediate corrective action if the Engineer's laboratory-molded density on any sample is less than 95.0% or greater than 98.0%, to bring the mixture within these tolerances. The Engineer may suspend operations if the Contractor's corrective actions do not produce acceptable results. The Engineer will allow production to resume when the proposed corrective action is likely to yield acceptable results.

The Engineer may use alternate methods for determining the asphalt binder content and aggregate gradation if the aggregate mineralogy is such that Tex-236-F does not yield reliable results. Use the applicable test procedure if an alternate test method is selected.

Table 13
Production and Placement Testing

Description	Test Method
Individual % retained for #8 sieve and larger	Tex-200-F or Tex-236-F
Individual % retained for sieves smaller than #8 and larger than #200	
% passing the #200 sieve	
Laboratory-molded density	Tex-207-F
Laboratory-molded bulk specific gravity	
In-Place air voids	
VMA	Tex-204-F
Moisture content	Tex-212-F, Part II
Theoretical maximum specific (Rice) gravity	Tex-227-F
Asphalt binder content	Tex-236-F
Hamburg Wheel test	Tex-242-F
Recycled Asphalt Shingles (RAS)[1]	Tex-217-F, Part III
Asphalt binder sampling and testing	Tex-500-C
Tack coat sampling and testing	Tex-500-C, Part III
Boil test	Tex-530-C

1. Testing performed by the Construction Division or designated laboratory.

4.8.3.1. **Voids in Mineral Aggregates (VMA)**. The Engineer may determine the VMA for any production lot. Take immediate corrective action if the VMA value for any lot is less than the minimum VMA requirement for production listed in Table 8. Suspend production and shipment of the mixture if the Engineer's VMA result is more than 0.5% below the minimum VMA requirement for production listed in Table 8. In addition to suspending production, the Engineer may require removal and replacement or may allow the lot to be left in place without payment.

4.8.3.2. **Hamburg Wheel Test**. The Engineer may perform a Hamburg Wheel test at any time during production, including when the boil test indicates a change in quality from the materials submitted for JMF1. In addition to testing production samples, the Engineer may obtain cores and perform Hamburg Wheel tests on any areas of the roadway where rutting is observed. Suspend production until further Hamburg Wheel tests meet the specified values when the production or core samples fail the Hamburg Wheel test criteria in Table 10. Core samples, if taken, will be obtained from the center of the finished mat or other areas excluding the vehicle wheel paths. The Engineer may require up to the entire lot of any mixture failing the Hamburg Wheel test to be removed and replaced at the Contractor's expense.

If the Department's or Department-approved laboratory's Hamburg Wheel test results in a "remove and replace" condition, the Contractor may request that the Department confirm the results by re-testing the failing material. The Construction Division will perform the Hamburg Wheel tests and determine the final disposition of the material in question based on the Department's test results.

4.8.4. **Individual Loads of Hot-Mix**. The Engineer can reject individual truckloads of hot-mix. When a load of hot-mix is rejected for reasons other than temperature, contamination, or excessive uncoated particles, the Contractor may request that the rejected load be tested. Make this request within 4 hr. of rejection. The Engineer will sample and test the mixture. If test results are within the operational tolerances shown in Table 11, payment will be made for the load. If test results are not within operational tolerances, no payment will be made for the load.

4.9. **Placement Acceptance**.

4.9.1. **Placement Lot**. A placement lot is defined as the area placed during a production lot (one day's production). Placement lot numbers will correspond with production lot numbers.

4.9.2. **Miscellaneous Areas**. Miscellaneous areas include areas that typically involve significant handwork or discontinuous paving operations, such as temporary detours, driveways, mailbox turnouts, crossovers, gores, spot level-up areas, and other similar areas. Miscellaneous areas also include level-ups and thin overlays when the layer thickness specified on the plans is less than the minimum untrimmed core height eligible for testing shown in Table 12. The specified layer thickness is based on the rate of 110 lb./sq. yd. for each inch of pavement unless another rate is shown on the plans. Compact miscellaneous areas in accordance with Section 340.4.7., "Compaction." Miscellaneous areas are not subject to in-place air void determination except for temporary detours when shown on the plans.

4.9.3. **Placement Sampling**. Provide the equipment and means to obtain and trim roadway cores on site. On site is defined as in close proximity to where the cores are taken. Obtain the cores within one working day of the time the placement lot is completed unless otherwise approved. Obtain two 6-in. diameter cores side-by-side at each location selected by the Engineer for in-place air void determination unless otherwise shown on the plans. For Type D and Type F mixtures, 4-in. diameter cores are allowed. Mark the cores for identification, measure and record the untrimmed core height, and provide the information to the Engineer. The Engineer will witness the coring operation and measurement of the core thickness.

Visually inspect each core and verify that the current paving layer is bonded to the underlying layer. Take corrective action if an adequate bond does not exist between the current and underlying layer to ensure that an adequate bond will be achieved during subsequent placement operations.

Trim the cores immediately after obtaining the cores from the roadway in accordance with Tex-207-F if the core heights meet the minimum untrimmed value listed in Table 12. Trim the cores on site in the presence of the Engineer. Use a permanent marker or paint pen to record the date and lot number on each core as well as the designation as Core A or B. The Engineer may require additional information to be marked on the core and may choose to sign or initial the core. The Engineer will take custody of the cores immediately after they are trimmed and will retain custody of the cores until the Department's testing is completed. Before turning the trimmed cores over to the Engineer, the Contractor may wrap the trimmed cores or secure them in a manner that will reduce the risk of possible damage occurring during transport by the Engineer. After testing, the Engineer will return the cores to the Contractor.

The Engineer may have the cores transported back to the Department's laboratory at the HMA plant via the Contractor's haul truck or other designated vehicle. In such cases where the cores will be out of the Engineer's possession during transport, the Engineer will use Department-provided security bags and the Roadway Core Custody protocol located at http://www.txdot.gov/business/specifications.htm to provide a secure means and process that protects the integrity of the cores during transport.

Instead of the Contractor trimming the cores on site immediately after coring, the Engineer and the Contractor may mutually agree to have the trimming operations performed at an alternate location such as a field laboratory or other similar location. In such cases, the Engineer will take possession of the cores immediately after they are obtained from the roadway and will retain custody of the cores until testing is completed. Either the Department or Contractor representative may perform trimming of the cores. The Engineer will witness all trimming operations in cases where the Contractor representative performs the trimming operation.

Dry the core holes and tack the sides and bottom immediately after obtaining the cores. Fill the hole with the same type of mixture and properly compact the mixture. Repair core holes with other methods when approved.

4.9.4. **Placement Testing**. The Engineer may measure in-place air voids at any time during the project to verify specification compliance.

4.9.4.1. **In-Place Air Voids**. The Engineer will measure in-place air voids in accordance with Tex-207-F and Tex-227-F. Cores not meeting the height requirements in Table 12 will not be tested. Before drying to a constant weight, cores may be pre-dried using a Corelok or similar vacuum device to remove excess moisture. The Engineer will use the corresponding theoretical maximum specific gravity to determine the air void content of each core. The Engineer will use the average air void content of the 2 cores to determine the in-place air voids at the selected location.

The Engineer will use the vacuum method to seal the core if required by Tex-207-F. The Engineer will use the test results from the unsealed core if the sealed core yields a higher specific gravity than the unsealed core. After determining the in-place air void content, the Engineer will return the cores and provide test results to the Contractor.

Take immediate corrective action when the in-place air voids exceed the range of 3.8% and 8.5% to bring the operation within these tolerances. The Engineer may suspend operations or require removal and replacement if the in-place air voids are less than 2.7% or greater than 9.9%. The Engineer will allow paving to resume when the proposed corrective action is likely to yield between 3.8% and 8.5% in-place air voids. Areas defined in Section 340.9.2., "Miscellaneous Areas," are not subject to in-place air void determination.

4.9.5. **Irregularities**. Identify and correct irregularities including segregation, rutting, raveling, flushing, fat spots, mat slippage, irregular color, irregular texture, roller marks, tears, gouges, streaks, uncoated aggregate particles, or broken aggregate particles. The Engineer may also identify irregularities, and in such cases, the Engineer will promptly notify the Contractor. If the Engineer determines that the irregularity will adversely affect pavement performance, the Engineer may require the Contractor to remove and replace (at the Contractor's expense) areas of the pavement that contain irregularities and areas where the mixture does not bond to the existing pavement. If irregularities are detected, the Engineer may require the Contractor to immediately suspend operations or may allow the Contractor to continue operations for no more than one day while the Contractor is taking appropriate corrective action.

~~4.9.6. **Ride Quality**. Use Surface Test Type A to evaluate ride quality in accordance with Item 585, "Ride Quality for Pavement Surfaces," unless otherwise shown on the plans.~~

5. MEASUREMENT

Hot mix will be measured by the square yard of specified total thickness (inches) of composite hot mix, ~~Hot mix will be measured by the ton of composite hot mix~~, which includes asphalt, aggregate, and additives. ~~Measure the weight on scales in accordance with Item 520, "Weighing and Measuring Equipment."~~

6. PAYMENT

The work performed and materials furnished in accordance with this Item and measured as provided under Article 340.5., "Measurement," will be paid for at the unit bid price for "Dense Graded Hot-Mix Asphalt (SQ)" of the mixture type, SAC, and binder specified. These prices are full compensation for surface preparation, materials including tack coat, placement, equipment, labor, tools, and incidentals.

Trial batches will not be paid for unless they are included in pavement work approved by CCSUD. ~~the Department.~~

~~Payment adjustment for ride quality, if applicable, will be determined in accordance with Item 585, "Ride Quality for Pavement Surfaces~~."

Item 506

Temporary Erosion, Sedimentation, and Environmental Controls

1. DESCRIPTION

Install, maintain, and remove erosion, sedimentation, and environmental control measures to prevent or reduce the discharge of pollutants in accordance with the Storm Water Pollution Prevention Plan (SWP3) on the plans and the Texas Pollutant Discharge Elimination System (TPDES) General Permit TXR150000. Control measures are defined as Best Management Practices used to prevent or reduce the discharge of pollutants. Control measures include, but are not limited to, rock filter dams, temporary pipe slope drains, temporary paved flumes, construction exits, earthwork for erosion control, pipe, construction perimeter fence, sandbags, temporary sediment control fence, biodegradable erosion control logs, vertical tracking, temporary or permanent seeding, and other measures. Erosion and sediment control devices must be selected from the *Erosion Control Approved Products* or *Sediment Control Approved Products* lists. Perform work in a manner to prevent degradation of receiving waters, facilitate project construction, and comply with applicable federal, state, and local regulations. Ensure the installation and maintenance of control measures is performed in accordance with the manufacturer's or designer's specifications.

Provide the Contractor Certification of Compliance before performing SWP3 or soil disturbing activities. By signing the Contractor Certification of Compliance, the Contractor certifies they have read and understand the requirements applicable to this project pertaining to the SWP3, the plans, and the TPDES General Permit TXR150000. The Contractor is responsible for any penalties associated with non-performance of installation or maintenance activities required for compliance. Ensure the most current version of the certificate is executed for this project.

2. MATERIALS

Furnish materials in accordance with the following:

- Item 161, "Compost,"
- Item 432, "Riprap," and
- Item 556, "Pipe Underdrains."

2.1. **Rock Filter Dams**.

2.1.1. **Aggregate**. Furnish aggregate with approved hardness, durability, cleanliness, and resistance to crumbling, flaking, and eroding. Provide the following:

- Types 1, 2, and 4 Rock Filter Dams. Use 3 to 6 in. aggregate.
- Type 3 Rock Filter Dams. Use 4 to 8 in. aggregate.

2.1.2. **Wire**. Provide minimum 20 gauge galvanized wire for the steel wire mesh and tie wires for Types 2 and 3 rock filter dams. Type 4 dams require:

- a double-twisted, hexagonal weave with a nominal mesh opening of 2-1/2 × 3-1/4 in.;
- minimum 0.0866 in. steel wire for netting;
- minimum 0.1063 in. steel wire for selvages and corners; and
- minimum 0.0866 in. for binding or tie wire.

2.1.3. **Sandbag Material**. Furnish sandbags meeting Section 506.2.8., "Sandbags," except that any gradation of aggregate may be used to fill the sandbags.

2.2. **Temporary Pipe Slope Drains**. Provide corrugated metal pipe, polyvinyl chloride (PVC) pipe, flexible tubing, watertight connection bands, grommet materials, prefabricated fittings, and flared entrance sections that conform to the plans. Recycled and other materials meeting these requirements are allowed if approved.

Furnish concrete in accordance with Item 432, "Riprap."

2.3. **Temporary Paved Flumes**. Furnish asphalt concrete, hydraulic cement concrete, or other comparable non-erodible material that conforms to the plans. Provide rock or rubble with a minimum diameter of 6 in. and a maximum volume of 1/2 cu. ft. for the construction of energy dissipaters.

2.4. **Construction Exits**. Provide materials that meet the details shown on the plans and this Section.

2.4.1. **Rock Construction Exit**. Provide crushed aggregate for long- and short-term construction exits. Furnish aggregates that are clean, hard, durable, and free from adherent coatings such as salt, alkali, dirt, clay, loam, shale, soft or flaky materials, and organic and injurious matter. Use 4- to 8-in. aggregate for Type 1. Use 2- to 4-in. aggregate for Type 3.

2.4.2. **Timber Construction Exit**. Furnish No. 2 quality or better railroad ties and timbers for long-term construction exits, free of large and loose knots and treated to control rot. Fasten timbers with nuts and bolts or lag bolts, of at least 1/2 in. diameter, unless otherwise shown on the plans or allowed. Provide plywood or pressed wafer board at least 1/2 in. thick for short-term exits.

2.4.3. **Foundation Course**. Provide a foundation course consisting of flexible base, bituminous concrete, hydraulic cement concrete, or other materials as shown on the plans or directed.

2.5. **Embankment for Erosion Control**. Provide rock, loam, clay, topsoil, or other earth materials that will form a stable embankment to meet the intended use.

2.6. **Pipe**. Provide pipe outlet material in accordance with Item 556, "Pipe Underdrains," and details shown on the plans.

2.7. **Construction Perimeter Fence**.

2.7.1. **Posts**. Provide essentially straight wood or steel posts that are at least 60 in. long. Furnish soft wood posts with a minimum diameter of 3 in., or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/5 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.7.2. **Fence**. Provide orange construction fencing as approved.

2.7.3. **Fence Wire**. Provide 14 gauge or larger galvanized smooth or twisted wire. Provide 16 gauge or larger tie wire.

2.7.4. **Flagging**. Provide brightly-colored flagging that is fade-resistant and at least 3/4 in. wide to provide maximum visibility both day and night.

2.7.5. **Staples**. Provide staples with a crown at least 1/2 in. wide and legs at least 1/2 in. long.

2.7.6. **Used Materials**. Previously used materials meeting the applicable requirements may be used if approved.

2.8. **Sandbags**. Provide sandbag material of polypropylene, polyethylene, or polyamide woven fabric with a minimum unit weight of 4 oz. per square yard, a Mullen burst-strength exceeding 300 psi, and an ultraviolet stability exceeding 70%.

Use natural coarse sand or manufactured sand meeting the gradation given in Table 1 to fill sandbags. Filled sandbags must be 24 to 30 in. long, 16 to 18 in. wide, and 6 to 8 in. thick.

Table 1
Sand Gradation

Sieve Size	Retained (% by Weight)
#4	Maximum 3%
#100	Minimum 80%
#200	Minimum 95%

Aggregate may be used instead of sand for situations where sandbags are not adjacent to traffic. The aggregate size must not exceed 3/8 in.

2.9. **Temporary Sediment Control Fence**. Provide a net-reinforced fence using woven geo-textile fabric. Logos visible to the traveling public will not be allowed.

2.9.1. **Fabric**. Provide fabric materials in accordance with DMS-6230, "Temporary Sediment Control Fence Fabric."

2.9.2. **Posts**. Provide essentially straight wood or steel posts with a minimum length of 48 in., unless otherwise shown on the plans. Furnish soft wood posts at least 3 in. in diameter, or use nominal 2 × 4 in. boards. Furnish hardwood posts with a minimum cross-section of 1-1/2 × 1-1/2 in. Furnish T- or L-shaped steel posts with a minimum weight of 1.25 lb. per foot.

2.9.3. **Net Reinforcement**. Provide net reinforcement of at least 12.5 gauge (SWG) galvanized welded wire mesh, with a maximum opening size of 2 × 4 in., at least 24 in. wide, unless otherwise shown on the plans.

2.9.4. **Staples**. Provide staples with a crown at least 3/4 in. wide and legs 1/2 in. long.

2.9.5. **Used Materials**. Use recycled material meeting the applicable requirements if approved.

2.10. **Biodegradable Erosion Control Logs**.

2.10.1. **Core Material**. Furnish core material that is biodegradable or recyclable. Use compost, mulch, aspen excelsior wood fibers, chipped site vegetation, agricultural rice or wheat straw, coconut fiber, 100% recyclable fibers, or any other acceptable material unless specifically called out on the plans. Permit no more than 5% of the material to escape from the containment mesh. Furnish compost meeting the requirements of Item 161, "Compost."

2.10.2. **Containment Mesh**. Furnish containment mesh that is 100% biodegradable, photodegradable, or recyclable such as burlap, twine, UV photodegradable plastic, polyester, or any other acceptable material.

Furnish biodegradable or photodegradable containment mesh when log will remain in place as part of a vegetative system.

Furnish recyclable containment mesh for temporary installations.

2.10.3. **Size**. Furnish biodegradable erosion control logs with diameters shown on the plans or as directed. Stuff containment mesh densely so logs do not deform.

3. QUALIFICATIONS, TRAINING, AND EMPLOYEE REQUIREMENTS

3.1. **Contractor Responsible Person Environmental (CRPE) Qualifications and Responsibilities**. Provide and designate in writing at the preconstruction conference a CRPE and alternate CRPE who have overall responsibility for the storm water management program. The CRPE will implement storm water and erosion control practices; will oversee and observe storm water control measure monitoring and management; will monitor the project site daily and produce daily monitoring reports as long as there are BMPs in place or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or on contract non-work days, daily inspections are not required unless a rain event has occurred. The CRPE will provide recommendations on how to improve the effectiveness of control measures. Attend the Department's preconstruction conference

for the project. Ensure training is completed as identified in Section 506.3.3., "Training," by all applicable personnel before employees work on the project. Document and submit a list, signed by the CRPE, of all applicable Contractor and subcontractor employees who have completed the training. Include the employee's name, the training course name, and date the employee completed the training. Provide the most current list at the preconstruction conference or before SWP3 or soil disturbing activities. Update the list as needed and provide the updated list when updated.

3.2. **Contractor Superintendent Qualifications and Responsibilities**. Provide a superintendent that is competent, has experience with and knowledge of storm water management, and is knowledgeable of the requirements and the conditions of the TPDES General Permit TXR150000. The superintendent will manage and oversee the day to day operations and activities at the project site; work with the CRPE to provide effective storm water management at the project site; represent and act on behalf of the Contractor; and attend the Department's preconstruction conference for the project.

3.3. **Training**. All Contractor and subcontractor employees involved in soil disturbing activities, small or large structures, storm water control measures, and seeding activities must complete training as prescribed by the Department.

4. CONSTRUCTION

4.1. **Contractor Responsibilities**. Implement the SWP3 for the project site in accordance with the plans and specifications, TPDES General Permit TXR150000, and as directed. Coordinate storm water management with all other work on the project. Develop and implement an SWP3 for project-specific material supply plants within and outside of the Department's right of way in accordance with the specific or general storm water permit requirements. Prevent water pollution from storm water associated with construction activity from entering any surface water or private property on or adjacent to the project site.

4.2. **Implementation**. The CRPE, or alternate CRPE, must be accessible by phone and able to respond to project-related storm water management or other environmental emergencies 24 hr. per day.

4.2.1. **Commencement**. Implement the SWP3 as shown and as directed. Contractor-proposed recommendations for changes will be allowed as approved. Conform to the established guidelines in the TPDES General Permit TXR150000 to make changes. Do not implement changes until approval has been received and changes have been incorporated into the plans. Minor adjustments to meet field conditions are allowed and will be recorded in the SWP3.

4.2.2. **Phasing**. Implement control measures before the commencement of activities that result in soil disturbance. Phase and minimize the soil disturbance to the areas shown on the plans. Coordinate temporary control measures with permanent control measures and all other work activities on the project to assure economical, effective, safe, and continuous water pollution prevention. Provide control measures that are appropriate to the construction means, methods, and sequencing allowed by the Contract. Exercise precaution throughout the life of the project to prevent pollution of ground waters and surface waters. Schedule and perform clearing and grubbing operations so that stabilization measures will follow immediately thereafter if project conditions permit. Bring all grading sections to final grade as soon as possible and implement temporary and permanent control measures at the earliest time possible. Implement temporary control measures when required by the TPDES General Permit TXR150000 or otherwise necessitated by project conditions.

Do not prolong final grading and shaping. Preserve vegetation where possible throughout the project, and minimize clearing, grubbing, and excavation within stream banks, bed, and approach sections.

4.3. **General**.

4.3.1. **Temporary Alterations or Control Measure Removal**. Altering or removal of control measures is allowed when control measures are restored within the same working day.

4.3.2. **Stabilization**. Initiate stabilization for disturbed areas no more than 14 days after the construction activities in that portion of the site have temporarily or permanently ceased. Establish a uniform vegetative cover or use another stabilization practice in accordance with the TPDES General Permit TXR150000.

4.3.3. **Finished Work**. Remove and dispose of all temporary control measures upon acceptance of vegetative cover or other stabilization practice unless otherwise directed. Complete soil disturbing activities and establish a uniform perennial vegetative cover. A project will not be considered for acceptance until a vegetative cover of 70% density of existing adjacent undisturbed areas is obtained or equivalent permanent stabilization is obtained in accordance with the TPDES General Permit TXR150000. An exception will be allowed in arid areas as defined in the TPDES General Permit TXR150000.

4.3.4. **Restricted Activities and Required Precautions**. Do not discharge onto the ground or surface waters any pollutants such as chemicals, raw sewage, fuels, lubricants, coolants, hydraulic fluids, bitumens, or any other petroleum product. Operate and maintain equipment on-site to prevent actual or potential water pollution. Manage, control, and dispose of litter on-site such that no adverse impacts to water quality occur. Prevent dust from creating a potential or actual unsafe condition, public nuisance, or condition endangering the value, utility, or appearance of any property. Wash out concrete trucks only as described in the TPDES General Permit TXR150000. Use appropriate controls to minimize the offsite transport of suspended sediments and other pollutants if it is necessary to pump or channel standing water (i.e., dewatering). Prevent discharges that would contribute to a violation of Edwards Aquifer Rules, water quality standards, the impairment of a listed water body, or other state or federal law.

4.4. **Installation, Maintenance, and Removal Work**. Perform work in accordance with the SWP3, according to manufacturers' guidelines, and in accordance with the TPDES General Permit TXR150000. Install and maintain the integrity of temporary erosion and sedimentation control devices to accumulate silt and debris until soil disturbing activities are completed and permanent erosion control features are in place or the disturbed area has been adequately stabilized as approved.

The Department will inspect and document the condition of the control measures at the frequency shown on the plans and will provide the Construction SWP3 Field Inspection and Maintenance Reports to the Contractor. Make corrections as soon as possible before the next anticipated rain event or within 7 calendar days after being able to enter the worksite for each control measure. The only acceptable reason for not accomplishing the corrections with the time frame specified is when site conditions are "Too Wet to Work." Take immediate action if a correction is deemed critical as directed. When corrections are not made within the established time frame, all work will cease on the project and time charges will continue while the control measures are brought into compliance. Commence work once the Engineer reviews and documents the project is in compliance. Commencing work does not release the Contractor of the liability for noncompliance of the SWP3, plans, or TPDES General Permit TXR150000.

The Engineer may limit the disturbed area if the Contractor cannot control soil erosion and sedimentation resulting from the Contractor's operations. Implement additional controls as directed.

Remove devices upon approval or as directed. Finish-grade and dress the area upon removal. Stabilize disturbed areas in accordance with the permit, and as shown on the plans or directed. Materials removed are considered consumed by the project. Retain ownership of stockpiled material and remove it from the project when new installations or replacements are no longer required.

4.4.1. **Rock Filter Dams for Erosion Control**. Remove trees, brush, stumps, and other objectionable material that may interfere with the construction of rock filter dams. Place sandbags as a foundation when required or at the Contractor's option.

Place the aggregate to the lines, height, and slopes specified, without undue voids for Types 1, 2, 3, and 5. Place the aggregate on the mesh and then fold the mesh at the upstream side over the aggregate and secure it to itself on the downstream side with wire ties, or hog rings for Types 2 and 3, or as directed. Place rock filter dams perpendicular to the flow of the stream or channel unless otherwise directed. Construct filter dams according to the following criteria unless otherwise shown on the plans:

4.4.1.1. **Type 1 (Non-Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.2. **Type 2 (Reinforced)**.

- **Height**. At least 18 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.3. **Type 3 (Reinforced)**.

- **Height**. At least 36 in. measured vertically from existing ground to top of filter dam.
- **Top Width**. At least 2 ft.
- **Slopes**. No steeper than 2:1.

4.4.1.4. **Type 4 (Sack Gabions)**. Unfold sack gabions and smooth out kinks and bends. Connect the sides by lacing in a single loop–double loop pattern on 4- to 5-in. spacing for vertical filling. Pull the end lacing rod at one end until tight, wrap around the end, and twist 4 times. Fill with stone at the filling end, pull the rod tight, cut the wire with approximately 6 in. remaining, and twist wires 4 times.

Place the sack flat in a filling trough, fill with stone, connect sides, and secure ends as described above for horizontal filling.

Lift and place without damaging the gabion. Shape sack gabions to existing contours.

4.4.1.5. **Type 5**. Provide rock filter dams as shown on the plans.

4.4.2. **Temporary Pipe Slope Drains**. Install pipe with a slope as shown on the plans or as directed. Construct embankment for the drainage system in 8-in. lifts to the required elevations. Hand-tamp the soil around and under the entrance section to the top of the embankment as shown on the plans or as directed. Form the top of the embankment or earth dike over the pipe slope drain at least 1 ft. higher than the top of the inlet pipe at all points. Secure the pipe with hold-downs or hold-down grommets spaced a maximum of 10 ft. on center. Construct the energy dissipaters or sediment traps as shown on the plans or as directed. Construct the sediment trap using concrete or rubble riprap in accordance with Item 432, "Riprap," when designated on the plans.

4.4.3. **Temporary Paved Flumes**. Construct paved flumes as shown on the plans or as directed. Provide excavation and embankment (including compaction of the subgrade) of material to the dimensions shown on the plans unless otherwise indicated. Install a rock or rubble riprap energy dissipater, constructed from the materials specified above, to a minimum depth of 9 in. at the flume outlet to the limits shown on the plans or as directed.

4.4.4. **Construction Exits**. Prevent traffic from crossing or exiting the construction site or moving directly onto a public roadway, alley, sidewalk, parking area, or other right of way areas other than at the location of construction exits when tracking conditions exist. Construct exits for either long- or short-term use.

4.4.4.1. **Long-Term**. Place the exit over a foundation course as required. Grade the foundation course or compacted subgrade to direct runoff from the construction exits to a sediment trap as shown on the plans or as directed. Construct exits with a width of at least 14 ft. for one-way and 20 ft. for two-way traffic for the full width of the exit, or as directed.

4.4.4.1.1. **Type 1**. Construct to a depth of at least 8 in. using crushed aggregate as shown on the plans or as directed.

4.4.4.1.2. **Type 2**. Construct using railroad ties and timbers as shown on the plans or as directed.

4.4.4.2. **Short-Term**.

4.4.4.2.1. **Type 3**. Construct using crushed aggregate, plywood, or wafer board. This type of exit may be used for daily operations where long-term exits are not practical.

4.4.4.2.2. **Type 4**. Construct as shown on the plans or as directed.

4.4.5. **Earthwork for Erosion Control**. Perform excavation and embankment operations to minimize erosion and to remove collected sediments from other erosion control devices.

4.4.5.1. **Excavation and Embankment for Erosion Control Features**. Place earth dikes, swales, or combinations of both along the low crown of daily lift placement, or as directed, to prevent runoff spillover. Place swales and dikes at other locations as shown on the plans or as directed to prevent runoff spillover or to divert runoff. Construct cuts with the low end blocked with undisturbed earth to prevent erosion of hillsides. Construct sediment traps at drainage structures in conjunction with other erosion control measures as shown on the plans or as directed.

Create a sediment basin, where required, providing 3,600 cu. ft. of storage per acre drained, or equivalent control measures for drainage locations that serve an area with 10 or more disturbed acres at one time, not including offsite areas.

4.4.5.2. **Excavation of Sediment and Debris**. Remove sediment and debris when accumulation affects the performance of the devices, after a rain, and when directed.

4.4.6. **Construction Perimeter Fence**. Construct, align, and locate fencing as shown on the plans or as directed.

4.4.6.1. **Installation of Posts**. Embed posts 18 in. deep or adequately anchor in rock, with a spacing of 8 to 10 ft.

4.4.6.2. **Wire Attachment**. Attach the top wire to the posts at least 3 ft. from the ground. Attach the lower wire midway between the ground and the top wire.

4.4.6.3. **Flag Attachment**. Attach flagging to both wire strands midway between each post. Use flagging at least 18 in. long. Tie flagging to the wire using a square knot.

4.4.7. **Sandbags for Erosion Control**. Construct a berm or dam of sandbags that will intercept sediment-laden storm water runoff from disturbed areas, create a retention pond, detain sediment, and release water in sheet flow. Fill each bag with sand so that at least the top 6 in. of the bag is unfilled to allow for proper tying of the open end. Place the sandbags with their tied ends in the same direction. Offset subsequent rows of sandbags 1/2 the length of the preceding row. Place a single layer of sandbags downstream as a secondary debris trap. Place additional sandbags as necessary or as directed for supplementary support to berms or dams of sandbags or earth.

4.4.8. **Temporary Sediment-Control Fence**. Provide temporary sediment-control fence near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the fence into erosion-control measures used to control sediment in areas of higher flow. Install the fence as shown on the plans, as specified in this Section, or as directed.

4.4.8.1. **Installation of Posts**. Embed posts at least 18 in. deep, or adequately anchor, if in rock, with a spacing of 6 to 8 ft. and install on a slight angle toward the runoff source.

4.4.8.2. **Fabric Anchoring**. Dig trenches along the uphill side of the fence to anchor 6 to 8 in. of fabric. Provide a minimum trench cross-section of 6 × 6 in. Place the fabric against the side of the trench and align approximately 2 in. of fabric along the bottom in the upstream direction. Backfill the trench, then hand-tamp.

4.4.8.3. **Fabric and Net Reinforcement Attachment**. Attach the reinforcement to wooden posts with staples, or to steel posts with T-clips, in at least 4 places equally spaced unless otherwise shown on the plans. Sewn

vertical pockets may be used to attach reinforcement to end posts. Fasten the fabric to the top strand of reinforcement by hog rings or cord every 15 in. or less.

4.4.8.4. **Fabric and Net Splices**. Locate splices at a fence post with a minimum lap of 6 in. attached in at least 6 places equally spaced unless otherwise shown on the plans. Do not locate splices in concentrated flow areas.

Requirements for installation of used temporary sediment-control fence include the following:

- fabric with minimal or no visible signs of biodegradation (weak fibers),
- fabric without excessive patching (more than 1 patch every 15 to 20 ft.),
- posts without bends, and
- backing without holes.

4.4.9. **Biodegradable Erosion Control Logs**. Install biodegradable erosion control logs near the downstream perimeter of a disturbed area to intercept sediment from sheet flow. Incorporate the biodegradable erosion control logs into the erosion measures used to control sediment in areas of higher flow. Install, align, and locate the biodegradable erosion control logs as specified below, as shown on the plans, or as directed.

Secure biodegradable erosion control logs in a method adequate to prevent displacement as a result of normal rain events, prevent damage to the logs, and as approved, such that flow is not allowed under the logs. Temporarily removing and replacing biodegradable erosion logs as to facilitate daily work is allowed at the Contractor's expense.

4.4.10. **Vertical Tracking**. Perform vertical tracking on slopes to temporarily stabilize soil. Provide equipment with a track undercarriage capable of producing a linear soil impression measuring a minimum of 12 in. long × 2 to 4 in. wide × 1/2 to 2 in. deep. Do not exceed 12 in. between track impressions. Install continuous linear track impressions where the 12 in. length impressions are perpendicular to the slope. Vertical tracking is required on projects where soil disturbing activities have occurred unless otherwise approved.

4.5. **Monitoring and Documentation**. Monitor the control measures on a daily basis as long as there are BMPs in place and/or soil disturbing activities are evident to ensure compliance with the SWP3 and TPDES General Permit TXR150000. During time suspensions when work is not occurring or contract non-work days, daily inspections are not required unless a rain event has occurred. Monitoring will consist of, but is not limited to, observing, inspecting, and documenting site locations with control measures and discharge points to provide maintenance and inspection of controls as described in the SWP3. Keep written records of daily monitoring. Document in the daily monitoring report the control measure condition, the date of inspection, required corrective actions, responsible person for making the corrections, and the date corrective actions were completed. Maintain records of all monitoring reports at the project site or at an approved place. Provide copies within 7 days. Together, the CRPE and an Engineer's representative will complete the Construction Stage Gate Checklist on a periodic basis as directed.

5. MEASUREMENT

5.1. **Rock Filter Dams**. Installation or removal of rock filter dams will be measured by the foot or by the cubic yard. The measured volume will include sandbags, when used.

5.1.1. **Linear Measurement**. When rock filter dams are measured by the foot, measurement will be along the centerline of the top of the dam.

5.1.2. **Volume Measurement**. When rock filter dams are measured by the cubic yard, measurement will be based on the volume of rock computed by the method of average end areas.

5.1.2.1. **Installation**. Measurement will be made in final position.

5.1.2.2. **Removal**. Measurement will be made at the point of removal.

5.2. **Temporary Pipe Slope Drains**. Temporary pipe slope drains will be measured by the foot.

5.3. **Temporary Paved Flumes**. Temporary paved flumes will be measured by the square yard of surface area. The measured area will include the energy dissipater at the flume outlet.

5.4. **Construction Exits**. Construction exits will be measured by the square yard of surface area.

5.5. **Earthwork for Erosion and Sediment Control**.

5.5.1. **Equipment and Labor Measurement**. Equipment and labor used will be measured by the actual number of hours the equipment is operated and the labor is engaged in the work.

5.5.2. **Volume Measurement**.

5.5.2.1. **In Place**.

5.5.2.1.1. **Excavation**. Excavation will be measured by the cubic yard in its original position and the volume computed by the method of average end areas.

5.5.2.1.2. **Embankment**. Embankment will be measured by the cubic yard in its final position by the method of average end areas. The volume of embankment will be determined between:

- the original ground surfaces or the surface upon that the embankment is to be constructed for the feature and
- the lines, grades and slopes of the accepted embankment for the feature.

5.5.2.2. **In Vehicles**. Excavation and embankment quantities will be combined and paid for under "Earthwork (Erosion and Sediment Control, In Vehicle)." Excavation will be measured by the cubic yard in vehicles at the point of removal. Embankment will be measured by the cubic yard in vehicles measured at the point of delivery. Shrinkage or swelling factors will not be considered in determining the calculated quantities.

5.6. **Construction Perimeter Fence**. Construction perimeter fence will be measured by the foot.

5.7. **Sandbags for Erosion Control**. Sandbags will be measured as each sandbag or by the foot along the top of sandbag berms or dams.

5.8. **Temporary Sediment-Control Fence**. Installation or removal of temporary sediment-control fence will be measured by the foot.

5.9. **Biodegradable Erosion Control Logs**. Installation or removal of biodegradable erosion control logs will be measured by the foot along the centerline of the top of the control logs.

5.10. **Vertical Tracking**. Vertical tracking will not be measured or paid for directly but is considered subsidiary to this Item.

6. PAYMENT

The following will not be paid for directly but are subsidiary to pertinent Items:

- erosion-control measures for Contractor project-specific locations (PSLs) inside and outside the right of way (such as construction and haul roads, field offices, equipment and supply areas, plants, and material sources);
- removal of litter, unless a separate pay item is shown on the plans;
- repair to devices and features damaged by Contractor operations;
- added measures and maintenance needed due to negligence, carelessness, lack of maintenance, and failure to install permanent controls;

- removal and reinstallation of devices and features needed for the convenience of the Contractor;
- finish grading and dressing upon removal of the device; and
- minor adjustments including but not limited to plumbing posts, reattaching fabric, minor grading to maintain slopes on an erosion embankment feature, or moving small numbers of sandbags.

Stabilization of disturbed areas will be paid for under pertinent Items except vertical tacking which is subsidiary.

Furnishing and installing pipe for outfalls associated with sediment traps and ponds will not be paid for directly but is subsidiary to the excavation and embankment under this Item.

6.1. **Rock Filter Dams**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.1.1. **Installation**. Installation will be paid for as "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.1.2. **Removal**. Removal will be paid for as "Rock Filter Dams (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

When the Engineer directs that the rock filter dam installation or portions thereof be replaced, payment will be made at the unit price bid for "Rock Filter Dams (Remove)" and for "Rock Filter Dams (Install)" of the type specified. This price is full compensation for furnishing and operating equipment, finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.2. **Temporary Pipe Slope Drains**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Pipe Slope Drains" of the size specified. This price is full compensation for furnishing materials, removal and disposal, furnishing and operating equipment, labor, tools, and incidentals.

Removal of temporary pipe slope drains will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the pipe slope drain installation or portions thereof be replaced, payment will be made at the unit price bid for "Temporary Pipe Slope Drains" of the size specified, which is full compensation for the removal and reinstallation of the pipe drain.

Earthwork required for the pipe slope drain installation, including construction of the sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

Riprap concrete or stone, when used as an energy dissipater or as a stabilized sediment trap, will be measured and paid for in accordance with Item 432, "Riprap."

6.3. **Temporary Paved Flumes**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Temporary Paved Flume (Install)" or "Temporary Paved Flume (Remove)." This price is full compensation for furnishing and placing materials, removal and disposal, equipment, labor, tools, and incidentals.

When the Engineer directs that the paved flume installation or portions thereof be replaced, payment will be made at the unit prices bid for "Temporary Paved Flume (Remove)" and "Temporary Paved Flume (Install)." These prices are full compensation for the removal and replacement of the paved flume and for equipment, labor, tools, and incidentals.

Earthwork required for the paved flume installation, including construction of a sediment trap, will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.4. **Construction Exits**. Contractor-required construction exits from off right of way locations or on-right of way PSLs will not be paid for directly but are subsidiary to pertinent Items.

The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" for construction exits needed on right of way access to work areas required by the Department will be paid for at the unit price bid for "Construction Exits (Install)" of the type specified or "Construction Exits (Remove)." This price is full compensation for furnishing and placing materials, excavating, removal and disposal, cleaning vehicles, labor, tools, and incidentals.

When the Engineer directs that a construction exit or portion thereof be removed and replaced, payment will be made at the unit prices bid for "Construction Exit (Remove)" and "Construction Exit (Install)" of the type specified. These prices are full compensation for the removal and replacement of the construction exit and for equipment, labor, tools, and incidentals.

Construction of sediment traps used in conjunction with the construction exit will be measured and paid for under "Earthwork for Erosion and Sediment Control."

6.5. **Earthwork for Erosion and Sediment Control**.

6.5.1. **Initial Earthwork for Erosion and Sediment Control**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Excavation (Erosion and Sediment Control, In Place)," "Embankment (Erosion and Sediment Control, In Place)," "Excavation (Erosion and Sediment Control, In Vehicle)," "Embankment (Erosion and Sediment Control, (In Vehicle)," or "Earthwork (Erosion and Sediment Control, In Vehicle)."

This price is full compensation for excavation and embankment including hauling, disposal of material not used elsewhere on the project; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

6.5.2. **Maintenance Earthwork for Erosion and Sediment Control for Cleaning and Restoring Control Measures**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid under a Contractor Force Account Item from invoice provided to the Engineer.

This price is full compensation for excavation, embankment, and re-grading including removal of accumulated sediment in various erosion control installations as directed, hauling, and disposal of material not used elsewhere on the project; excavation for construction of erosion-control features; embankments including furnishing material from approved sources and construction of erosion-control features; and equipment, labor, tools, and incidentals.

Earthwork needed to remove and obliterate erosion-control features will not be paid for directly but is subsidiary to pertinent Items unless otherwise shown on the plans.

Sprinkling and rolling required by this Item will not be paid for directly but will be subsidiary to this Item.

6.6. **Construction Perimeter Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid for "Construction Perimeter Fence." This price is full compensation for furnishing and placing the fence; digging, fence posts, wire, and flagging; removal and disposal; and materials, equipment, labor, tools, and incidentals.

Removal of construction perimeter fence will be not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the perimeter fence installation or portions thereof be removed and replaced, payment will be made at the unit price bid for "Construction Perimeter Fence," which is full compensation for the removal and reinstallation of the construction perimeter fence.

6.7. **Sandbags for Erosion Control**. Sandbags will be paid for at the unit price bid for "Sandbags for Erosion Control" (of the height specified when measurement is by the foot). This price is full compensation for materials, placing sandbags, removal and disposal, equipment, labor, tools, and incidentals.

Removal of sandbags will not be paid for directly but is subsidiary to the installation Item. When the Engineer directs that the sandbag installation or portions thereof be replaced, payment will be made at the unit price bid for "Sandbags for Erosion Control," which is full compensation for the reinstallation of the sandbags.

6.8. **Temporary Sediment-Control Fence**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.8.1. **Installation**. Installation will be paid for as "Temporary Sediment-Control Fence (Install)." This price is full compensation for furnishing and operating equipment finish backfill and grading, lacing, proper disposal, labor, materials, tools, and incidentals.

6.8.2. **Removal**. Removal will be paid for as "Temporary Sediment-Control Fence (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.9. **Biodegradable Erosion Control Logs**. The work performed and materials furnished in accordance with this Item and measured as provided under "Measurement" will be paid for at the unit price bid as follows:

6.9.1. **Installation**. Installation will be paid for as "Biodegradable Erosion Control Logs (Install)" of the size specified. This price is full compensation for furnishing and operating equipment finish backfill and grading, staking, proper disposal, labor, materials, tools, and incidentals.

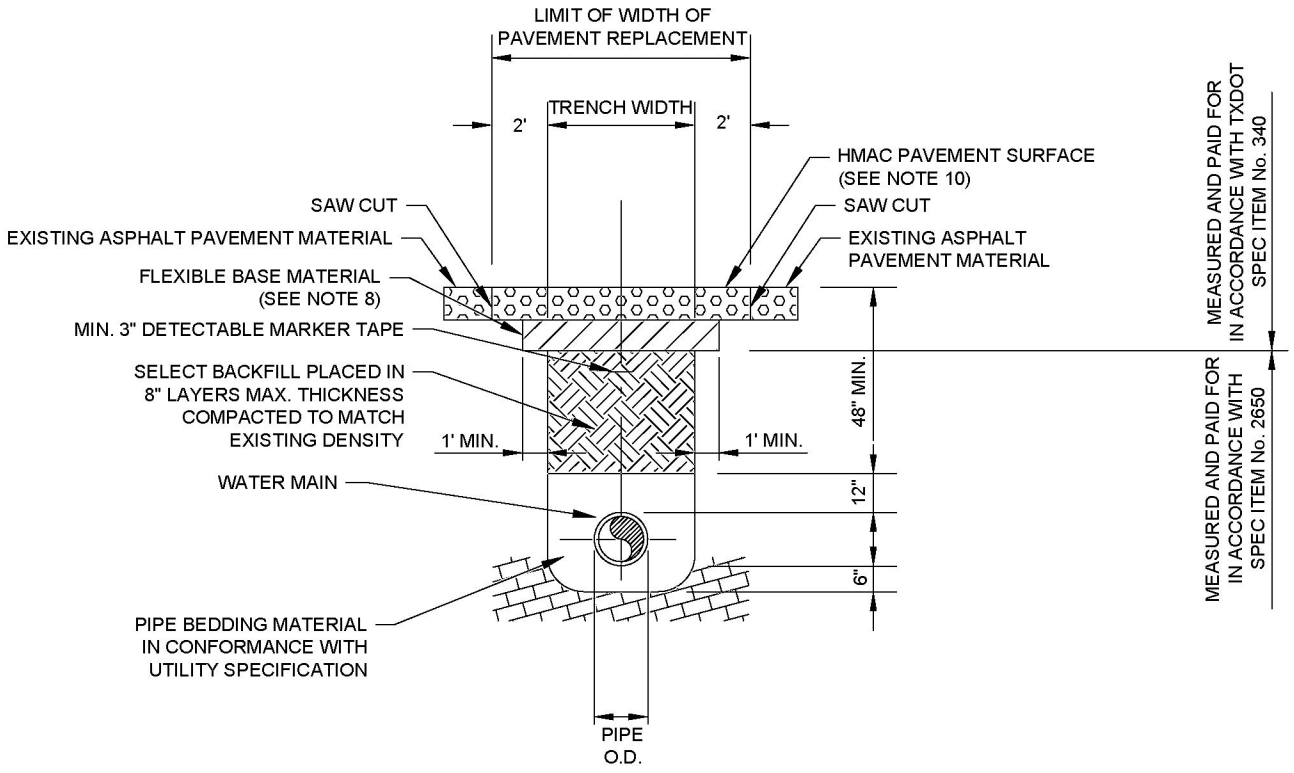
6.9.2. **Removal**. Removal will be paid for as "Biodegradable Erosion Control Logs (Remove)." This price is full compensation for furnishing and operating equipment, proper disposal, labor, materials, tools, and incidentals.

6.10. **Vertical Tracking**. Vertical tracking will not be measured or paid for directly but is considered subsidiary to this Item.

CRYSTAL CLEAR
SPECIAL UTILITY DISTRICT

WATER DETAILS

Asphalt Pavement and Driveway (Trench Repair) Detail
Casing Detail
Combination Air Valve Detail
Concrete Encasement Detail
Fire Hydrant Assembly Detail - New Braunfels
Fire Hydrant Assembly Detail - San Marcos
Fire Hydrant Detail
Flush Valve Detail 4 Inch or Smaller Detail
Flush Valve Detail 6 Inch or Larger Detail
Marker Details
Rock Berm Details
Service Connection Details
Silt Fence Details
Tank Transmitter Enclosure Detail
Temporary Flush Valve 8 Inch or Smaller Detail
Temporary Flush Valve 12 Inch or Larger Detail
Thrust Block Anchoring Details
Typical Gravel Chip Seal Driveway Repair Detail
Typical Iron Valve Box Details
Typical Trench Backfill Detail
Typical Trench Backfill Double Pipe Water Line Detail



TRENCH AND BACKFILL NOTES:

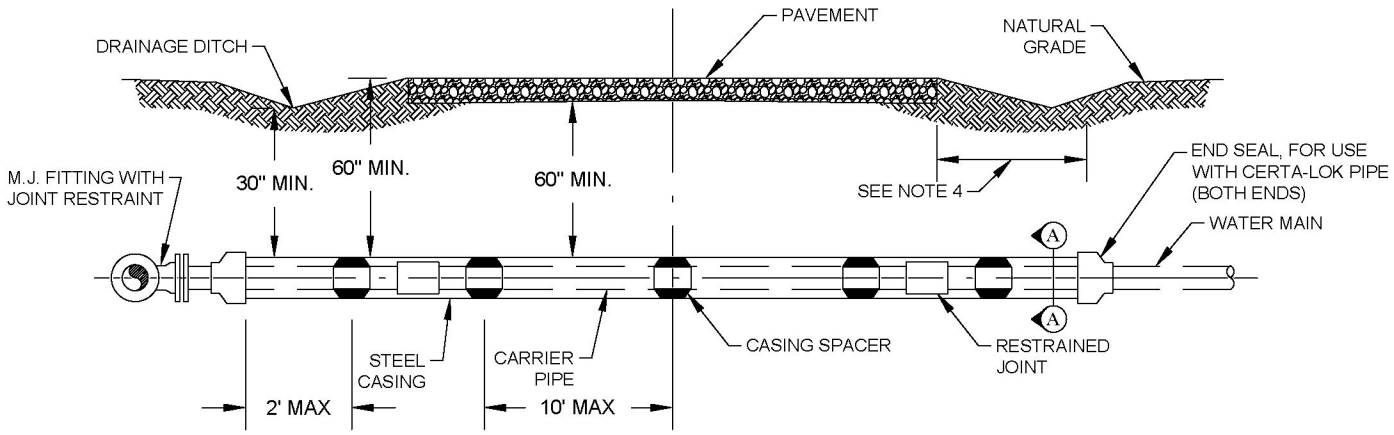
1. ADEQUATE BARRICADES & WARNING SIGNS SHALL BE ERECTED BEFORE ANY WORK IS STARTED IN PUBLIC RIGHT-OF-WAY.
2. THE ROADWAY SHALL BE CUT ONLY WHERE REQUIRED.
3. NO MORE THAN HALF OF THE WIDTH OF THE ROAD SHALL BE CUT & OPENED AT ONE TIME.
4. REFER TO SPECIFICATIONS FOR ANY SPECIAL REQUIREMENTS OR CONDITIONS
5. BACKFILL SHALL BE COMPLETED IMMEDIATELY AFTER PIPELINE LAYING WITHIN PUBLIC RIGHT-OF-WAYS OR CROSSING PUBLIC RIGHT-OF-WAYS & PRIVATE DRIVEWAYS.
6. THE EXISTING PAVING SURFACE SHALL BE SAW CUT IN A STRAIGHT LINE A MINIMUM OF 12" WIDER THAN UNDISTURBED SIDE OF THE TRENCH ASYMMETRICAL ABOVE THE CENTER LINE OF THE EXCAVATION.
7. ANY CONCRETE PAVING SHALL BE SAW CUT 6" WIDER THAN UNDISTURBED SIDES OF THE EXCAVATION.
8. LOCAL STREETS SHALL BE 10" AND MAJOR/MINOR STREETS SHALL BE 12" THICK. BASE MATERIAL SHALL BE PLACED 2' WIDER THAN TRENCH WIDTH ON BOTH SIDES. FLEXIBLE BASE SHALL BE TXDOT ITEM 247 TYPE A, GRADE 1.
9. DAMAGED PAVEMENT OUTSIDE THE TRENCH CUT SHALL BE REMOVED AND REPLACED WITH A BASE. THICKNESS OF 10" OR A THICKNESS MATCHING EXISTING, WHICHEVER IS GREATER, AT NO ADDITIONAL COST TO THE OWNER.
10. REPLACEMENT AC SURFACE LAYER SHALL BE OF THE TYPE AND THICKNESS BASED ON FUNCTIONAL CLASSIFICATION.
    A. MIN. 2" HMAC SHALL BE TXDOT ITEM 340, TYPE D FOR TRENCH REPAIR IN LOCAL/RESIDENTIAL STREETS AND DRIVEWAYS.
    B. MIN. 3" HMAC SHALL BE TXDOT ITEM 340, TYPE D FOR TRENCH REPAIR IN COLLECTION/ARTERIAL STREETS.

TRENCH SAFETY NOTES

1. TRENCH SAFETY SYSTEM, SHORING OR SIDE SLOPE TO BE IN ACCORDANCE WITH OSHA STANDARDS.
2. TRENCH SAFETY SYSTEM PLAN TO BE PROVIDED BY CONTRACTOR PRIOR TO CONSTRUCTION.

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	ASPHALT PAVEMENT AND DRIVEWAY (TRENCH REPAIR)	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1284	APPROVED	REVISION
			OCTOBER 2018	OCTOBER 2018
			SHEET 1 OF 1	



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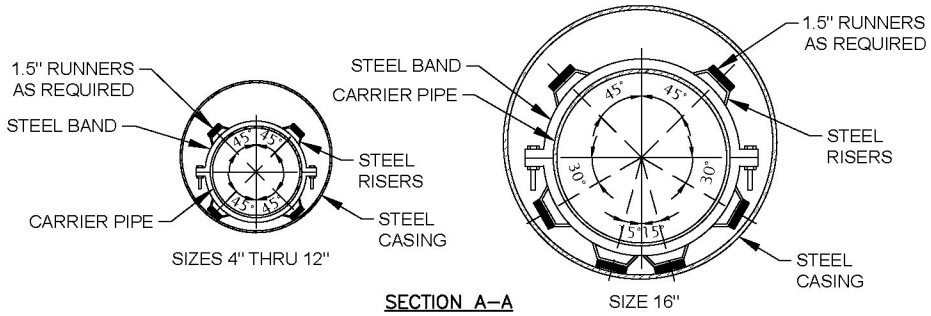


SECTION A–A

CARRIER PIPE			STEEL CASING					CASING SPACERS	
NOMINAL SIZE (IN)	PIPE OUTSIDE DIAMETER (IN)	RESTRAINT OUTSIDE DIA. (IN)	MIN. NOMINAL SIZE(IN)	OUTSIDE DIAMETER (IN)	INSIDE DIAMETER (IN)	WALL THICKNESS (IN)	WEIGHT CLASS	BAND WIDTH	No. OF RUNNERS PER TIE
4	4.80	9.25	10	10.750	10.250	0.25	STANDARD	8"	2 TOP, 2 BOTTOM
6	6.90	11.25	12	12.750	12.000	0.375	STANDARD	8"	2 TOP, 2 BOTTOM
8	9.05	14.75	16	16.000	15.250	0.375	STANDARD	8"	2 TOP, 2 BOTTOM
12	13.20	16.90	20	20.000	19.250	0.375	STANDARD	8"	2 TOP, 2 BOTTOM
16	17.40	25.51	30	30.000	29.250	0.375	STANDARD	8"	2 TOP, 4 BOTTOM

NOTES:

1. CARRIER PIPE SIZES ARE BASED ON CERTA-LOK C900/RJIB FOR 4" TO 12" PIPE DIAMETER AND CERTA-LOK C905/RJ FOR 14" TO 24" PIPE DIAMETER.
2. STEEL CASING SHALL BE STANDARD WEIGHT OR HEAVIER PIPE CONFORMING TO ASTM A-36, ASTM A-568, ASTM A-135, ASTM A-139 OR OTHER ACCEPTABLE STANDARD SPECIFICATION. PIPE SHALL BE COATED AND LINED IN ACCORDANCE WITH AWWA C-210 OR APPROVED EQUAL. PIPE JOINTS SHALL BE WELDED IN ACCORDANCE WITH AWWA C-206. STEEL CASING SHALL BE NEW OR USED IN GOOD CONDITION ACCEPTABLE TO CRYSTAL CLEAR SPECIAL UTILITY DISTRICT AND TO THE ROADWAY AUTHORITY.
3. SUBSEQUENT CASING SPACERS ARE REQUIRED FOR 4" TO 14" PIPE SIZES TO BE AT 10 FEET APART AND FOR 16" TO 30" PIPE SIZES TO BE AT 8 FEET APART WITHIN THE CASING WITH AT LEAST 3 SPACERS PER JOINT ON PIPE. ONE CASING SPACER SHALL BE REPLACED WITHIN 2 FEET OF ENDS OF CASING FOR ALL PIPE SIZES.
4. CASING PIPE SHALL EXTEND A MINIMUM OF 10 FT. PAST EDGE OF PAVEMENT ALONG TXDOT ROADWAYS AND A MINIMUM OF 5 FT. PAST EDGE OF PAVEMENT ALONG ALL OTHER ROADWAYS UNLESS OTHERWISE DIRECTED BY ENGINEER OR REGULATORY AUTHORITY.
5. CASING SPACERS SHALL BE MADE FROM T-304 STEEL OF A MINIMUM 14 GAUGE THICKNESS.
6. CASING SPACERS SHALL HAVE A SYNTHETIC RUBBER OR PVC LINER TO INSULATE THE PIPELINE FROM THE SPACER.
7. CASING SPACERS SHALL HAVE A 1.5" WIDE GLASS REINFORCED PLASTIC OR UHMW POLYMER RUNNERS TO INSULATE THE SPACER FROM THE CASING

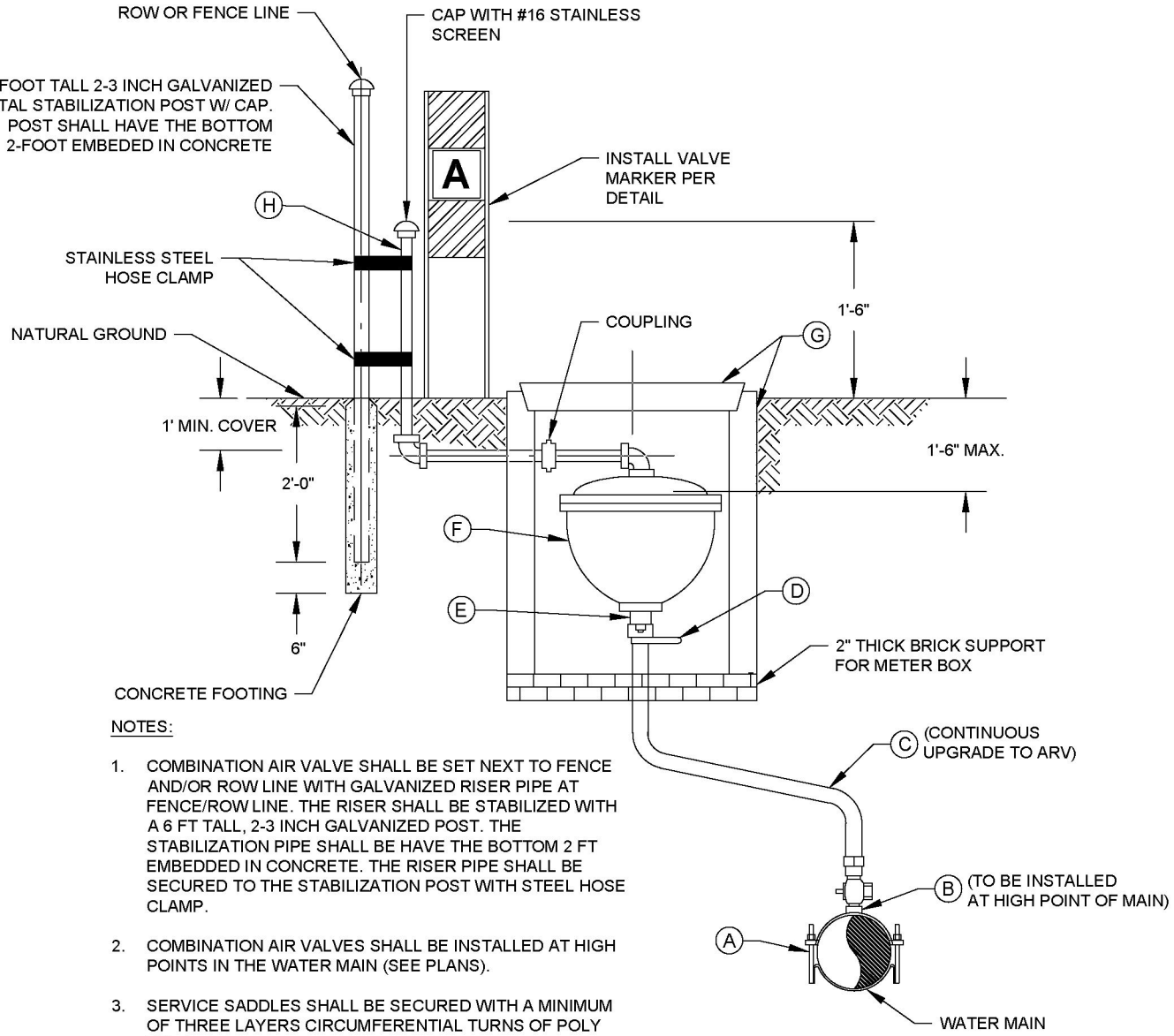
PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

CASING DETAIL

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

APPROVED	REVISION
JUNE 2015	FEB 2022

SHEET 1 OF 1



NOTES:

1. COMBINATION AIR VALVE SHALL BE SET NEXT TO FENCE AND/OR ROW LINE WITH GALVANIZED RISER PIPE AT FENCE/ROW LINE. THE RISER SHALL BE STABILIZED WITH A 6 FT TALL, 2-3 INCH GALVANIZED POST. THE STABILIZATION PIPE SHALL BE HAVE THE BOTTOM 2 FT EMBEDDED IN CONCRETE. THE RISER PIPE SHALL BE SECURED TO THE STABILIZATION POST WITH STEEL HOSE CLAMP.
2. COMBINATION AIR VALVES SHALL BE INSTALLED AT HIGH POINTS IN THE WATER MAIN (SEE PLANS).
3. SERVICE SADDLES SHALL BE SECURED WITH A MINIMUM OF THREE LAYERS CIRCUMFERENTIAL TURNS OF POLY TAPE.

TAP MATERIAL LIST		MATERIAL LIST SIZES	
LABEL	ITEM	1-INCH TAP	2-INCH TAP
A	APPROVED TAPPING SADDLE	1"	2"
B	CORPORATION STOP	1"	2"
C	CTS SDR9 HDPE TUBING	1"	2"
D	BRASS BALL VALVE WITH LEVER	1"	2"
E	BRASS NIPPLE THREADED	1"	2"
F	COMBINATION AIR VALVE	PER AEL*	
G	METER BOX AND LID	DFW2830FD OR DFW2836FD**	
H	GALVANIZED IRON PIPE AND FITTINGS	1"	2"

* AEL = APPROVED EQUIPMENT LIST
** METER BOX TO BE INSTALLED AS NECESSARY TO COVER FULL DEPTH OF COMBINATION AIR RELEASE VALVE.

NOT TO SCALE

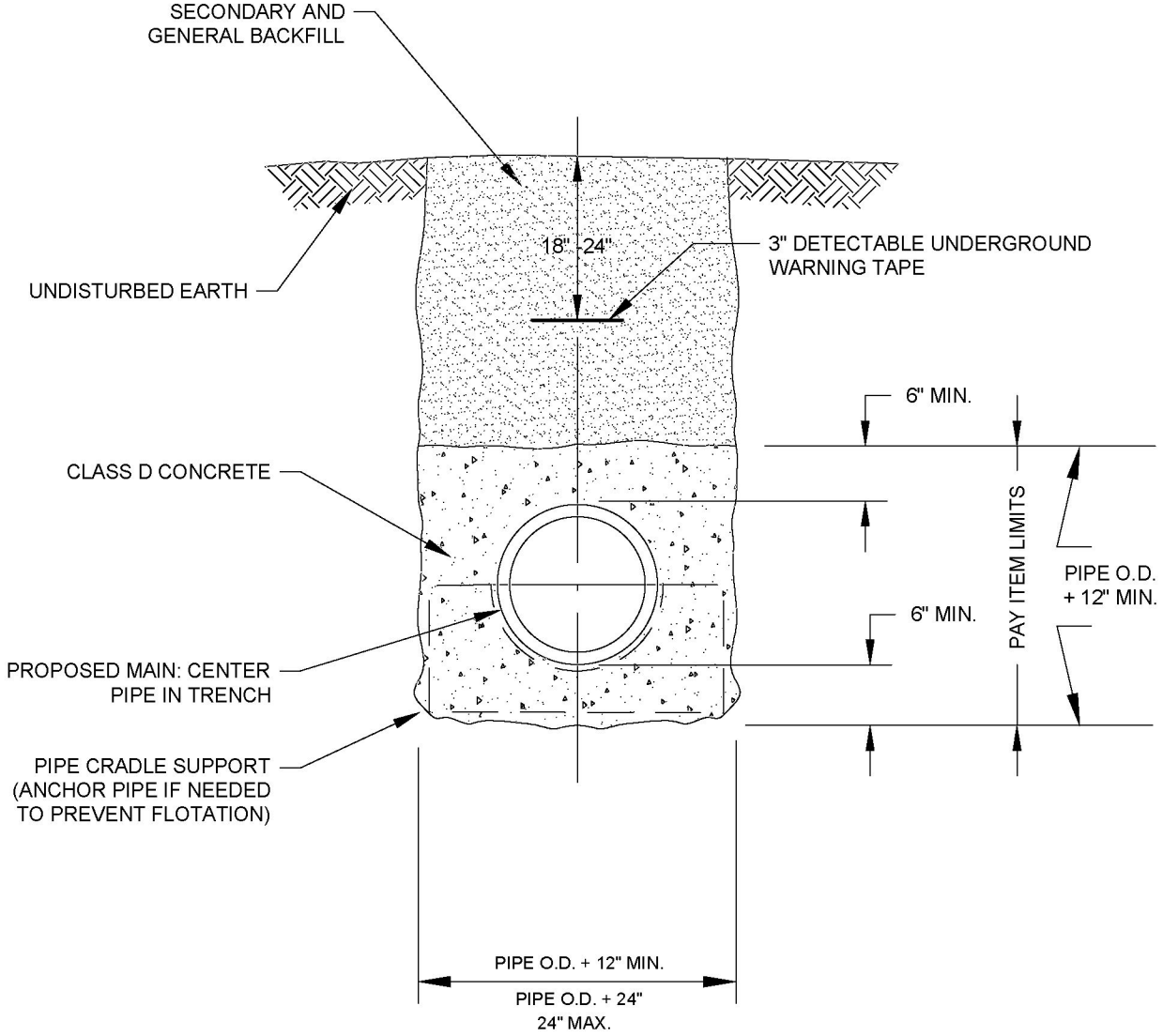
PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

COMBINATION AIR VALVE DETAIL

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	OCTOBER 2020

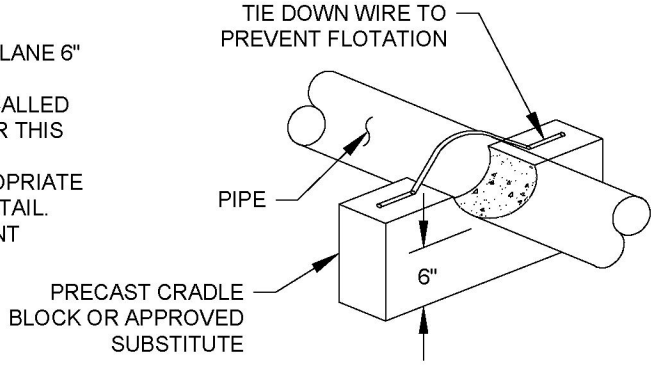
SHEET 1 OF 1



CONCRETE ENCASEMENT

NOTES:

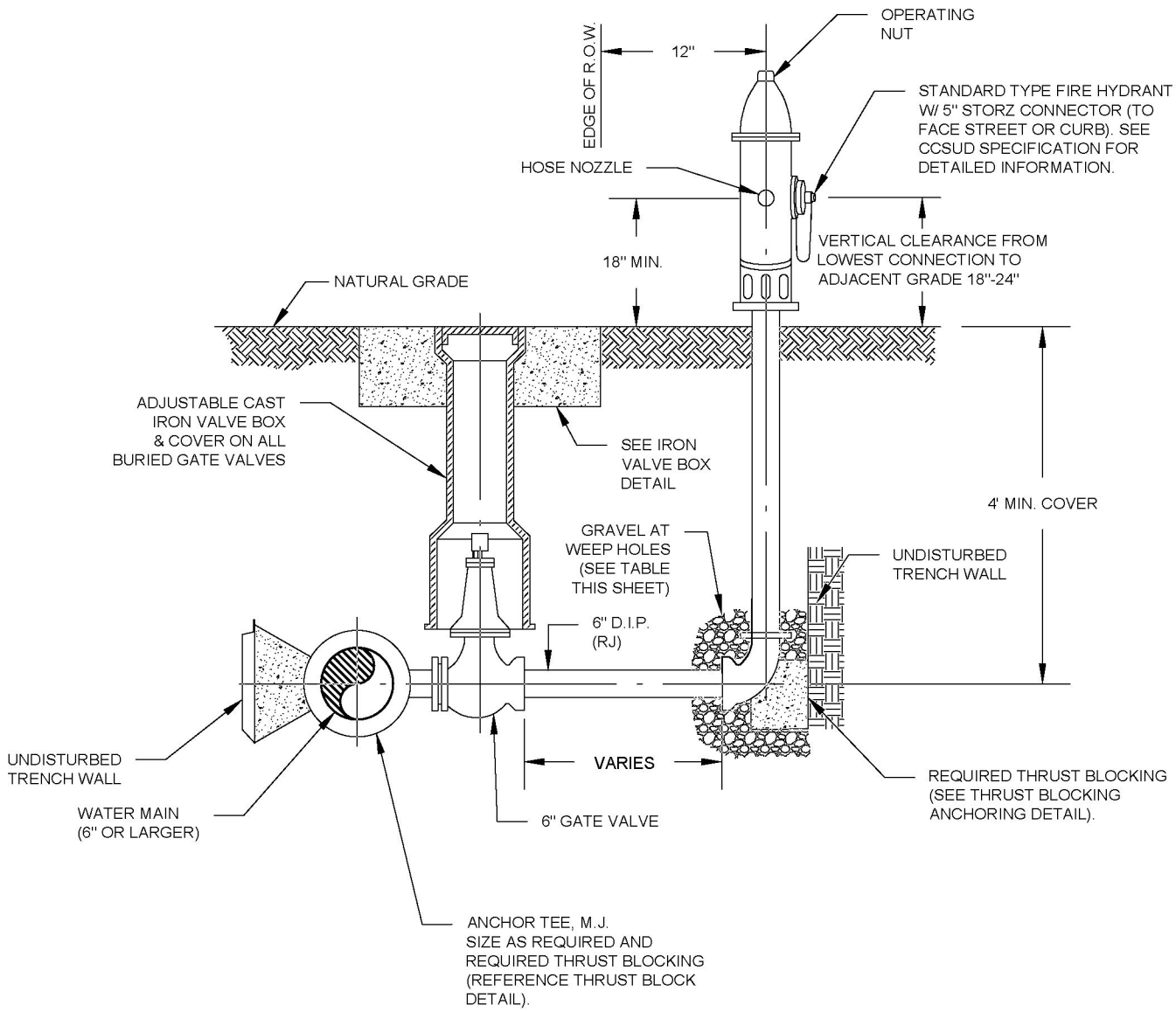
1. ALL CONCRETE ENCASEMENT SHALL BE POURED AT A PLANE 6" ABOVE THE PIPE BETWEEN EXCAVATED TRENCH WALL.
2. CONCRETE ENCASEMENT WILL BE USED ONLY WHERE CALLED OUT IN THE PLANS AND LIMITS OF PAYMENT WILL BE PER THIS DETAIL.
3. BACKFILL AND RESTORATION WORK WILL BE PER APPROPRIATE TRENCH DETAIL WITH EMBEDMENT FOLLOWING THIS DETAIL.
4. SUPPORTS ARE SUBSIDIARY TO CONCRETE ENCASEMENT



PIPE CRADLE SUPPORT

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	CONCRETE ENCASEMENT DETAIL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: MAY 2016	REVISION: FEB 2022
			SHEET 1 OF 1	



GRAVEL AT WEEPHOLE	
LENGTH OF HYDRANT RISER	CU. FT. OF GRAVEL REQUIRED
3'	2.5
4'	3
5'	3.5
6'	4
>6'	TBD BY CCSUD

NOTE:

1. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
2. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
3. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.
4. 12"x12"x4" THICK CONCRETE BLOCKS SHALL BE INSTALLED DIRECTLY UNDER ALL VALVES, FITTINGS, ETC.

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

FIRE HYDRANT ASSEMBLY DETAIL (NEW BRAUNFELS)

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1964

APPROVED	REVISION
JUNE 2015	NOV 2021

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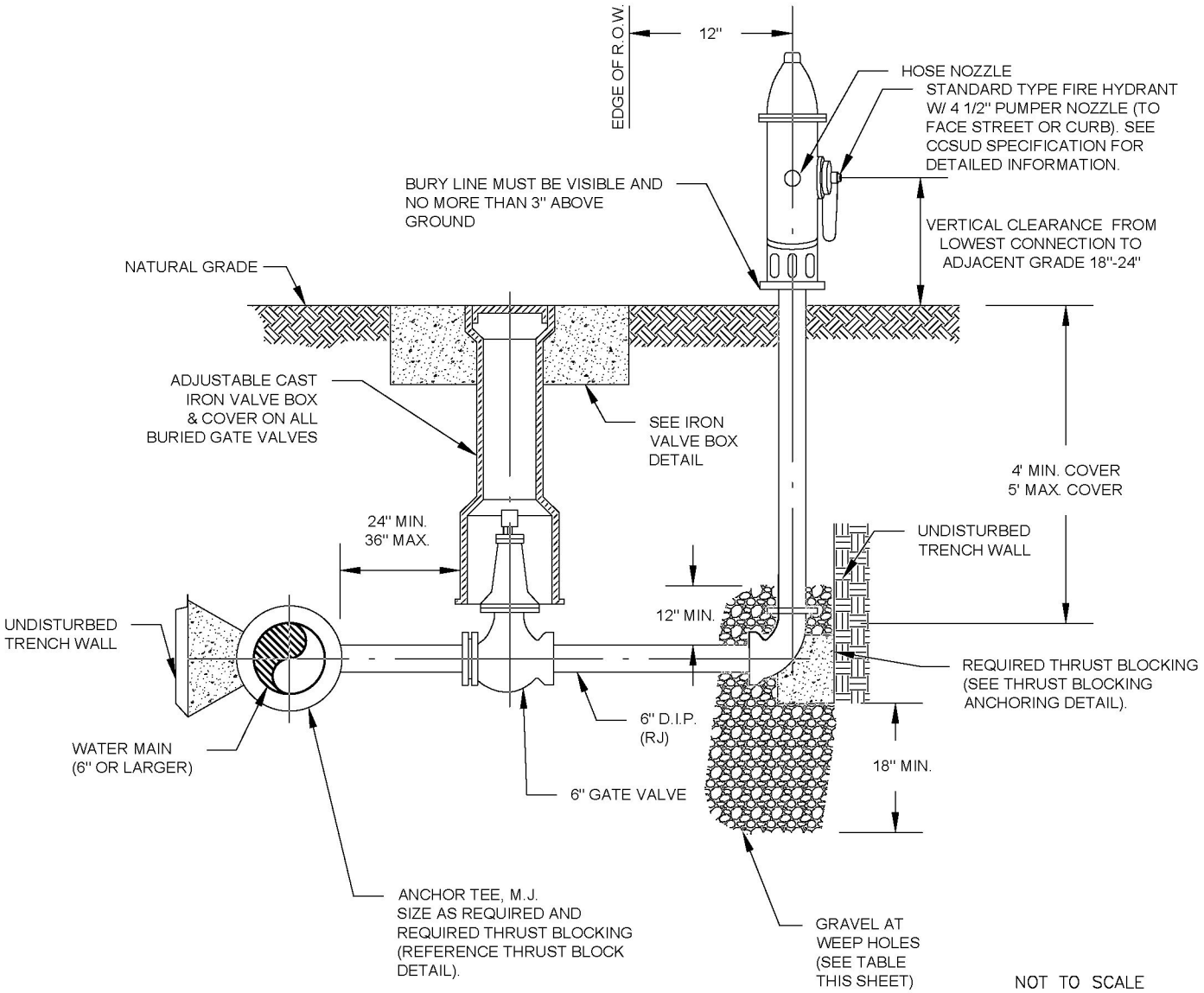


NOT TO SCALE

GRAVEL AT WEEPHOLE	
LENGTH OF HYDRANT RISER	CU. FT. OF GRAVEL REQUIRED
3'	2.5
4'	3
5'	3.5
6'	4
>6'	TBD BY CCSUD

NOTE:

1. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
2. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
3. ALL FITTINGS AND FITTING JOINTS MUST BE WRAPPED W/ THREE LAYERS OF 8-MIL POLYETHYLENE IN ACCORDANCE WITH AWWA C105-10, OR LATEST REVISION THERE OF.
4. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.
5. THE FIRE HYDRANT SHALL BE PLACED A MINIMUM OF FIVE FEET FROM ALL OBSTRUCTIONS.
6. A BLUE REFLECTIVE PAVEMENT MARKER MUST BE PLACED WITH EVERY FIRE HYDRANT ADJACENT TO A ROADWAY 6" -10" OFF CENTER LINE OF ROAD ON FIRE HYDRANT SIDE.

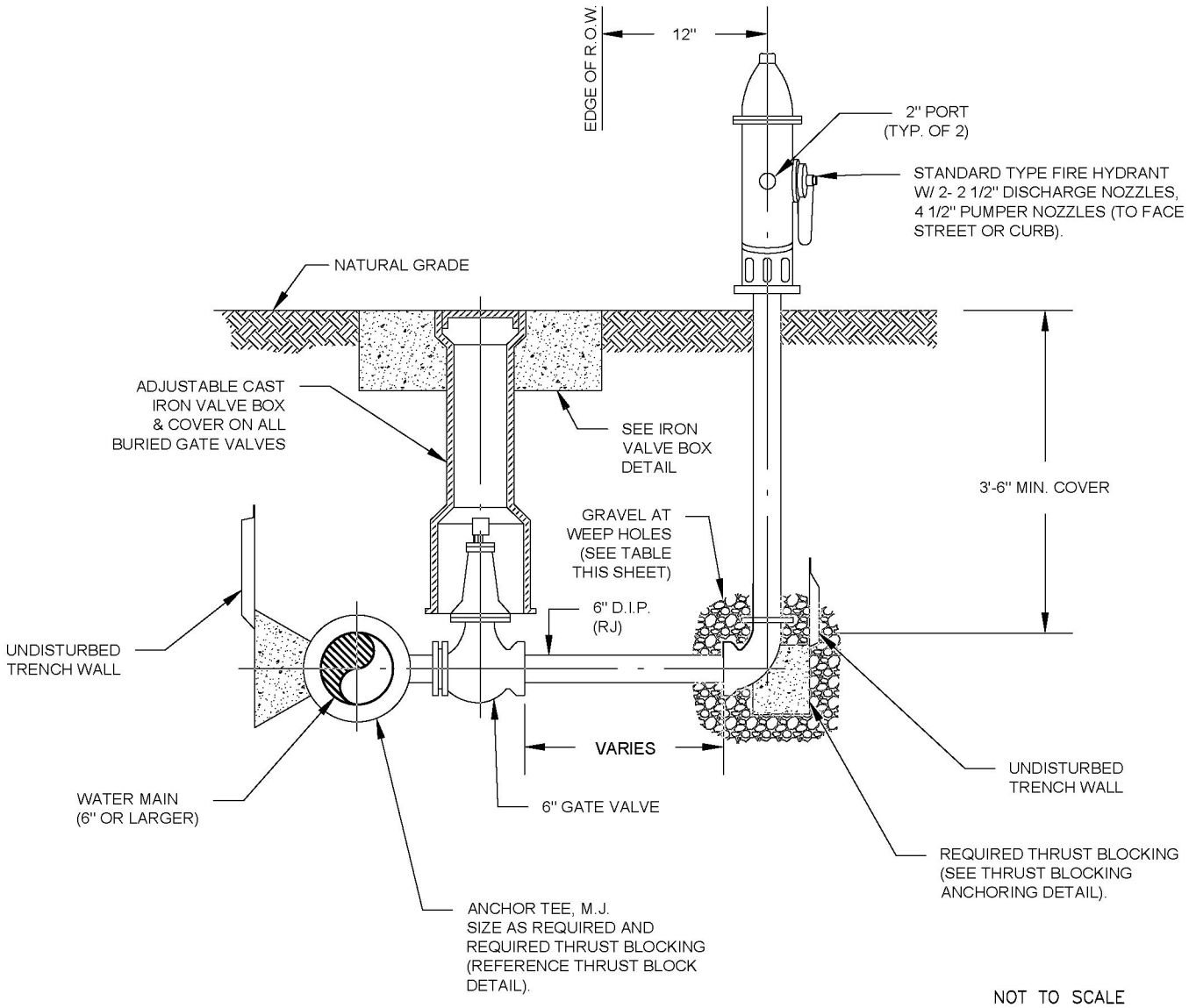
PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

FIRE HYDRANT ASSEMBLY DETAIL (SAN MARCOS)

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	JULY 2021

SHEET
1 OF 1



NOT TO SCALE

GRAVEL AT WEEPHOLE	
LENGTH OF HYDRANT RISER	CU. FT. OF GRAVEL REQUIRED
3'	2.5
4'	3
5'	3.5
6'	4
>6'	TBD BY CCSUD

NOTE:

1. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
2. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
3. ALL FITTINGS AND FITTING JOINTS MUST BE WRAPPED W/ THREE LAYERS OF 8-MIL POLYETHYLENE IN ACCORDANCE WITH AWWA C105-10, OR LATEST REVISION THERE OF.
4. 12"x12"x4" THICK CONCRETE BLOCKS SHALL BE INSTALLED DIRECTLY UNDER ALL VALVES, FITTINGS, ETC.

PROPERTY OF
CRYSTAL CLEAR
SPECIAL UTILITY DISTRICT

FIRE HYDRANT DETAIL

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1284

APPROVED	REVISION
JUNE 2015	JULY 2021

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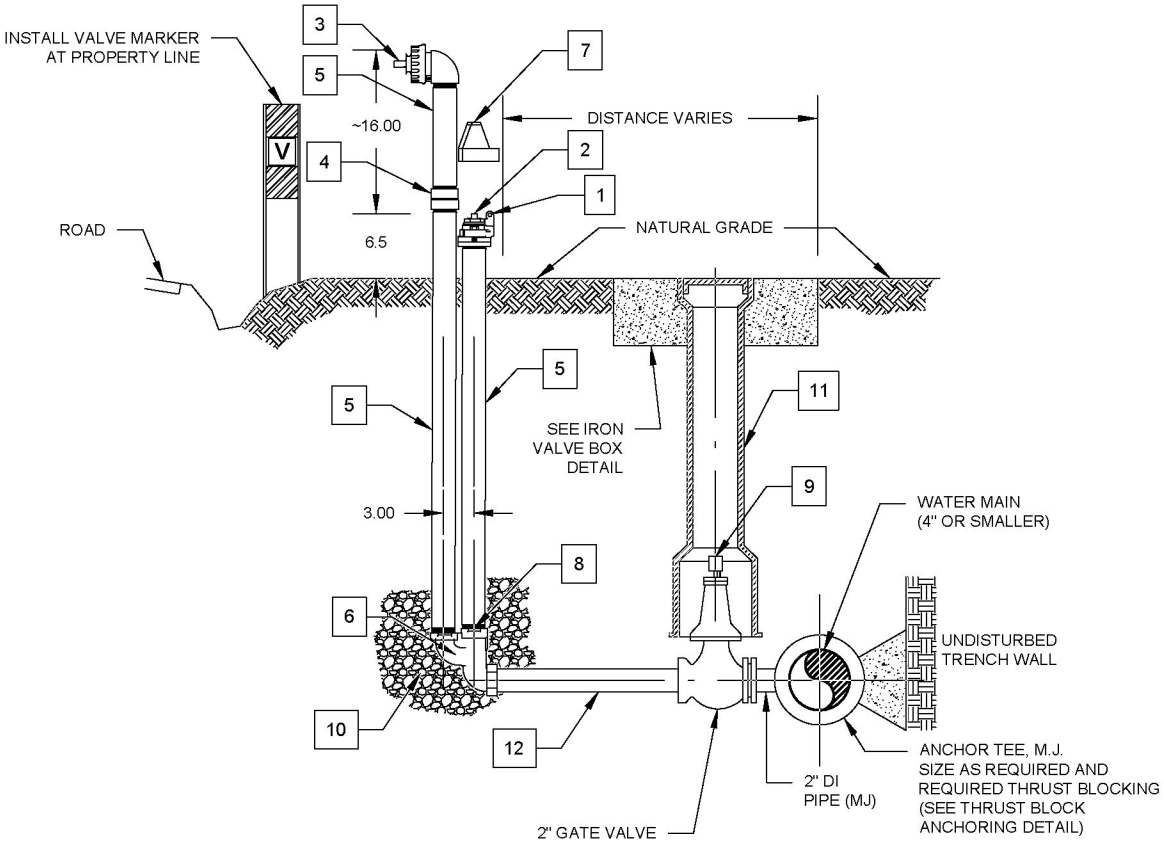

NOTE:

1. BURIED PIPING, FITTINGS, AND FITTING JOINTS SHALL BE WRAPPED IN POLYWRAP.
2. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
3. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
4. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.
5. 12"x12"x4" THICK CONCRETE BLOCKS SHALL BE INSTALLED DIRECTLY UNDER ALL VALVES, FITTINGS, ETC.

ITEM	ITEM/DESCRIPTION	NOTES
1	TOP CAP	
2	SLOTTED OPERATING NUT	
3	2-1/2" NST OUTLET	SHOWN WITH CAP
4	2" COUPLING	
5	2" STEEL PIPE	
6	INLET VALVE BODY	
7	LOCKING COVER	
8	DRAIN HOLE	
9	HYDRANT SHUT-OFF VALVE	
10	CRUSHED ROCK	
11	VALVE BOX	
12	2" BRASS PIPE (LEAD FREE)	ASTM B43

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

FLUSH VALVE DETAIL
4 INCH OR SMALLER

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1364

APPROVED	REVISION
JUNE 2015	DECEMBER 2020

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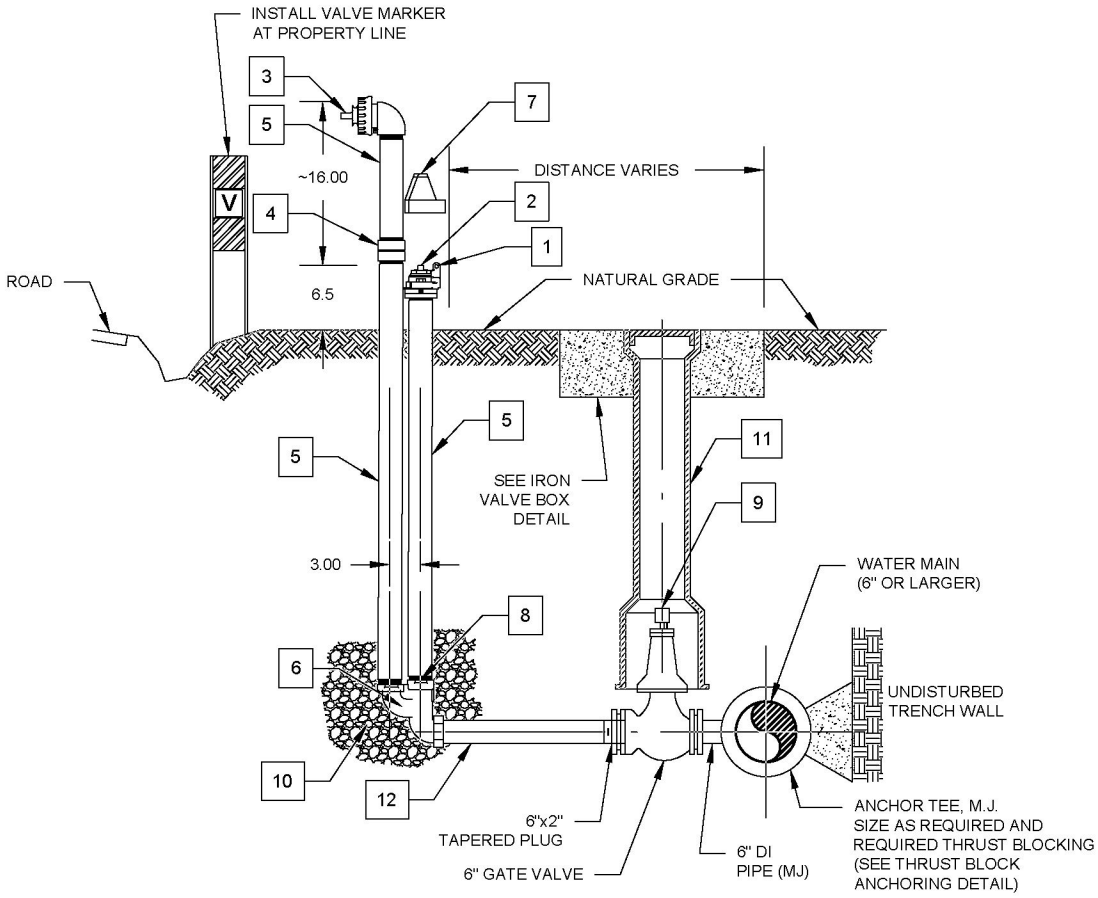

NOTE:

1. BURIED PIPING, FITTINGS, AND FITTING JOINTS SHALL BE WRAPPED IN POLYWRAP.
2. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
3. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
4. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.
5. 12"x12"x4" THICK CONCRETE BLOCKS SHALL BE INSTALLED DIRECTLY UNDER ALL VALVES, FITTINGS, ETC.

ITEM	ITEM/DESCRIPTION	NOTES
1	TOP CAP	
2	SLOTTED OPERATING NUT	
3	2-1/2" NST OUTLET	SHOWN WITH CAP
4	2" COUPLING	
5	2" STEEL PIPE	
6	INLET VALVE BODY	
7	LOCKING COVER	
8	DRAIN HOLE	
9	HYDRANT SHUT-OFF VALVE	
10	CRUSHED ROCK	
11	VALVE BOX	
12	2" BRASS PIPE (LEAD FREE)	ASTM B43

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

FLUSH VALVE DETAIL
6 INCH OR LARGER

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	DECEMBER 2020

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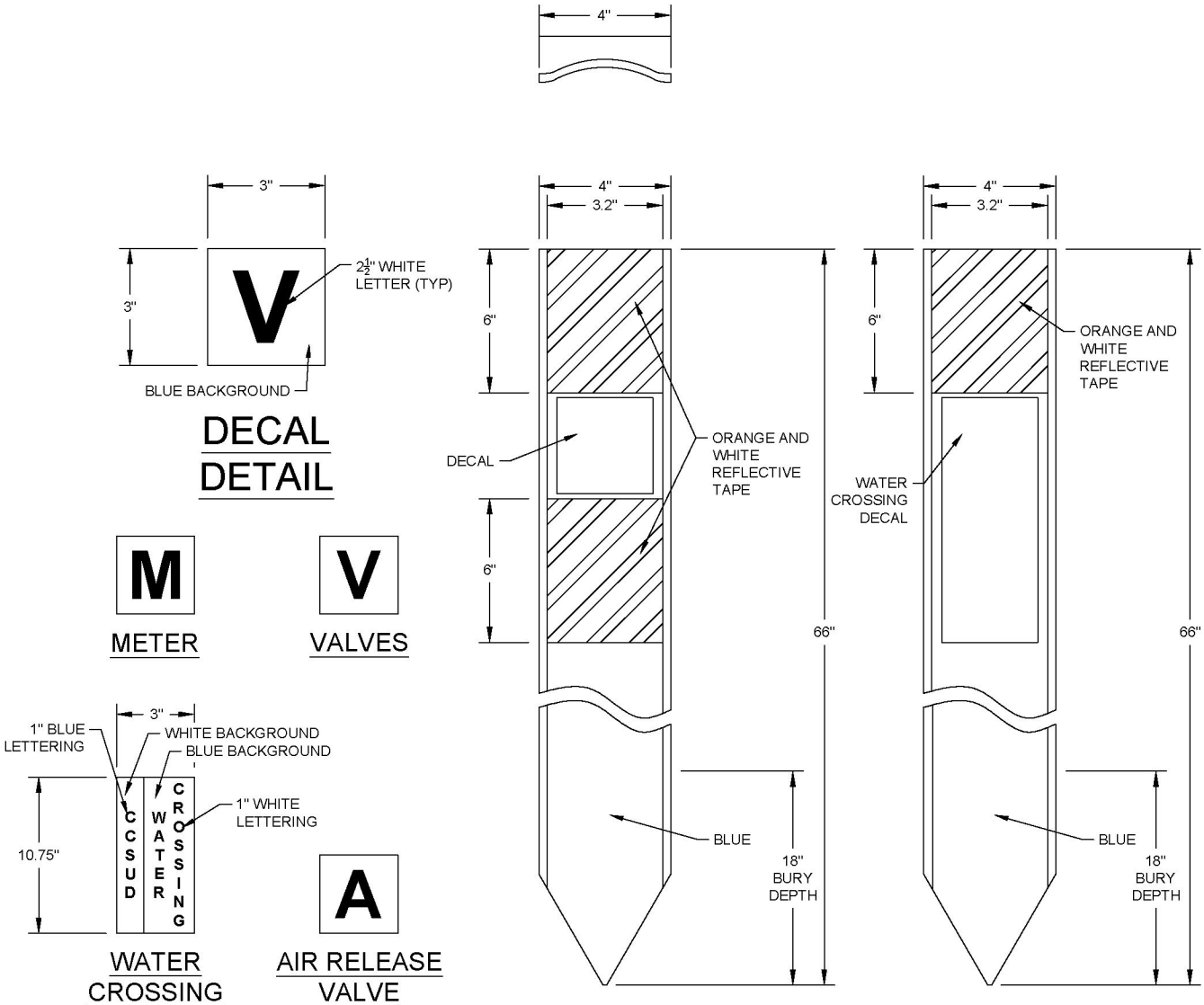
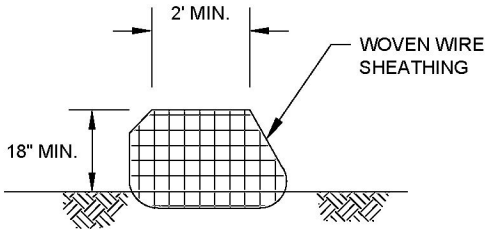


NOTES:

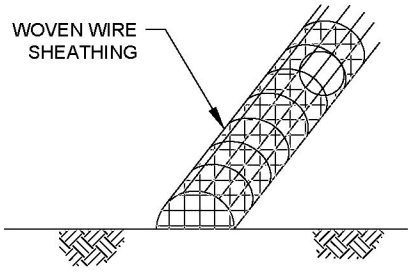
1. MARKERS SHALL BE 66" COMPOSITE POSTS SIMILAR TO RHINO FIBERCURVE COMPOSITE MARKER POST.
2. MARKERS SHALL BE PLACED AT ALL GATE VALVES, FLUSHING VALVES, & AIR RELEASE VALVES PER ITEM DETAIL.
3. MARKERS SHALL BE PLACED AT WATER METERS AS SPECIFIED ON PLANS
4. PIPELINE MARKERS SHALL BE PLACED ON R.O.W./FENCE LINE AT ALL ROAD CROSSINGS.

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	MARKER DETAILS	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1284	APPROVED	REVISION
			JUNE 2015	NOVEMBER 2019
			SHEET 1 OF 1	



CROSS-SECTION



ISOMETRIC

GENERAL NOTES

1. USE ONLY OPEN GRADED ROCK 4-8 INCH DIAMETER FOR STREAM FLOW CONDITIONS. USE OPEN GRADED ROCK 3-5 INCH DIAMETER FOR OTHER CONDITIONS.
2. THE ROCK BERM SHALL BE SECURED WITH A WOVEN WIRE SHEATHING HAVING MAXIMUM 1 INCH OPENING AND MINIMUM WIRE DIAMETER OF 20 GAUGE.
3. THE ROCK BERM SHALL BE INSPECTED WEEKLY OR AFTER EACH RAIN, AND THE STONE AND/OR FABRIC CORE-WOVEN WIRE SHEATHING SHALL BE REPLACED WHEN THE STRUCTURE CEASES TO FUNCTION AS INTENDED, DUE TO SILT ACCUMULATION AMONG THE ROCKS, WASHOUT, CONSTRUCTION TRAFFIC DAMAGE, ETC.
4. WHEN SILT REACHES A DEPTH EQUAL TO ONE-THIRD THE HEIGHT OF THE BERM OR ONE FOOT, WHICHEVER IS LESS, THE SILT SHALL BE REMOVED AND DISPOSED OF IN APPROVED SITE AND IN A MANNER AS TO NOT CREATE A SILTATION PROBLEM.
5. DAILY INSPECTION SHALL BE MADE ON SEVERE SERVICE ROCK BERMS. SILT SHALL BE REMOVED WHEN ACCUMULATION REACHES 6 INCHES.
6. WHEN THE SITE IS COMPLETELY STABILIZED, THE BERM AND ACCUMULATED SILT SHALL BE REMOVED AND DISPOSED OF IN AN APPROVED MANNER.

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

ROCK BERM DETAILS

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1284

APPROVED	REVISION
JUNE 2015	JUNE 2015

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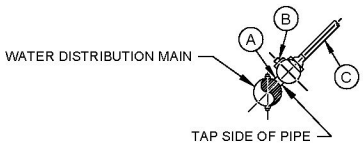
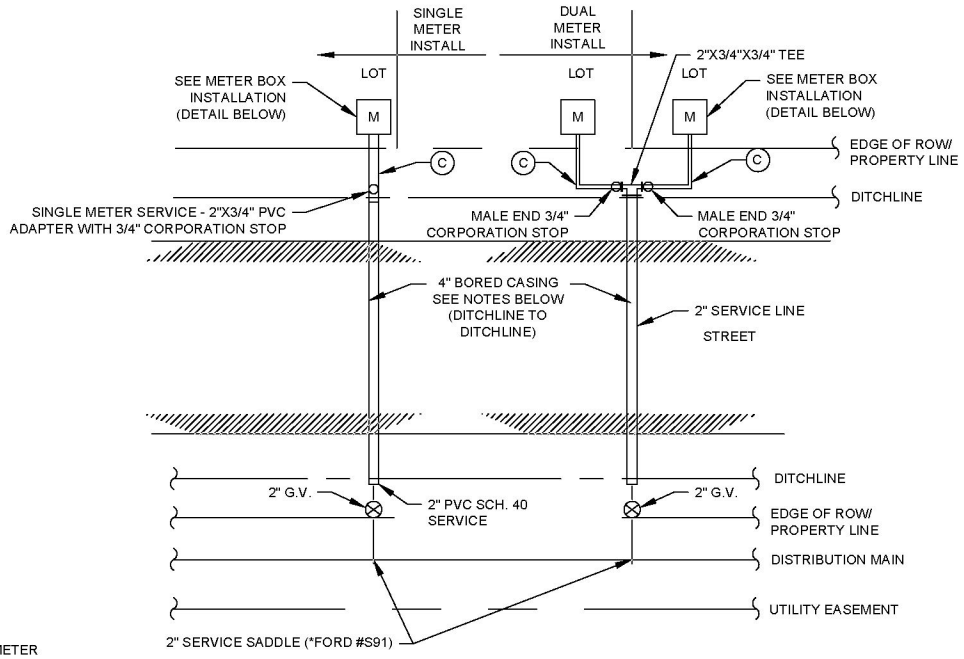


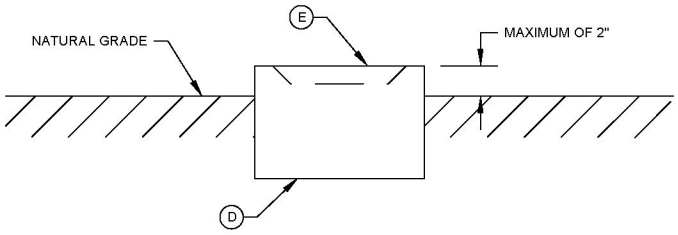
NOTES:
1. FOR SHORT SERVICE CONNECTIONS, THE METER SHALL BE LOCATED 3' AWAY FROM THE DISTRIBUTION MAIN INSIDE PRIVATE PROPERTY BETWEEN THE WATER MAIN AND THE HOUSE OR BUILDING THAT IS BEING SERVED BY THAT METER.

SHORT SERVICE DETAIL



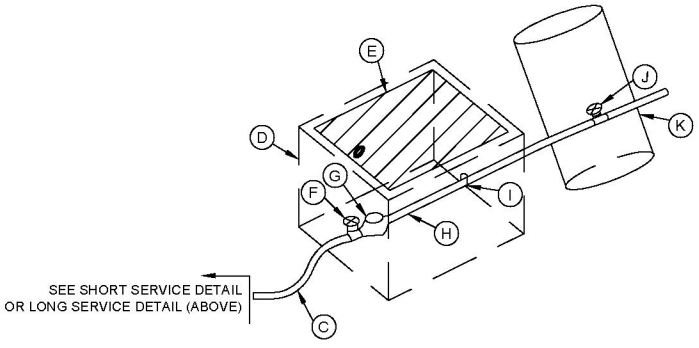
NOTES:
1. STEEL CASING MUST BE USED FOR TXDOT ROADWAYS.
2. HDPE CASING MAY BE USED FOR COUNTY OR RESIDENTIAL ROADWAYS IF APPROVED BY OWNER/ENGINEER.

LONG SERVICE DETAIL



NOTES:
1. METER BOX SHALL BE SET INTO GROUND TO SIT SLIGHTLY ABOVE NATURAL GRADE (NO MORE THAN 2").
2. USE NATIVE TOP SOIL TO BACKFILL TO EDGE OF METER BOX LID. BACKFILL TO NATURAL GRADE.

METER BOX PROFILE



MATERIAL LIST
- A. 3/4" SERVICE SADDLE FORD #S91
- B. 3/4" CORP. STOP (I.P. x COMP) FORD #F-100-3G-NL
- C. 3/4" POLYETHYLENE AWWA, C901-200 PSI
- D. PLASTIC METER BOX, MODEL NO. DFW1300.12.1C OR DFW1600X.12.1C
- E. METER BOX LID, MODEL NO. DFW1200.1C.LID OR DFW1500.1C.LID
- F. 3/4" BALL VALVE (METER CONV. x COMP.) FORD #BA43-332W-G-NL
- G. 5/8"x3/4" WATER METER (BY CCSUD)
- H. 3/4" DUAL CHECK VALVE (METER x I.P.) FORD #HHC31-323 (BY OWNER)
- I. SERVICE LINE (BY OWNER)
- J. CUSTOMER SHUT OFF VALVE (BY OWNER) FORD #644-333-NL
- K. 7-INCH ROUND VALVE BOX WITH REMOVABLE LID (BY OWNER)

*MATERIALS SHALL BE PER THE APPROVED EQUIPMENT LIST (AEL) OR APPROVED EQUIVALENT.

METER BOX INSTALLATION DETAIL

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

SERVICE CONNECTION DETAILS

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

APPROVED	REVISION
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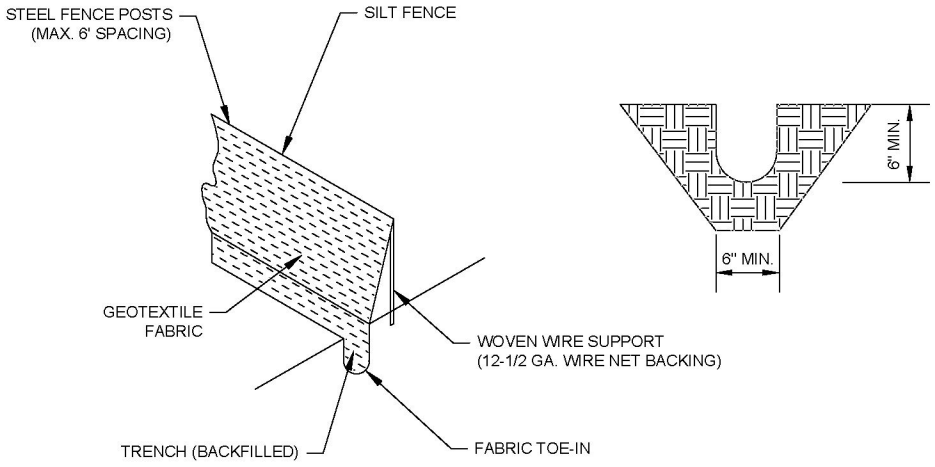
GENERAL NOTES

1. THE INSTALLER SHALL FOLLOW THE REQUIREMENTS FOR TEMPORARY AND PERMANENT EROSION AND SEDIMENTATION CONTROLS, INSPECTION AND MAINTENANCE PROCEDURES LISTED IN THE NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM STORMWATER POLLUTION PREVENTION PLAN.
2. THE INSTALLER AND ALL SUBCONTRACTORS SHALL COMPLETE THE POLLUTION PLAN CERTIFICATION.
3. A COPY OF THE POLLUTION PREVENTION PLAN SHALL BE KEPT AT THE CONSTRUCTION SITE FROM THE TIME CONSTRUCTION BEGINS UNTIL THE SITE IS FINALLY STABILIZED.
4. INSPECTION AND MAINTENANCE FORMS SHALL BE COMPLETED AS REQUIRED IN THE POLLUTION PLAN.
5. THE STORM WATER POLLUTION PREVENTION PLAN AND ALL OTHER RECORDS REQUIRED BY THE PERMIT SHALL BE RETAINED FOR THREE YEARS AFTER COMPLETION OF FINAL SITE STABILIZATION.
6. THE POLLUTION PREVENTION PLAN AND ASSOCIATED RECORDS MUST BE MADE AVAILABLE UPON REQUEST TO THE EPA'S DIRECTOR, OR ANY STATE OR LOCAL AGENCY WHO IS APPROVING EROSION AND SEDIMENTATION CONTROL PLANS AND TO THE OWNER AND ENGINEER.

GENERAL NOTES

1. STEEL POSTS WHICH SUPPORT THE SILT FENCE SHALL BE INSTALLED ON A SLIGHT ANGLE TOWARD THE ANTICIPATED RUNOFF SOURCE. POST MUST BE IMBEDDED A MINIMUM OF ONE FOOT.
2. THE TOE OF THE SILT FENCE SHALL BE TRENCHED IN WITH A SPACE OR MECHANICAL TRENCHER SO THAT THE DOWN SLOPE FACE OF THE TRENCH IS FLAT AND PERPENDICULAR TO THE LINE OF FLOW. WHERE FENCE CANNOT BE TRENCHED IN (E.G. PAVEMENT). WEIGHT FABRIC FLAP WITH WASHED GRAVEL ON UPHILL SIDE TO PREVENT FLOW UNDER FENCE.
3. THE TRENCH MUST BE A MINIMUM OF 6 INCHES WIDE TO ALLOW FOR THE SILT FENCE FABRIC TO BE LAID IN THE GROUND AND BACKFILLED WITH COMPACTED MATERIAL.
4. SILT FENCE SHOULD BE SECURELY FASTENED TO EACH STEEL SUPPORT POST OR TO WOVEN WIRE, WHICH IS IN TURN ATTACHED TO THE STEEL FENCE POST.
5. INSPECTION SHALL BE MADE WEEKLY OR AFTER EACH RAINFALL EVENT AND REPAIR OR REPLACEMENT SHALL BE MADE PROMPTLY AS NEEDED.
6. SILT FENCE SHALL BE REMOVED WHEN THE SITE IS COMPLETELY STABILIZED SO AS NOT TO BLOCK OR IMPEDE STORM FLOW OR DRAINAGE.
7. ACCUMULATED SILT SHALL BE REMOVED WHEN IT REACHES A DEPTH OF 6 INCHES. THE SILT SHALL BE DISPOSED OF IN AN APPROVED SITE AND IN SUCH A MANNER AS NOT TO CONTRIBUTE TO ADDITIONAL SILTATION.



NOT TO SCALE

SILT FENCE DETAIL
N.T.S.

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

SILT FENCE DETAILS

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1284

APPROVED	REVISION
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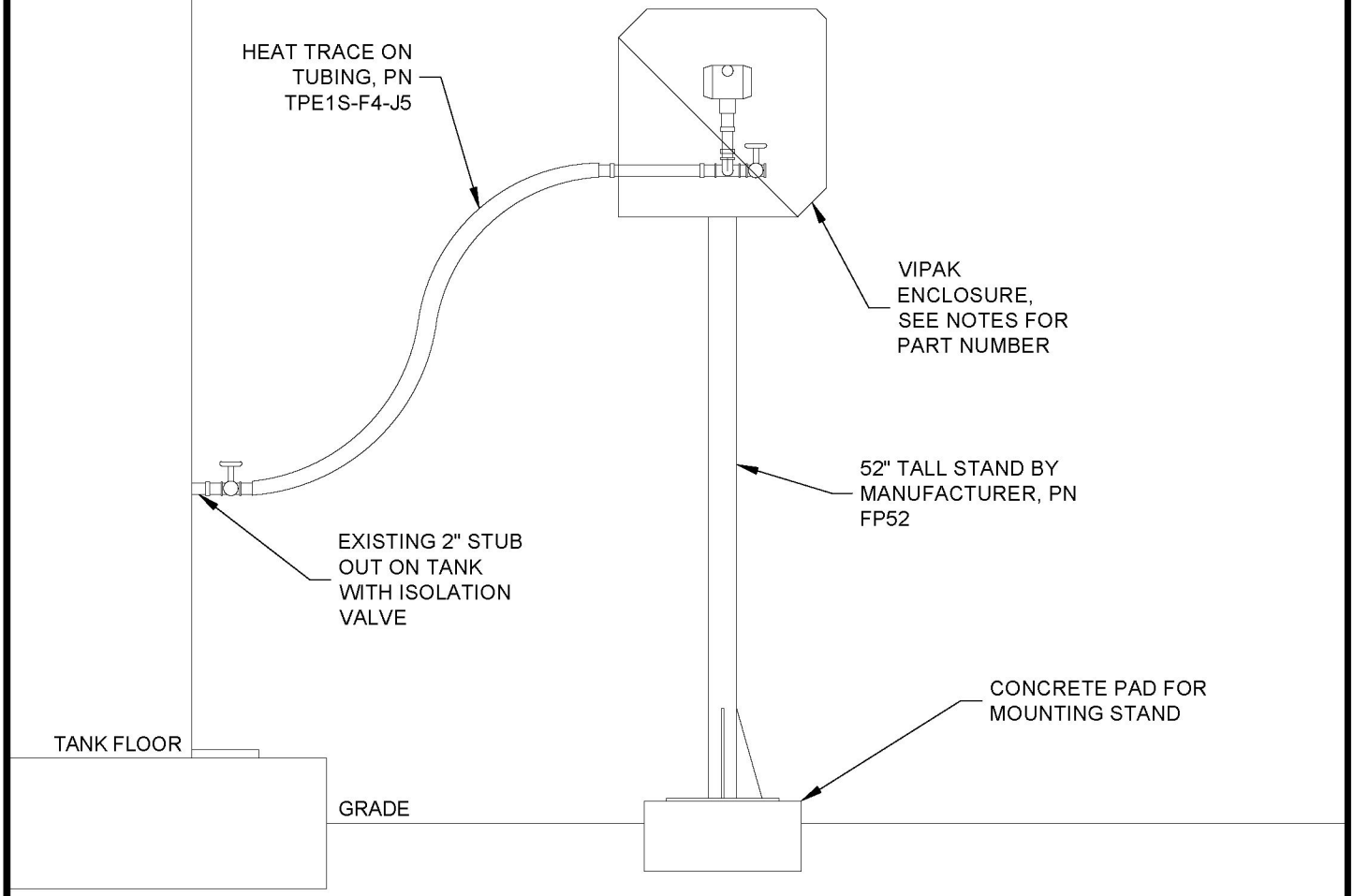
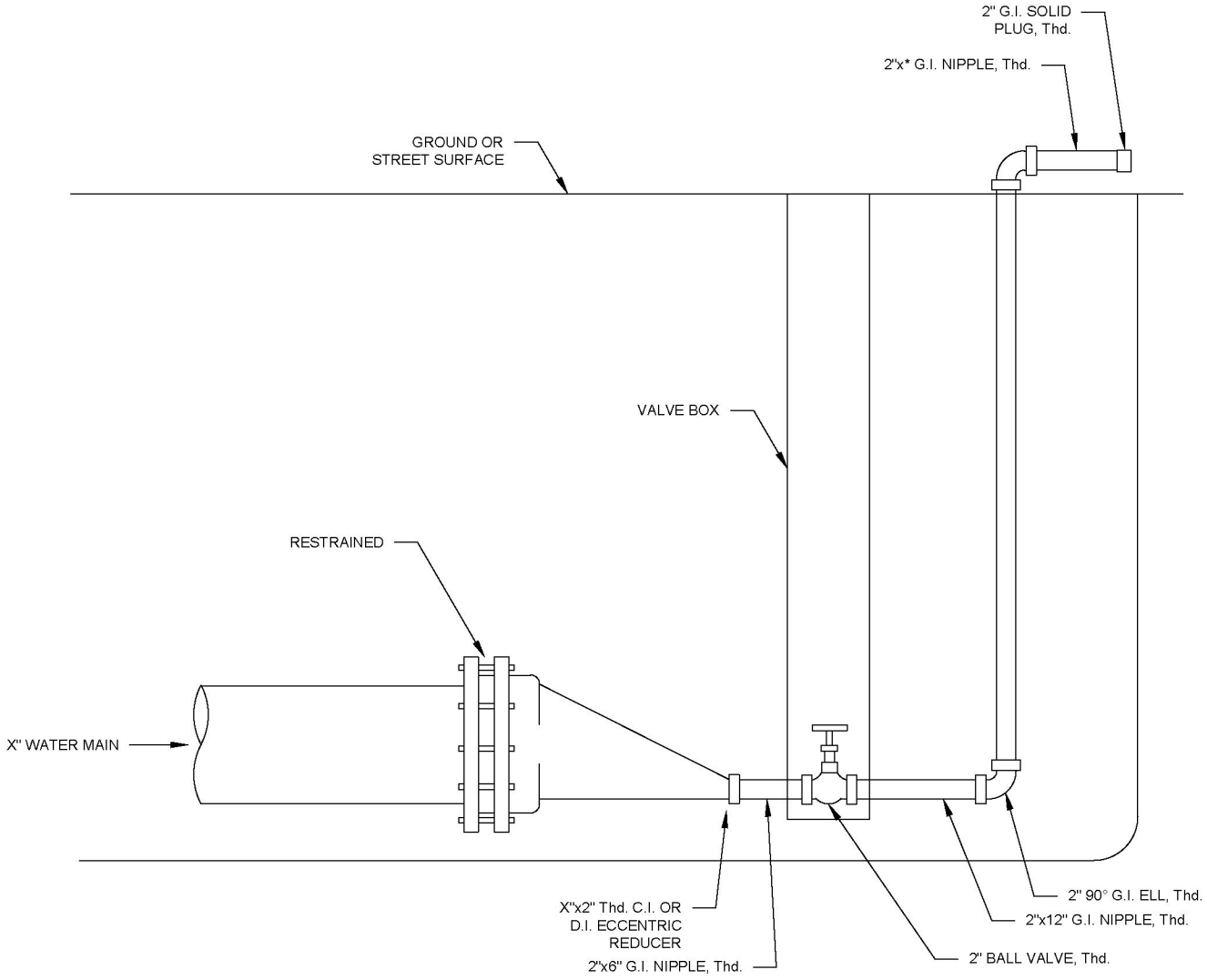


NOTE:

1. VIPAK ENCLOSURE BY OBRIEN. P/N: A1T-MK1-TS3110D2CJS9H-Y-IPK1-ES4S-W1U

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	TANK TRANSMITTER ENCLOSURE DETAIL	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1394	APPROVED	REVISION
			SEPT 2021	
			SHEET 1 OF 1	

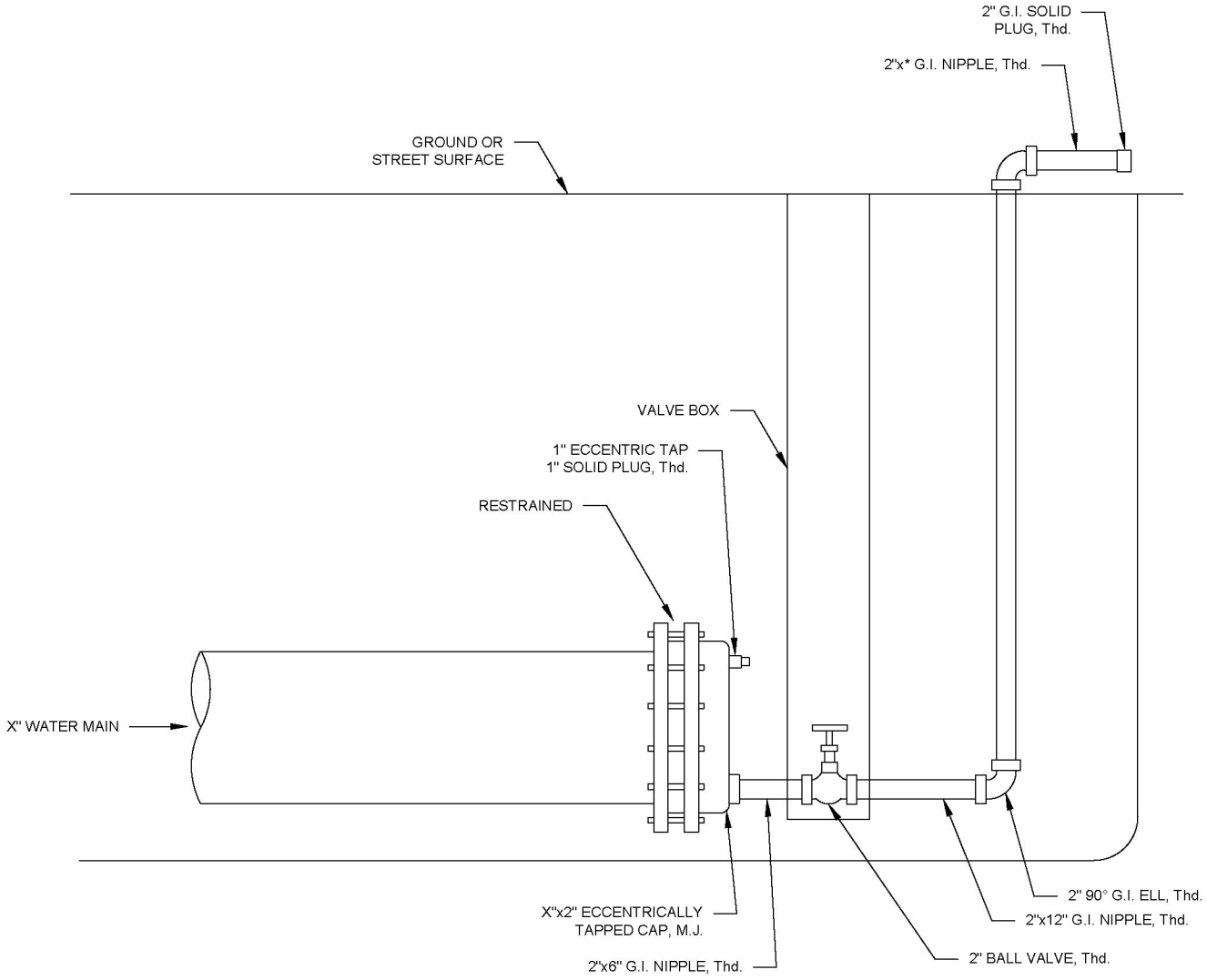


NOTE:

1. BURIED PIPING, FITTINGS, AND FITTING JOINTS SHALL BE WRAPPED IN POLYWRAP.
2. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
3. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
4. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF A POLY TAPE.

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	TEMPORARY FLUSH VALVE 8 INCH OR SMALLER	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1364	APPROVED: OCTOBER 2020 / REVISION: DECEMBER 2020
			SHEET 1 OF 1



NOTE:

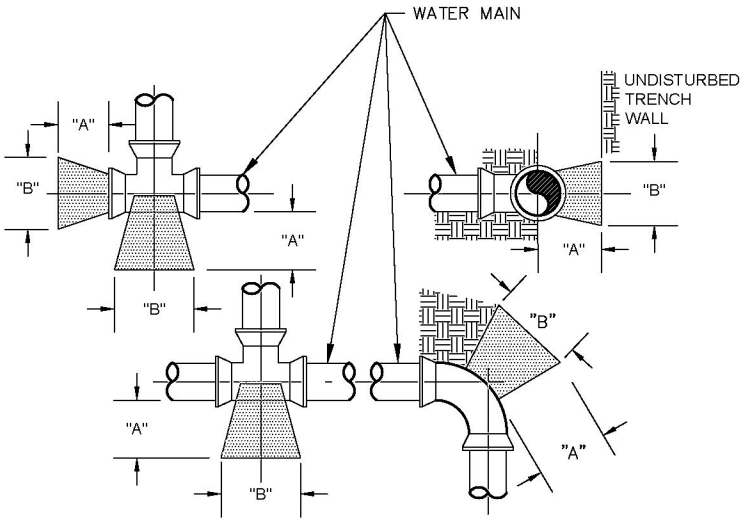
1. BURIED PIPING, FITTINGS, AND FITTINGS JOINTS SHALL BE WRAPPED IN POLYWRAP.
2. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
3. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
4. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	TEMPORARY FLUSH VALVE 12 INCH OR LARGER	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1364	APPROVED: OCTOBER 2020 / REVISION: DECEMBER 2020
			SHEET 1 OF 1

PIPE SIZE	DIMENSION "B" (SQUARE)				
	PLUGS & TEES	90° BENDS	45° BENDS	22 1/2° BENDS	VALVES
4"&6"	1'-3"	1'-6"	1'-0"	9"	1'-3"
8"	1'-9"	2'-0"	1'-6"	1'-0"	1'-6"
10"	2'-10"	2'-0"	1'-9"	1'-3"	2'-0"
12"	2'-6"	3'-0"	2'-3"	1'-6"	2'-3"
16"	3'-3"	4'-0"	2'-9"	2'-0"	2'-9"
20"	3'-9"	4'-6"	3'-3"	2'-3"	3'-3"

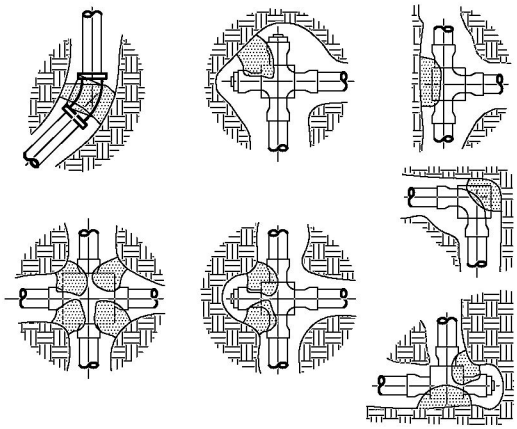
DIMENSION "A" SHALL BE A MINIMUM OF 1'-0" BUT IS TO BE INCREASED WHERE NECESSARY TO PROVIDE BEARING AGAINST UNDISTURBED TRENCH WALL.



THRUST BLOCK DIMENSIONING

NOTES:

1. THE EARTHBEARING SURFACE SHALL BE THE UNDISTURBED TRENCH WALL.
2. ALL PIPE JOINTS SHALL BE KEPT FREE FROM CONCRETE.
3. ALL THRUST BLOCKS SHALL CONTAIN A MINIMUM OF 1 1/2 CUBIC YARDS OF CONCRETE.
4. CONCRETE SHALL BE 2000 P.S.I. AT 28 DAYS MINIMUM.
5. ALL FITTINGS AND FITTING JOINTS MUST BE WRAPPED W/ POLYWRAP. POLYWRAP SHALL BE SECURED WITH A MINIMUM OF THREE CIRCUMFERENTIAL TURNS OF POLY TAPE.
6. 12"x12"x4" THICK CONCRETE BLOCKS SHALL BE INSTALLED DIRECTLY UNDER ALL VALVES, FITTINGS, ETC.



THRUST BLOCK ANCHORING DETAIL

NOT TO SCALE

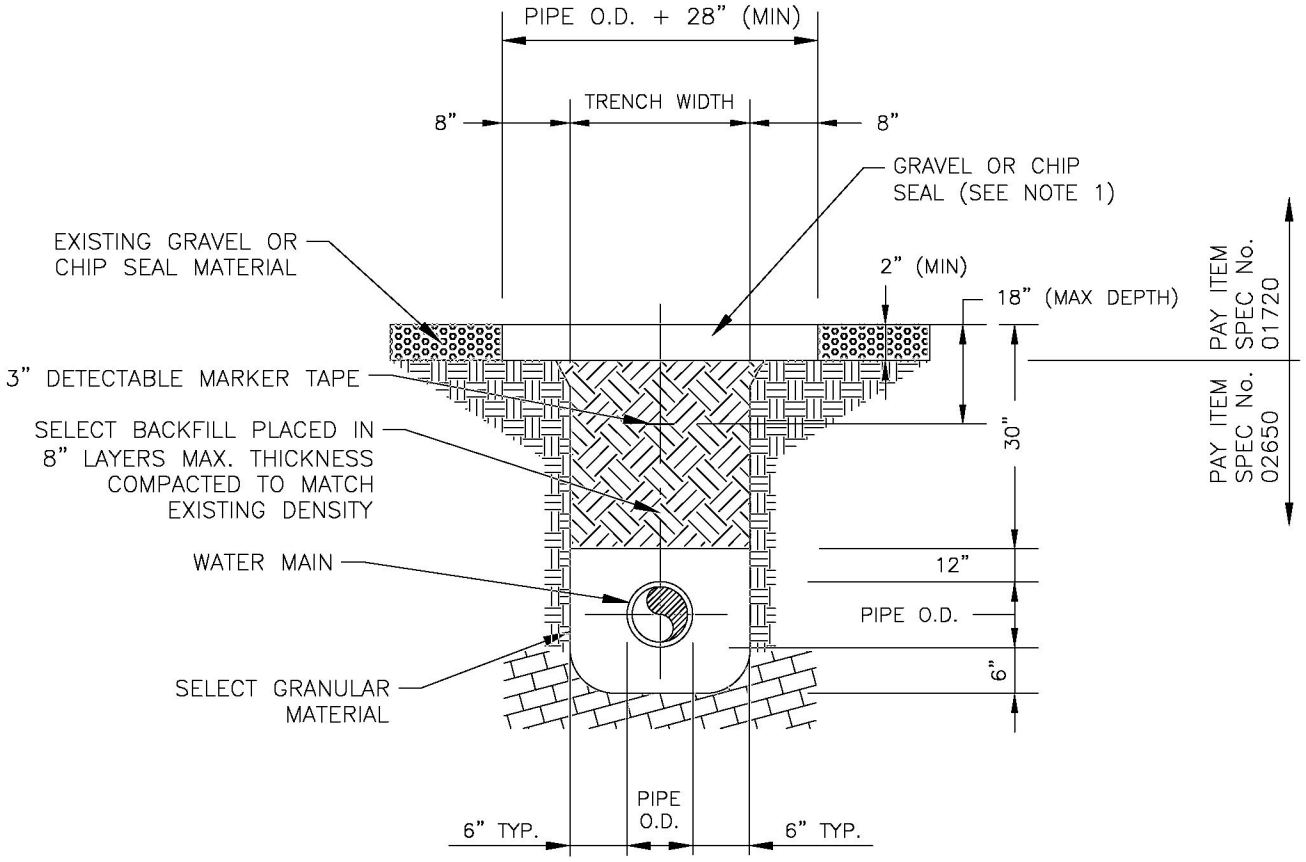
PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

THRUST BLOCK ANCHORING DETAILS

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	DECEMBER 2020

SHEET
1 OF 1



NOTES

1. GRAVEL OR CHIP SEAL (MATCH EXISTING PAVEMENT TYPE) SHALL BE A MINIMUM OF 2" THICK.
2. ROAD BASE AND SURFACE MATERIALS IN THE TRENCH CUT SHALL BE REPLACED IN KIND, OF EQUAL THICKNESS

TRENCHING NOTES

1. ADEQUATE BARRICADES & WARNING SIGNS SHALL BE ERECTED BEFORE ANY WORK IS STARTED IN PUBLIC RIGHT-OF-WAY.
2. THE DRIVEWAY SHALL BE CUT ONLY WHERE REQUIRED BY THE ENGINEER.
3. DRIVEWAY SHALL REMAIN ACCESSIBLE AT ALL TIMES.
4. REFER TO SPECIFICATIONS FOR ANY SPECIAL REQUIREMENTS OR CONDITIONS
5. BACKFILL SHALL BE COMPLETED IMMEDIATELY AFTER PIPELINE LAYING WITHIN PRIVATE DRIVEWAYS.

TRENCH SAFETY NOTES

1. TRENCH SAFETY SYSTEM, SHORING OR SIDE SLOPE TO BE IN ACCORDANCE WITH OSHA STANDARDS.
2. TRENCH SAFETY SYSTEM PLAN TO BE PROVIDED BY CONTRACTOR PRIOR TO CONSTRUCTION.
3. ALL EXCAVATION GREATER THAN 5' DEEP SHALL MEET TRENCH SAFETY NOTE.

NOT TO SCALE

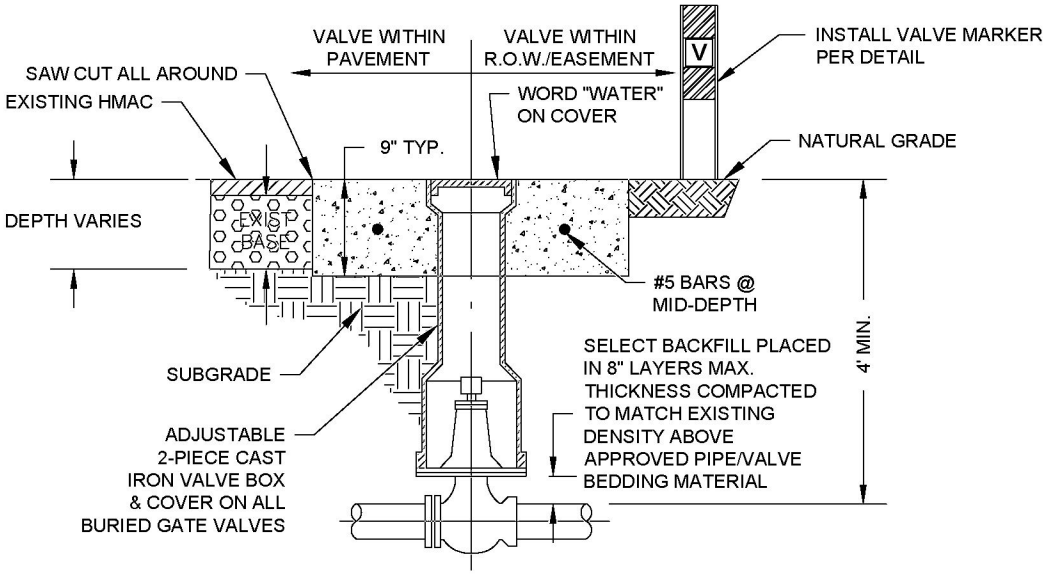
PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

TYPICAL GRAVEL/CHIP SEAL DRIVEWAY REPAIR DETAIL

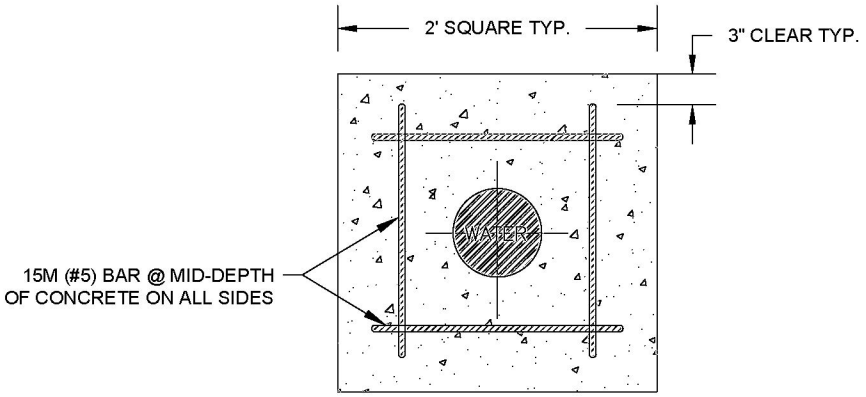
M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1394

APPROVED	REVISION
JULY 2019	

SHEET 1 OF 1



PROFILE



PLAN

NOTES:

1. VALVE BOXES SHALL BE FITTED WITH PLASTIC VALVE ID TAGS (BLUE EMEDCO 3-1/2" X 2-3/4") INDICATING OWNER (CCSUD) VALVE SIZE, YEAR OF INSTALLATION AND # OF TURNS TO OPEN.
2. SUBGRADE SHALL BE COMPACTED AS PER SPECIFICATIONS
3. VALVE CASTINGS SHALL BE ADJUSTED TO GRADE AFTER FINAL LIFT OF OVERLAY IS IN PLACE.
4. CLEAN VALVE BOX OF ALL DEBRIS DOWN TO THE BASE OF THE VALVE.
5. REMOVE EXISTING RISER PIPE DOWN 18" AND REPLACE TO THE NEW ELEVATION USING NEW PIPE AND A COLLAR CASTING.
6. WHEN CAST IRON CASTINGS TO BE REMOVED REQUIRE EXCAVATION GREATER THAN 20" DEEP, CONTRACTOR MAY ELECT TO FILL EXCAVATION WITH CONTROLLED LOW STRENGTH MATERIAL TO THE UNDERSIDE OF THE CONCRETE. PAVEMENT PATCH IN LIEU OF COMPACTED BACKFILL.
7. REINFORCING STEEL SHALL MEET SPECIFICATIONS.
8. VALVE BOXES MUST BE INSTALLED IN A STRAIGHT, VERTICAL POSITION.
9. VALVE MARKERS SHALL BE INSTALLED BEHIND EACH VALVE BOX WHEN VALVE IS LOCATED WITHIN EASEMENT OR R.O.W.

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

TYPICAL IRON VALVE BOX DETAILS

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	AUGUST 2018

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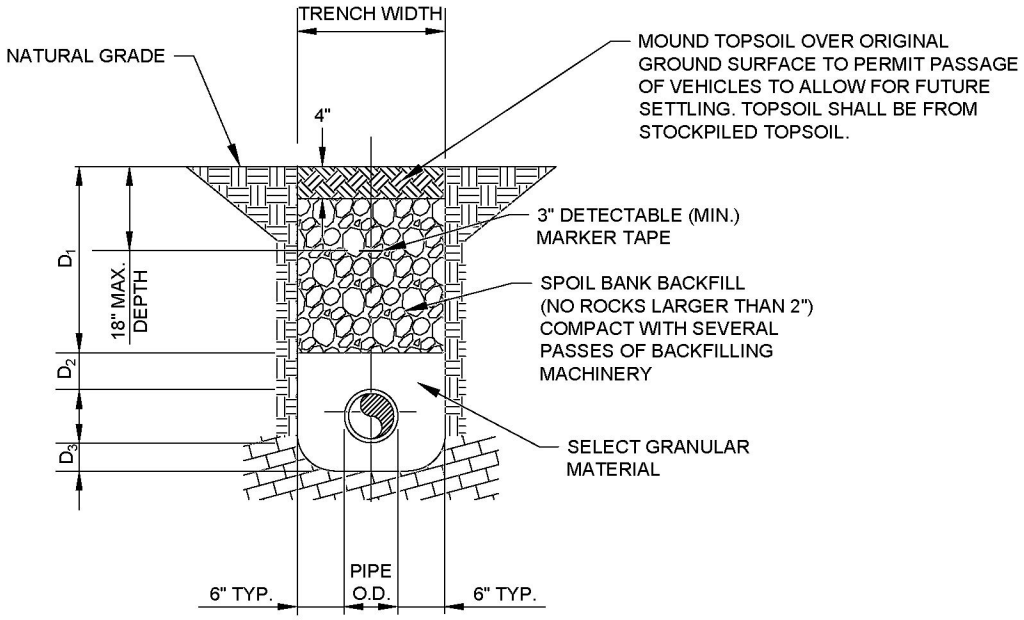
1 OF 1



	D_1	D_2	D_3
4" OR SMALLER	36"	6"	4"
6"-8"	30"	12"	6"
12" OR LARGER	42"	12"	6"

TRENCHING NOTES

1. ADEQUATE BARRICADES & WARNING SIGNS SHALL BE ERECTED BEFORE ANY WORK IS STARTED IN PUBLIC RIGHT-OF-WAY.
2. REFER TO SPECIFICATIONS FOR ANY SPECIAL REQUIREMENTS OR CONDITIONS.
3. BACKFILL SHALL BE COMPLETED IMMEDIATELY AFTER PIPELINE LAYING WITHIN PUBLIC RIGHT-OF-WAYS OR CROSSING PUBLIC RIGHT-OF-WAYS & PRIVATE DRIVEWAYS.

TRENCH SAFETY NOTES

1. TRENCH SAFETY SYSTEM, SHORING OR SIDE SLOPE TO BE IN ACCORDANCE WITH OSHA STANDARDS.
2. TRENCH SAFETY SYSTEM PLAN TO BE PROVIDED BY CONTRACTOR PRIOR TO CONSTRUCTION.

NOT TO SCALE

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

TYPICAL TRENCH BACKFILL DETAIL

M&S ENGINEERING
CIVIL | ELECTRICAL | STRUCTURAL | MEP
TEXAS REGISTERED ENGINEERING FIRM F-1384

APPROVED	REVISION
JUNE 2015	NOV 2021

SHEET
1 OF 1

Date: Aug 19, 2021, 10:25am User ID: kvogler
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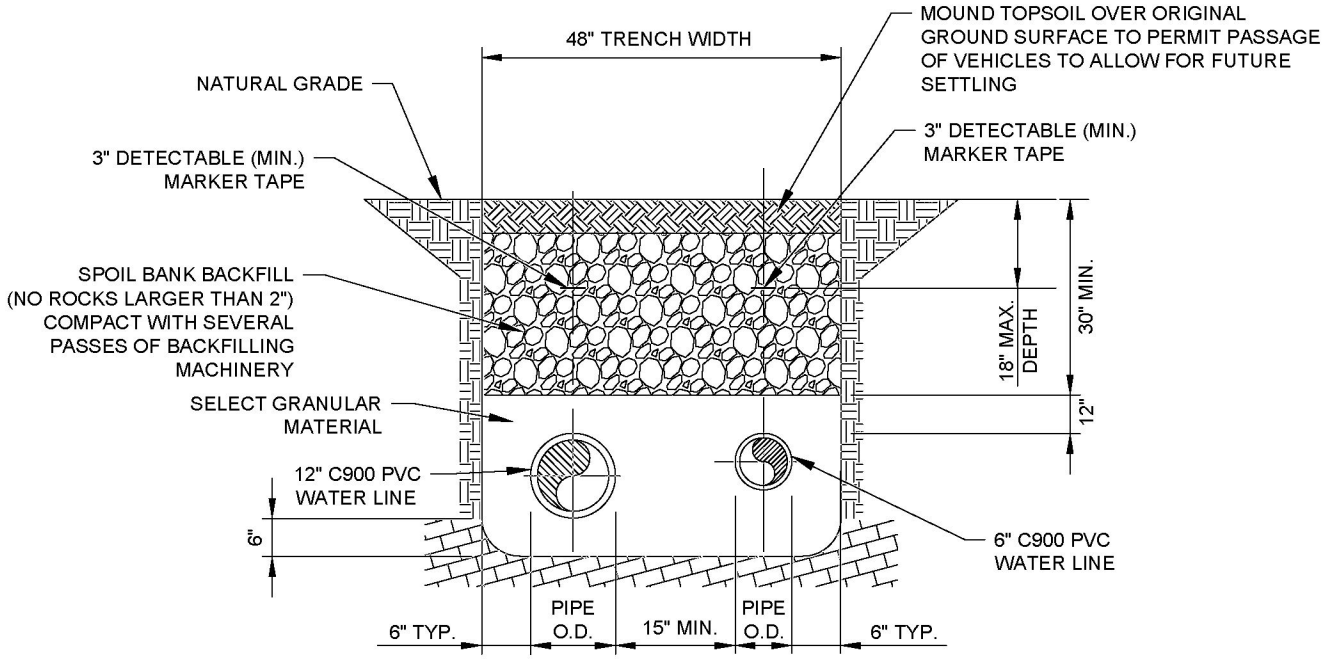


TRENCHING NOTES

1. ADEQUATE BARRICADES & WARNING SIGNS SHALL BE ERECTED BEFORE ANY WORK IS STARTED IN PUBLIC RIGHT-OF-WAY.
2. REFER TO SPECIFICATIONS FOR ANY SPECIAL REQUIREMENTS OR CONDITIONS
3. BACKFILL SHALL BE COMPLETED IMMEDIATELY AFTER PIPELINE LAYING WITHIN PUBLIC RIGHT-OF-WAYS OR CROSSING PUBLIC RIGHT-OF-WAYS & PRIVATE DRIVEWAYS.

TRENCH SAFETY NOTES

1. TRENCH SAFETY SYSTEM, SHORING OR SIDE SLOPE TO BE IN ACCORDANCE WITH OSHA STANDARDS.
2. TRENCH SAFETY SYSTEM PLAN TO BE PROVIDED BY CONTRACTOR PRIOR TO CONSTRUCTION.

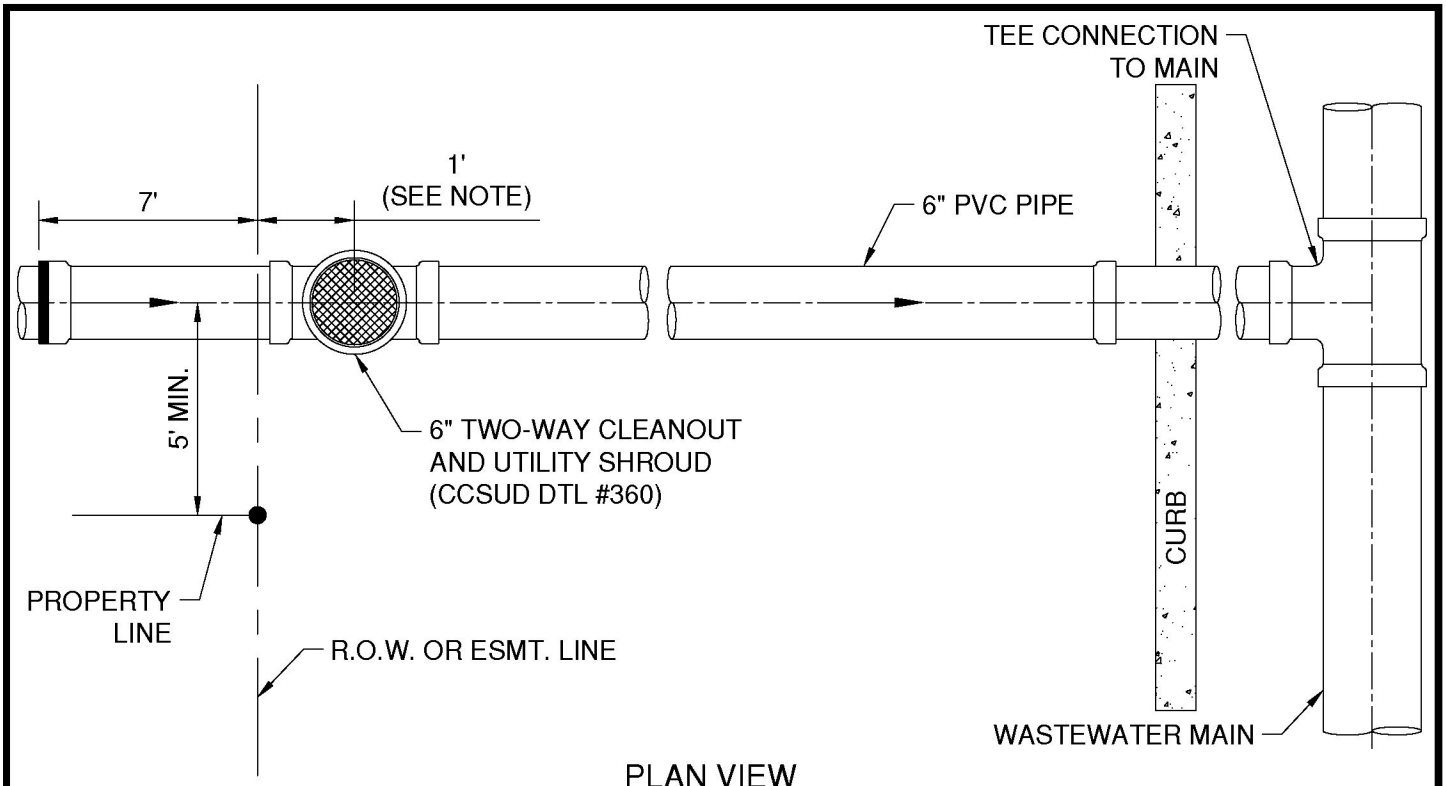
NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	TYPICAL TRENCH BACKFILL DOUBLE PIPE WATER LINES DETAIL	M&S ENGINEERING CIVIL | ELECTRICAL | STRUCTURAL | MEP TEXAS REGISTERED ENGINEERING FIRM F-1394	APPROVED: JUNE 2015 / REVISION: APRIL 2019
			SHEET 1 OF 1

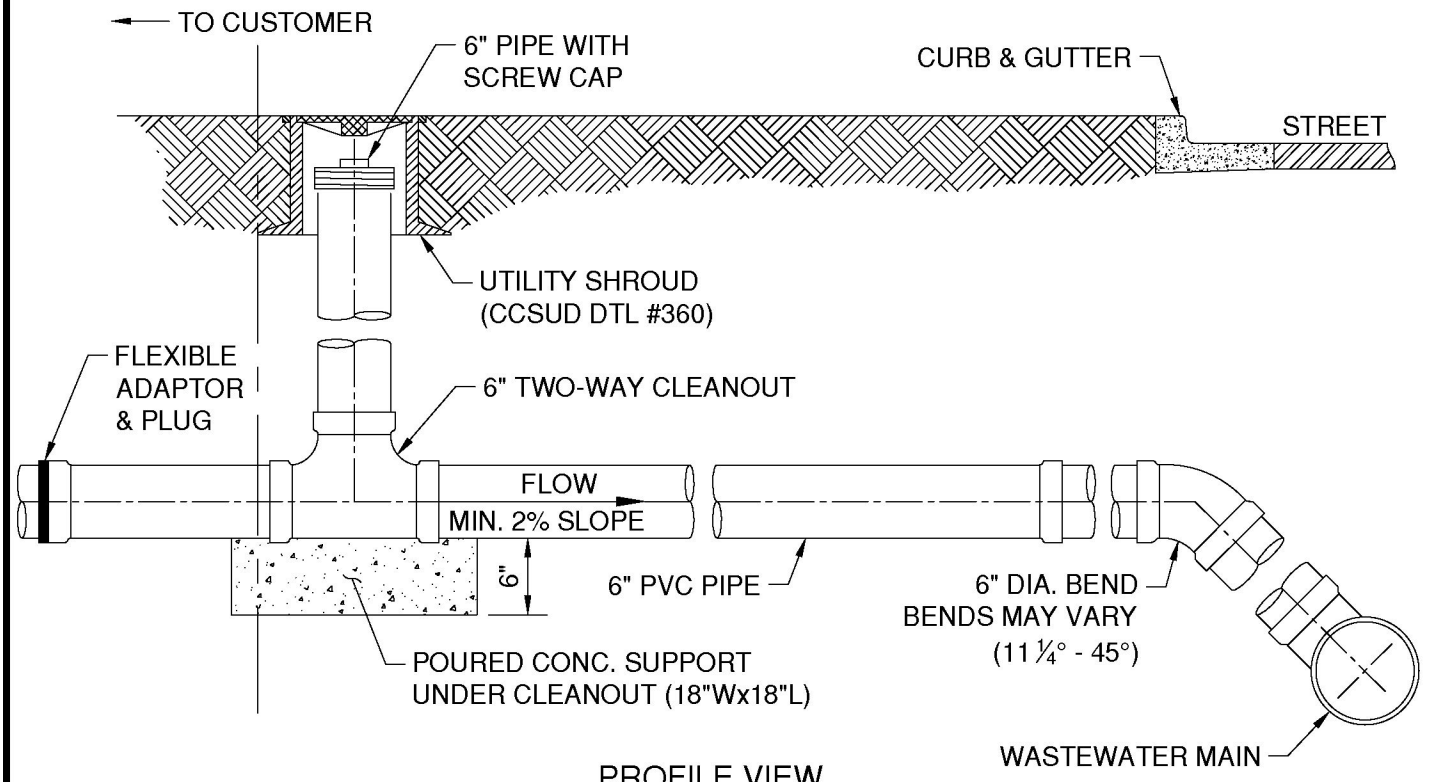
CRYSTAL CLEAR
SPECIAL UTILITY DISTRICT

WASTEWATER DETAILS

DTL-302 Single WW Service Connection
DTL-304 WW Sampling Site 5-foot and Under
DTL-305 Control or Mini Manhole
DTL-306 WW Cleanout Adjustment to Grade in Driveways
DTL-307 Security Post Sewer Monitor Equipment
DTL-310 Concrete Encasement
DTL-320 Manhole Plan
DTL-322 New Manhole Construction and Minor MH Adjustment
DTL-324 WW Manhole w Drop Inlet on CIP Base
DTL-325 WW Manhole w Drop Inlet on Precast Base
DTL-327 WW Manhole on CIP Foundation
DTL-328 WW Manhole on Precast Base
DTL-329 MH Ring and Encasement
DTL-331 SS Manhole Cover
DTL-334 Vented SS Manhole Cover
DTL-335 Shallow MH-Precast or Mono Top Slab and Chart
DTL-340 Abandoned Manhole
DTL-350 Deflection Testing Mandrel
DTL-360 Utility Shroud Sewer Cleanout Assembly



PLAN VIEW



PROFILE VIEW

*CLEANOUT SHALL NOT BE PLACED WITHIN SIDEWALK OR DRIVEWAY. IF SIDEWALK EXISTS AT EDGE OF PROPERTY LINE, CLEANOUT CAN BE LOCATED UP TO 1' WITHIN PROPERTY. CONSISTENT PLACEMENT IS REQUIRED.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #302 SINGLE WASTEWATER SERVICE CONNECTION DETAIL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 2

NOTES:

1. CONTRACTOR, DURING SUBDIVISION CONSTRUCTION, SHALL INSTALL WASTEWATER CONNECTION TO MAIN, 6" STUB WITH 6" SERVICE BRANCH WITH 2-WAY CLEANOUT, CONCRETE SUPPORT (MIN. 18"Wx18"Lx6"H), RISER FOR CLEAN OUT (CAPPED), UTILITY SHROUD, 7' EXTENSION, AND PLUG. ALL WASTEWATER PIPING SHALL HAVE ELASTOMERIC GASKET TYPE JOINTS AND SHALL SLOPE DOWNWARD TO MAIN 2%, 1/4" PER FOOT, MINIMUM TO 45° MAXIMUM. DEPTH OF SERVICE STUB AT PROPERTY LINE WILL BE SHOWN ON PLANS BY ENGINEER OR DESIGNATED REPRESENTATIVE IF GREATER THAN 4', OTHERWISE, THE INSTALLED DEPTH WILL TYPICALLY BE 4' TO 6'. IF WASTEWATER SERVICE LINE TO MAIN REQUIRES DEFLECTION EXCEEDING 45°, REFER TO DETAIL DRAWING 301. ALL INSTALLATIONS SHALL BE MADE IN ACCORDANCE WITH INFORMATION SHOWN ON APPLICABLE STANDARD DRAWINGS AND WILL BE INSPECTED BY CCSUD CONSTRUCTION INSPECTION PERSONNEL.

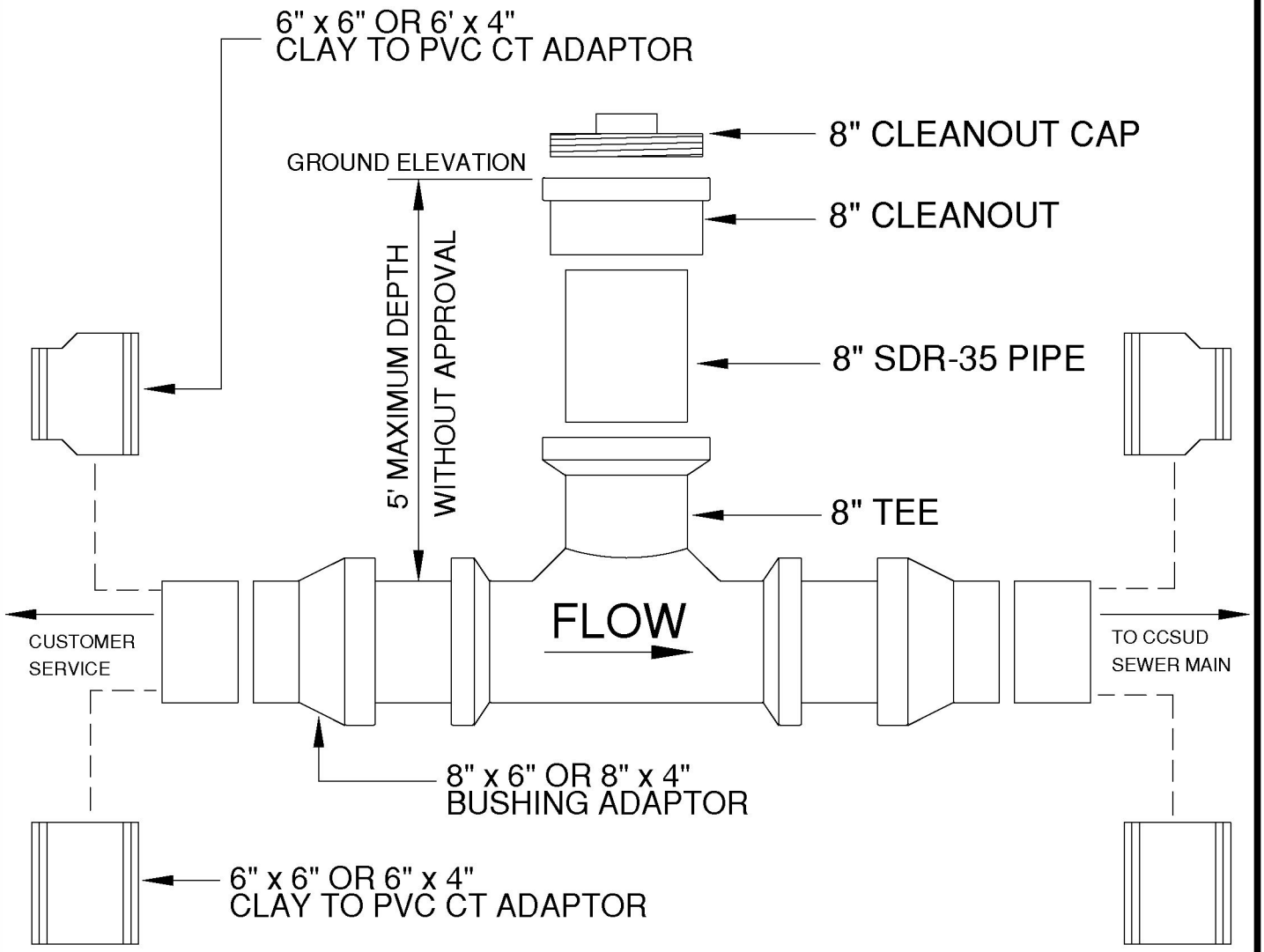
2. CUSTOMER SHALL REMOVE PLUG, INSTALL 4" WASTEWATER LINE [EXTEND 4" PIPE 6" MINIMUM INTO 6" PIPE AND JOINT WITH FLEXIBLE ADAPTOR]. IF WASTEWATER WILL NOT SATISFACTORILY FLOW BY GRAVITY TO SEWER MAIN ADJACENT TO PROPERTY, PUMP EQUIPMENT MUST BE PROVIDED BY THE CUSTOMER AS PART OF CUSTOMER'S WASTEWATER SYSTEM.

3. CUSTOMER IS RESPONSIBLE FOR PIPING SYSTEM UNTIL WASTEWATER IS CONNECTED. ANY MISSING OR DAMAGED PARTS SHALL BE REINSTALLED BY CUSTOMER WHO SHALL GUARANTEE, FOR A PERIOD OF TWO (2) YEARS FROM DATE OF FINAL ACCEPTANCE, THAT CONNECTIONS TO CCSUD SYSTEMS ARE FREE FROM DEFECTS IN WORKMANSHIP OR MATERIALS. CUSTOMER ALSO HAS THE RESPONSIBILITY TO ASSURE THAT 2-WAY CLEANOUTS REMAIN CLEAR OF SIDEWALKS AND OTHER OBSTRUCTIONS.

4. CCSUD'S ACTIVITY IS LIMITED TO INSPECTION OF CONNECTIONS TO THE WASTEWATER SYSTEM. FOR MAINTENANCE PURPOSES, CCSUD'S RESPONSIBILITY ENDS AT THE CUSTOMER'S WASTEWATER CONNECTION TO THE 2-WAY CLEANOUT OR THE PROPERTY LINE, WHICHEVER IS CLOSER TO WASTEWATER MAIN.

5. PIPING IN STREET RIGHT-OF-WAY AND IN EASEMENT AREA SHALL BE BEDDED IN GRANULAR MATERIALS AS REQUIRED BY CCSUD STANDARD SPECIFICATION; MATERIALS SHALL BE AS SPECIFIED; BACKFILL ABOVE THE GRANULAR BEDDING. SERVICE LINES IN THESE AREAS SHALL HAVE A MINIMUM COVER BELOW FINAL STREET GRADE OF 42"; ANY EXCEPTION MUST BE SPECIFICALLY APPROVED BY THE ENGINEER.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #302 SINGLE WASTEWATER SERVICE CONNECTION DETAIL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 2 OF 2



PROPERTY OF
CRYSTAL CLEAR
SPECIAL UTILITY DISTRICT

DTL #304

WASTEWATER SAMPLING SITE FOR SERVICE 5' AND UNDER IN DEPTH (FROM GROUND ELEV.)

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

APPROVED	REVISION
	04/30/03

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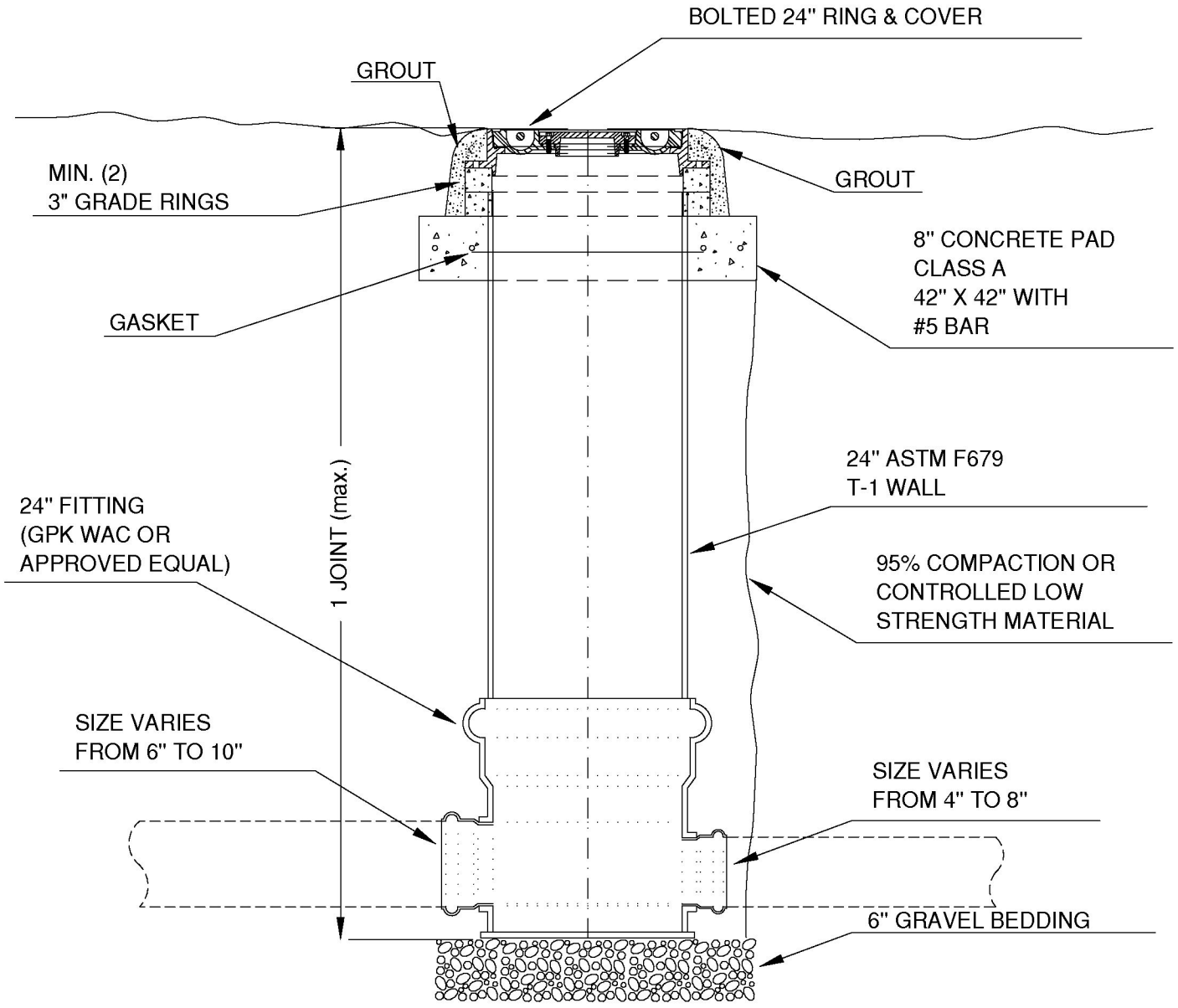
1 OF 1

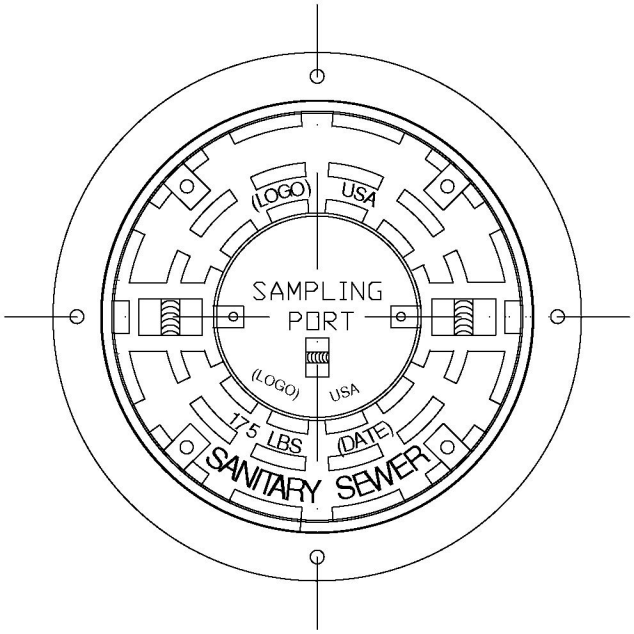
DISTRICT SIDE

OWNER SIDE

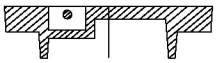


PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #305 CONTROL OR MINI MANHOLE	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: REVISION: 04/16/03 SHEET 1 OF 2

BOLTED 24" RING & COVER



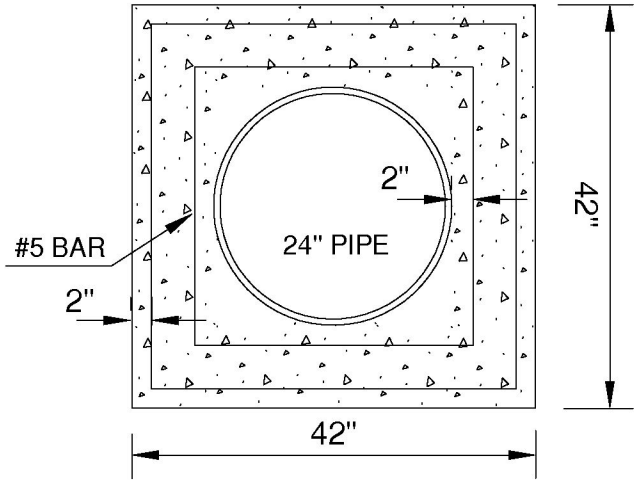
SAMPLING PORT COVER



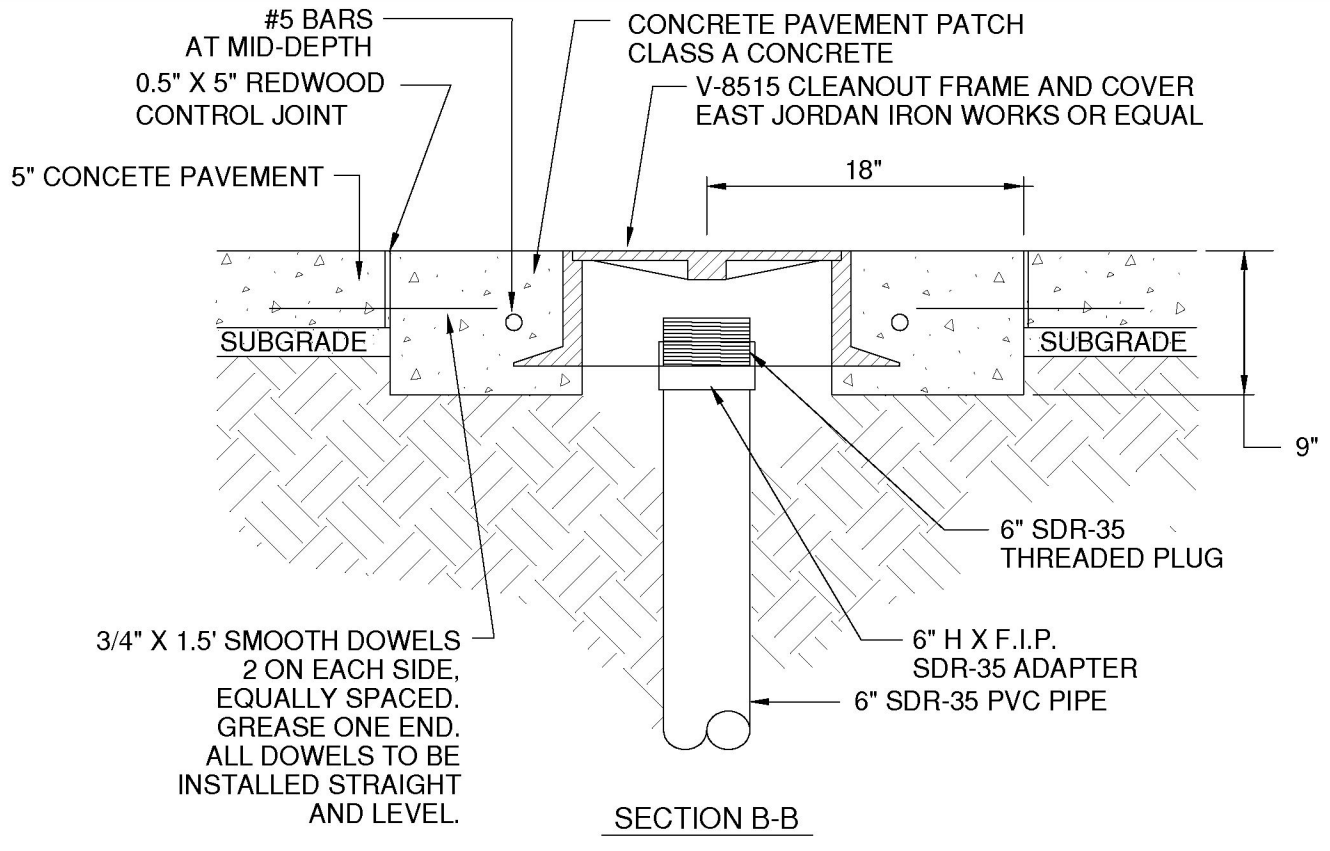
NOTE:

48" CONCRETE MANHOLE WITH 24" SAMPLING PORT LID MAY BE USED IN PLACE OF THIS CONTROL MANHOLE.

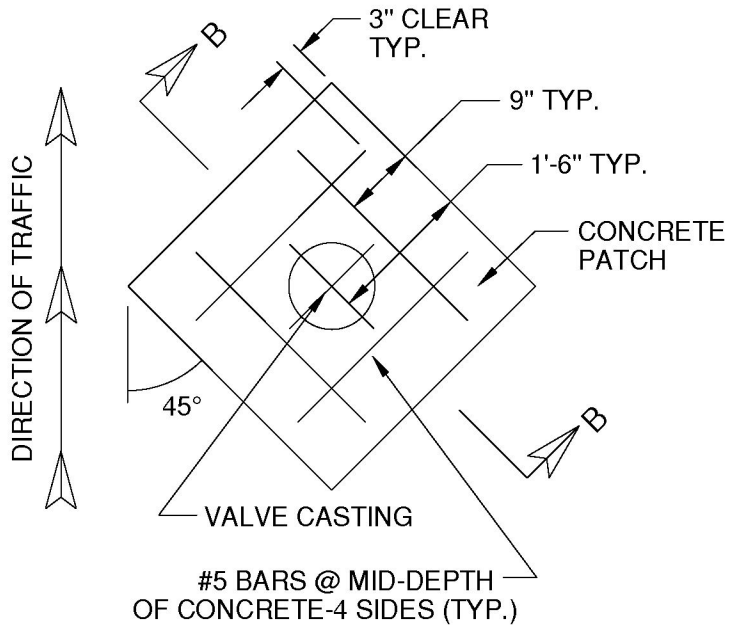
42" X 42" CONCRETE PAD



PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #305 CONTROL OR MINI MANHOLE	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 04/16/03 | REVISION: SHEET 2 OF 2



SECTION B-B

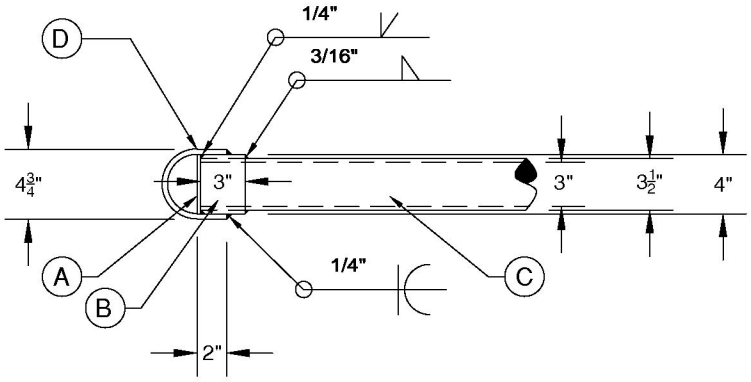


PLAN VIEW

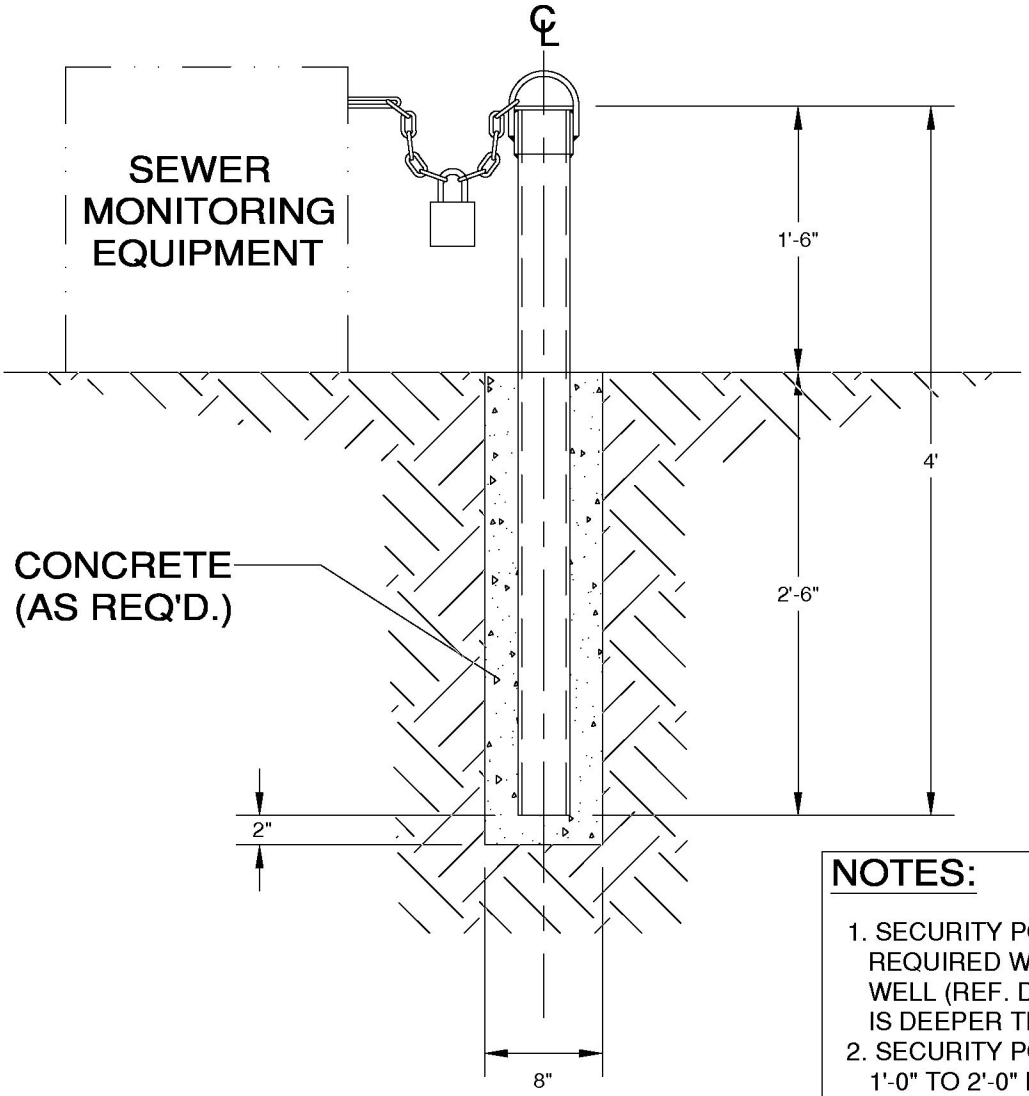
NOTES:

1. SERVICES SHOULD BE DESIGNED TO AVOID ALIGNMENT WITH DRIVEWAYS.
2. SUBGRADE SHALL BE COMPACTED AS PER, SUBGRADE PREPARATION.
3. FRAME SHALL BE ADJUSTED TO GRADE AFTER FINAL LIFT OF OVERLAY IS IN PLACE.
4. REINFORCING STEEL SHALL MEET, REINFORCING STEEL.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #306 WASTEWATER CLEANOUT ADJUSTMENT TO GRADE IN DRIVEWAYS	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: REVISION: 04/15/03 SHEET 1 OF 1



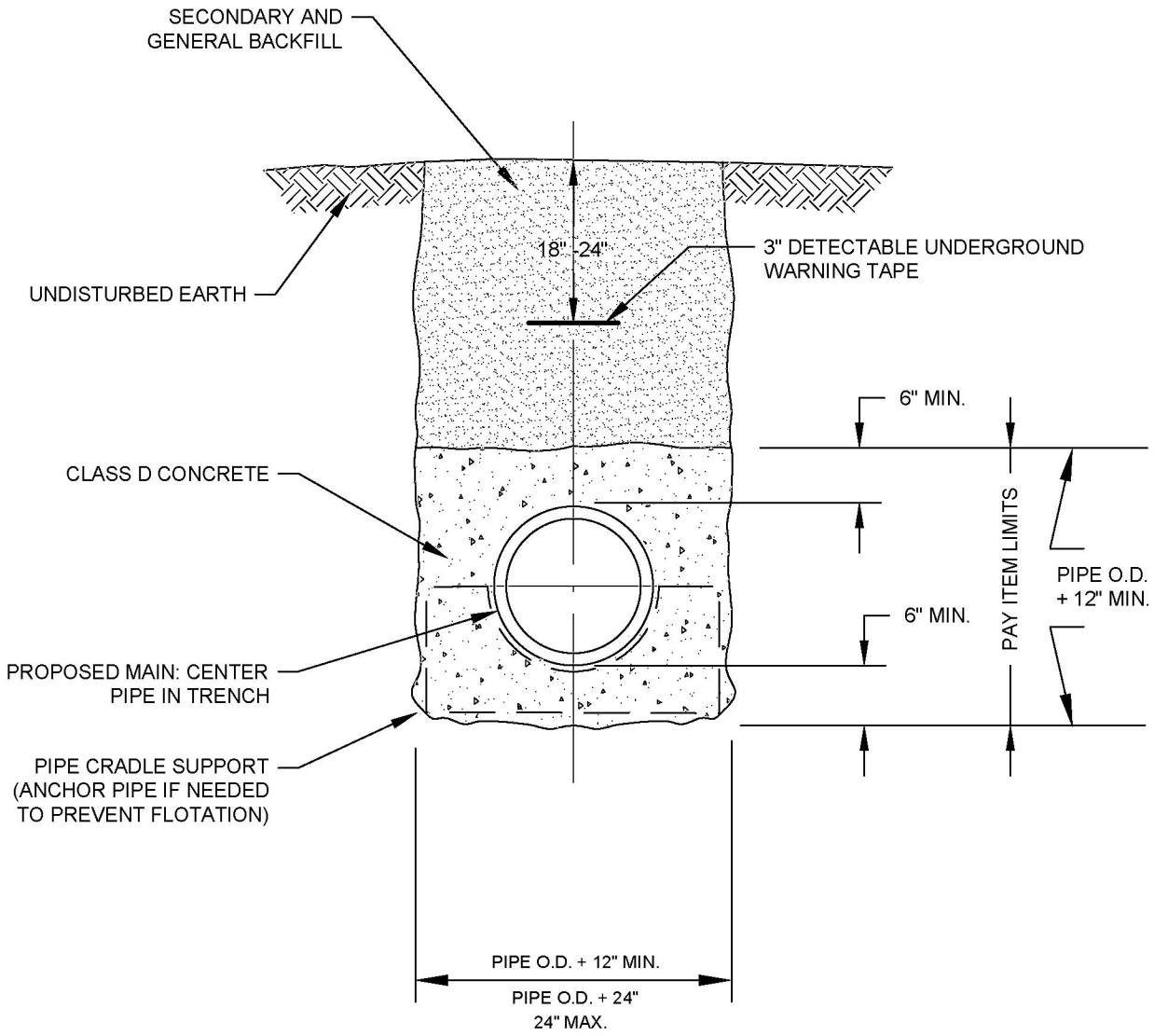
DETIAL A (1 EA.) 1/4" X 4" DIA. STEEL PLATE
DETIAL B (1 EA.) 4" O.D. X 3 5/8" I.D. X 3" LENGTH STD. GALV. PIPE
DETIAL C (1 EA.) 3 1/2" O.D. X 3" I.D. X 3'-11 3/4" LENGTH STD. GALV. PIPE
DETIAL D (1 EA.) 3/8" X 12" STEEL ROD



NOTES:

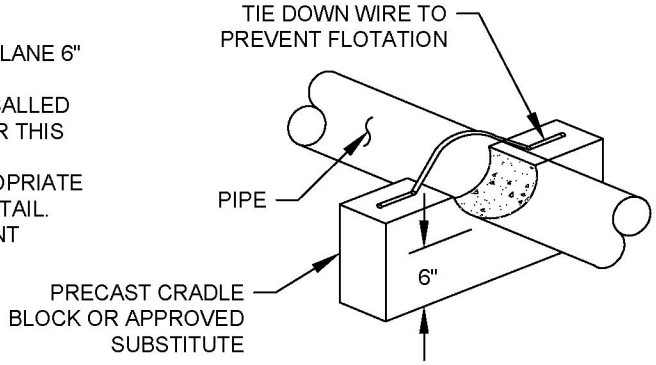
1. SECURITY POST WILL BE REQUIRED WHERE SAMPLING WELL (REF. DWG. 304) IS DEEPER THAN 5'-0"
2. SECURITY POST TO BE LOCATED 1'-0" TO 2'-0" FROM SAMPLING WELL

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #307 SECURITY POST FOR SEWER MONITORING EQUIPMENT	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: REVISION: 04/16/03 SHEET 1 OF 1



CONCRETE ENCASEMENT

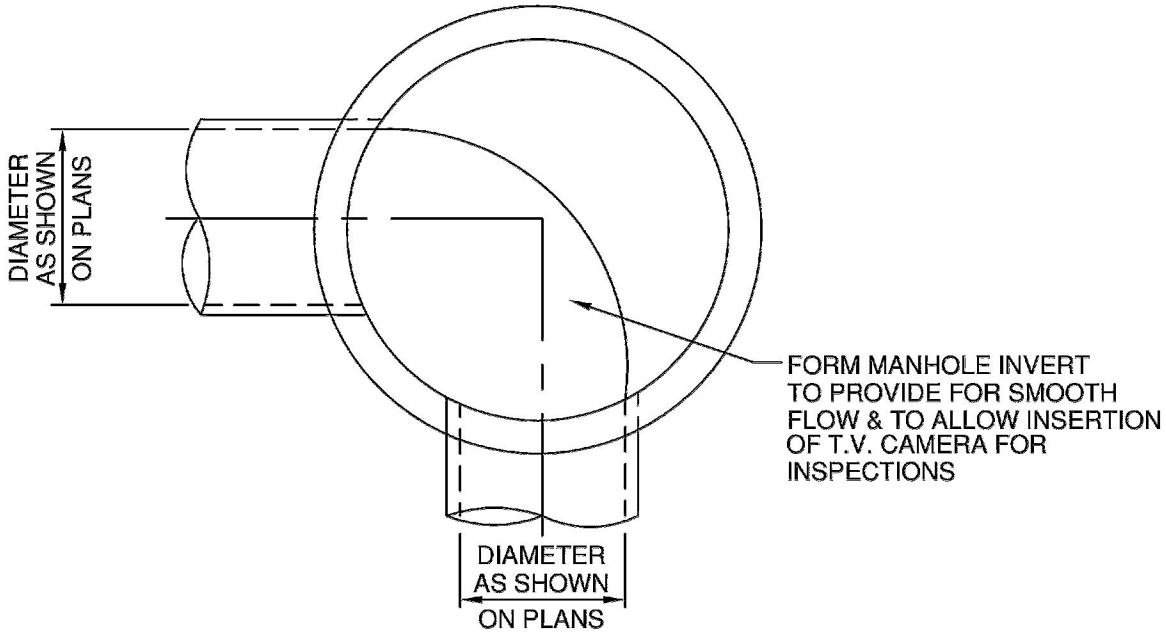
NOTES:
1. ALL CONCRETE ENCASEMENT SHALL BE POURED AT A PLANE 6" ABOVE THE PIPE BETWEEN EXCAVATED TRENCH WALL.
2. CONCRETE ENCASEMENT WILL BE USED ONLY WHERE CALLED OUT IN THE PLANS AND LIMITS OF PAYMENT WILL BE PER THIS DETAIL.
3. BACKFILL AND RESTORATION WORK WILL BE PER APPROPRIATE TRENCH DETAIL WITH EMBEDMENT FOLLOWING THIS DETAIL.
4. SUPPORTS ARE SUBSIDIARY TO CONCRETE ENCASEMENT



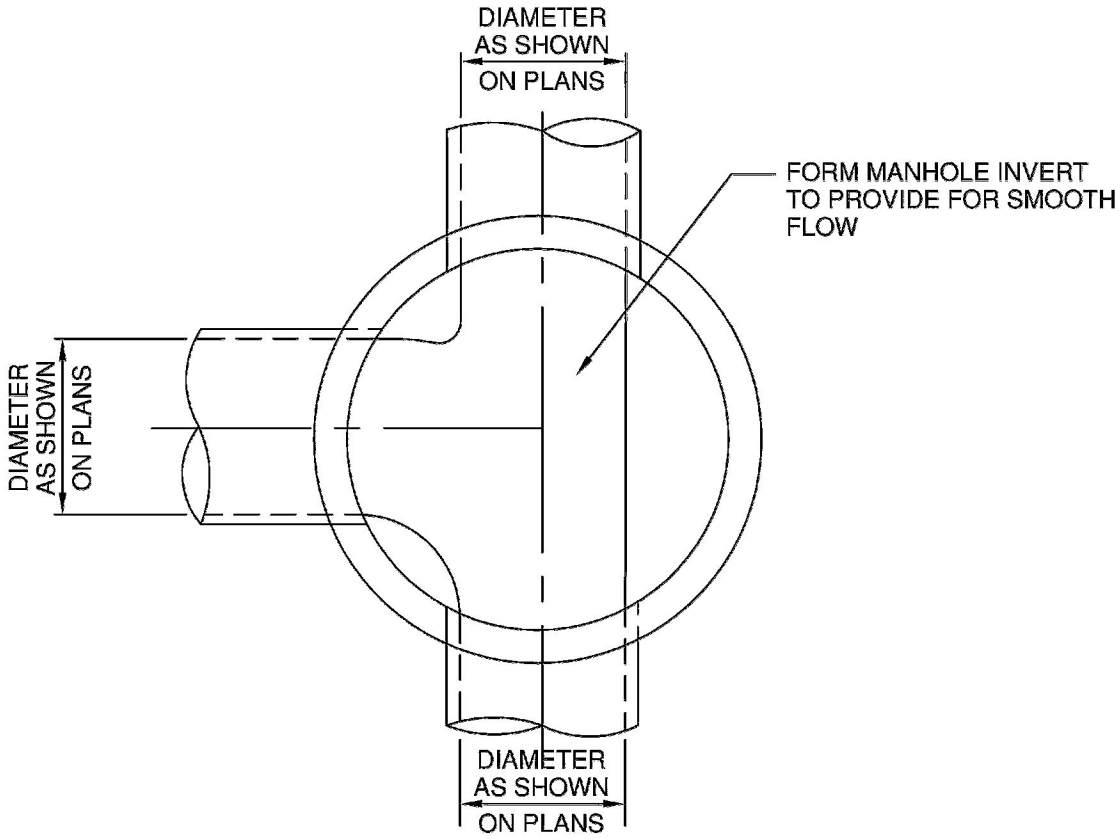
PIPE CRADLE SUPPORT

NOT TO SCALE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #310 CONCRETE ENCASEMENT	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED | REVISION FEB 2022 SHEET 1 OF 1



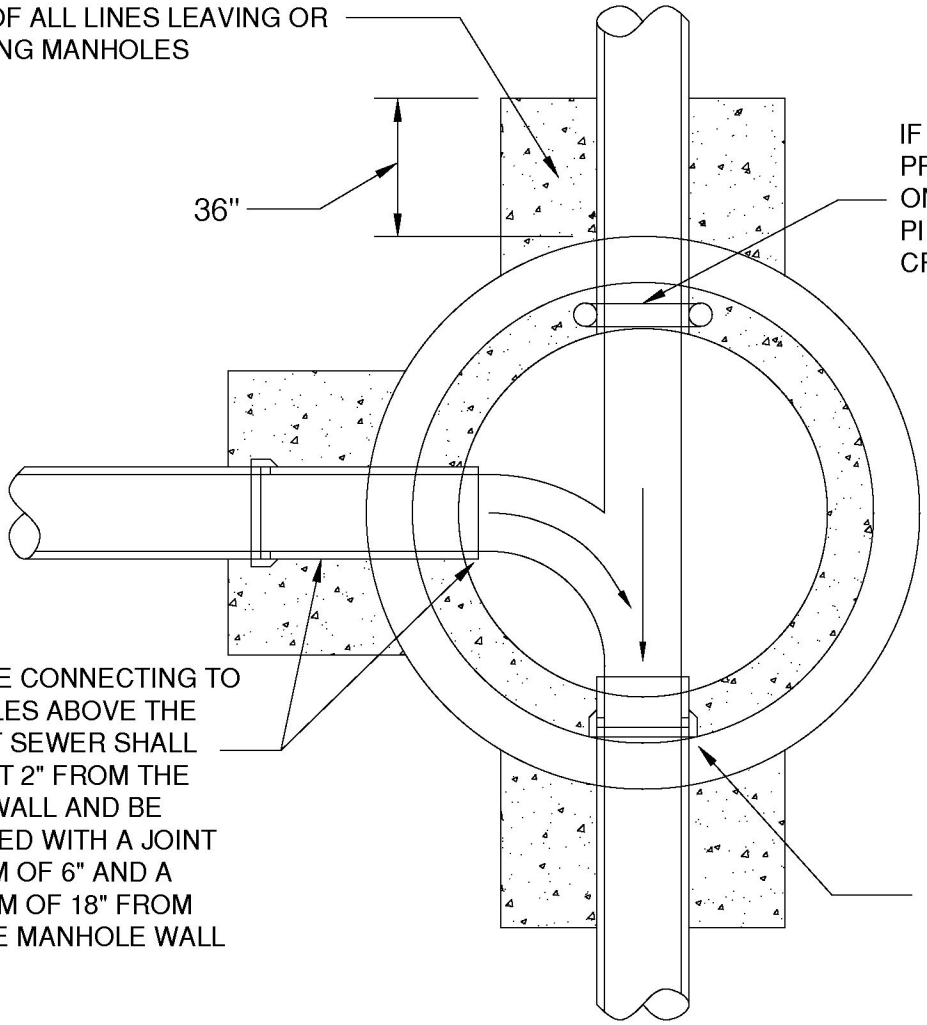
TYPICAL MANHOLE AT ANGLE IN SEWER



TYPICAL JUNCTION MANHOLE

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #320 MANHOLE INVERT PLAN	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED	REVISION 04/16/03
			SHEET 1 OF 2	

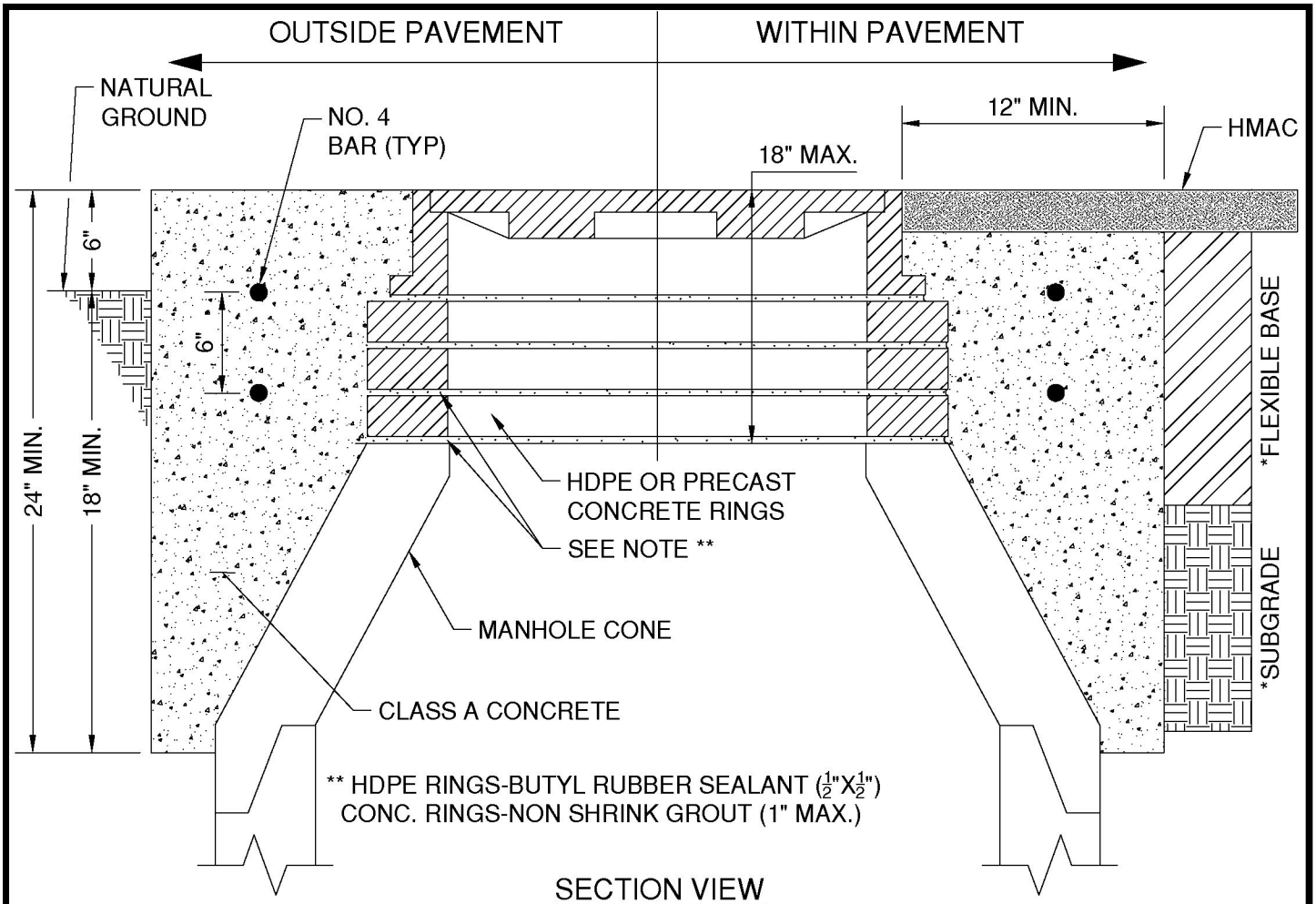
STANDARD MANHOLE



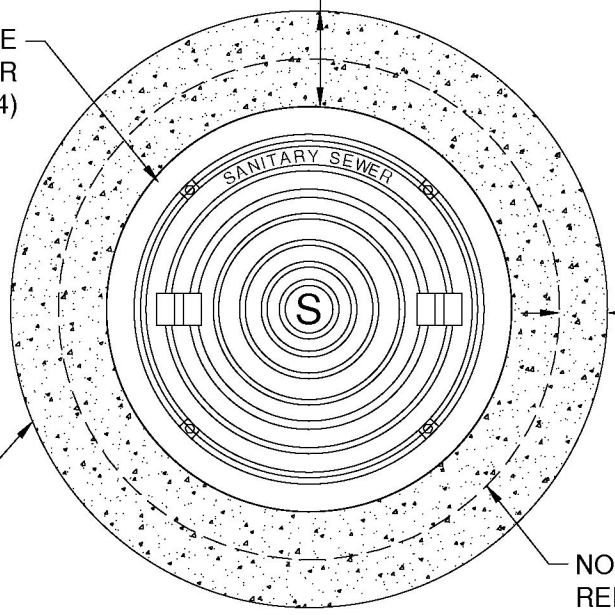
MANHOLE FLOOR PLAN

AUGUST 1998

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #320 STANDARD MANHOLE MANHOLE FLOOR PLAN	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: REVISION: 05/05/03 SHEET 2 OF 2



SECTION VIEW



TYPICAL CCSUD MANHOLE RING AND 32" COVER (CCSUD DTL #331 OR #334)

*SUBGRADE AND BASE MATERIALS SHALL BE COMPACTED ACCORDING TO CCSUD STANDARD SPECIFICATIONS

MANHOLE ENCASEMENT REQUIRED ON ALL MANHOLES

NO. 4 REINFORCING BAR

TOP VIEW

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #322 NEW MANHOLE CONSTRUCTION AND MINOR MANHOLE ADJUSTMENT	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1

Date: Feb 15, 2022, 1:46pm User ID: kvogler
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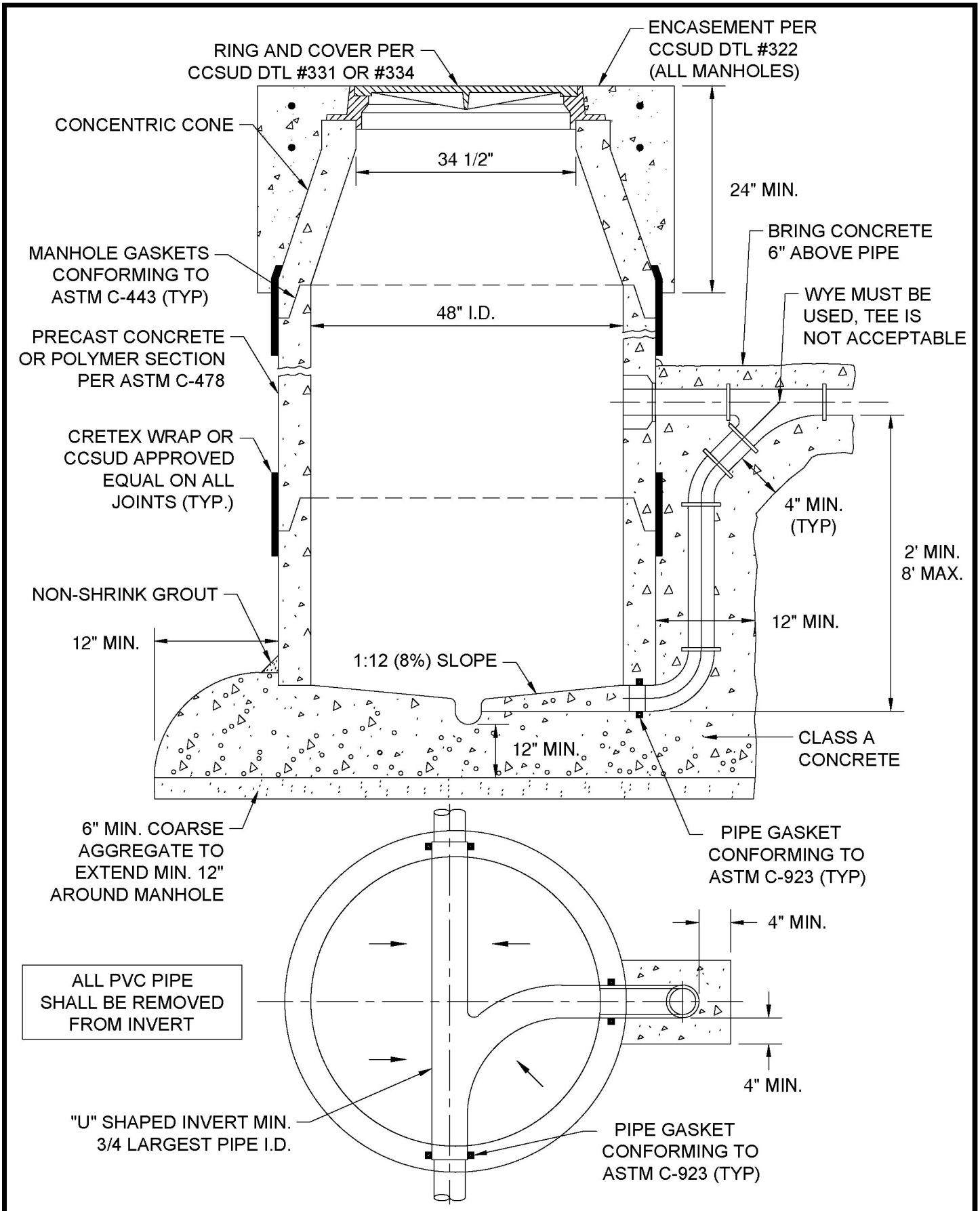

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

DTL #324

WASTEWATER MANHOLE W/ DROP INLET ON CAST IN PLACE BASE

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

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08/17/21	

SHEET
1 OF 1

Date: Feb 15, 2022, 1:48pm User ID: kvogler
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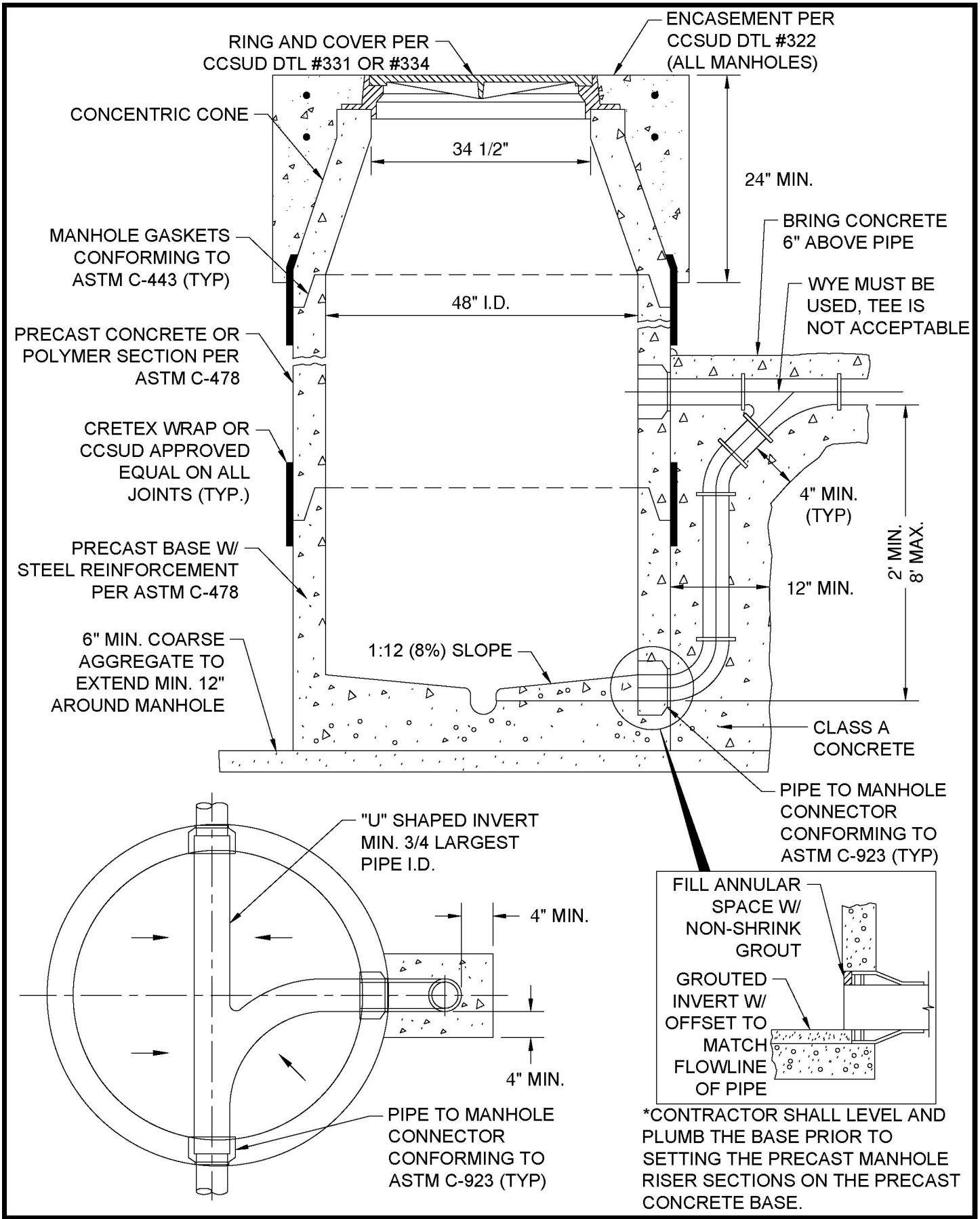

*CONTRACTOR SHALL LEVEL AND PLUMB THE BASE PRIOR TO SETTING THE PRECAST MANHOLE RISER SECTIONS ON THE PRECAST CONCRETE BASE.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #325 WASTEWATER MANHOLE W/ DROP INLET ON PRECAST BASE	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1

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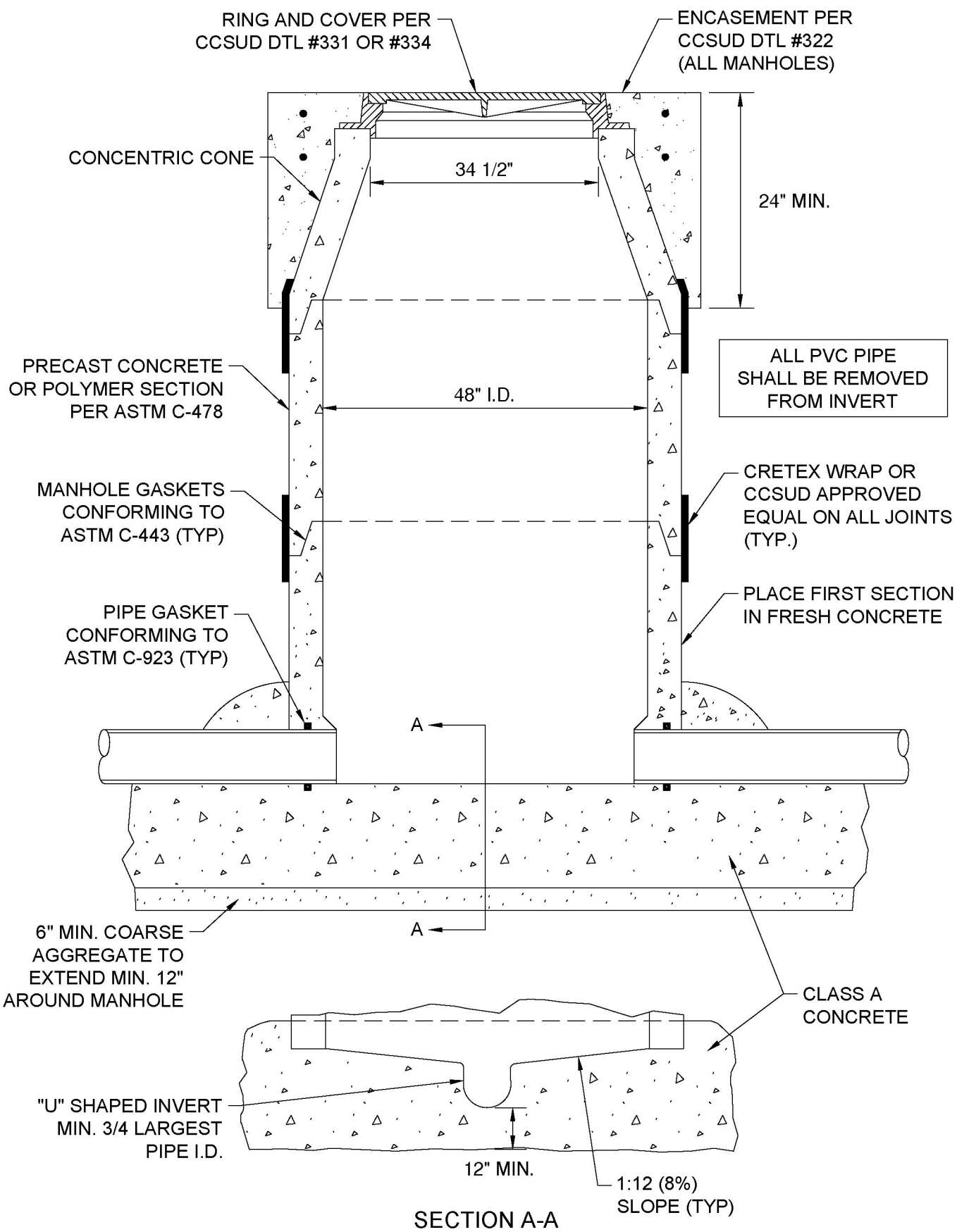
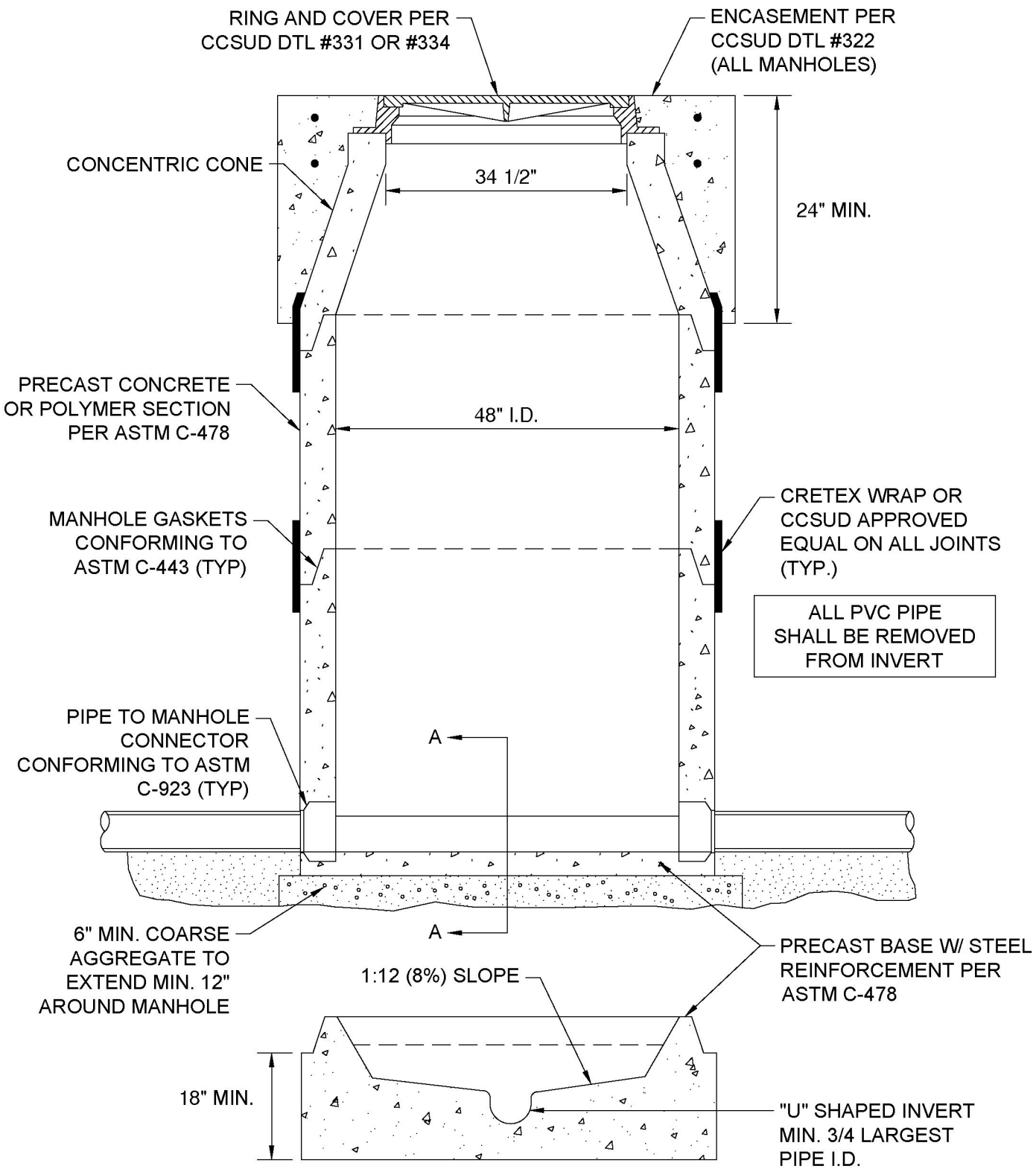


SECTION A-A

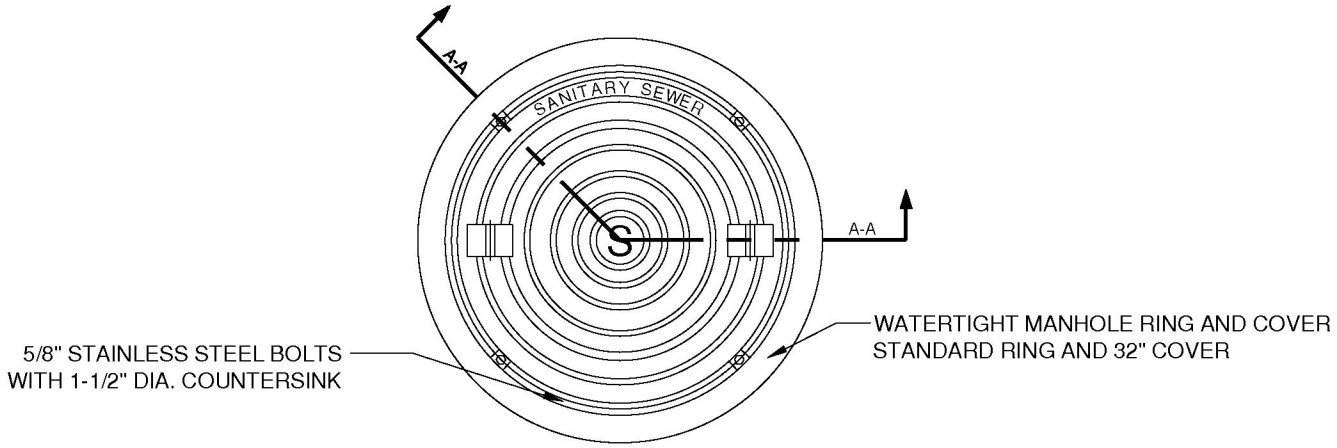
PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #327 WASTEWATER MANHOLE ON CAST IN PLACE FOUNDATION	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 | REVISION: SHEET 1 OF 1



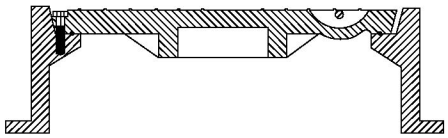
SECTION A-A

*CONTRACTOR SHALL LEVEL AND PLUMB THE BASE PRIOR TO SETTING THE PRECAST MANHOLE RISER SECTIONS ON THE PRECAST CONCRETE BASE.

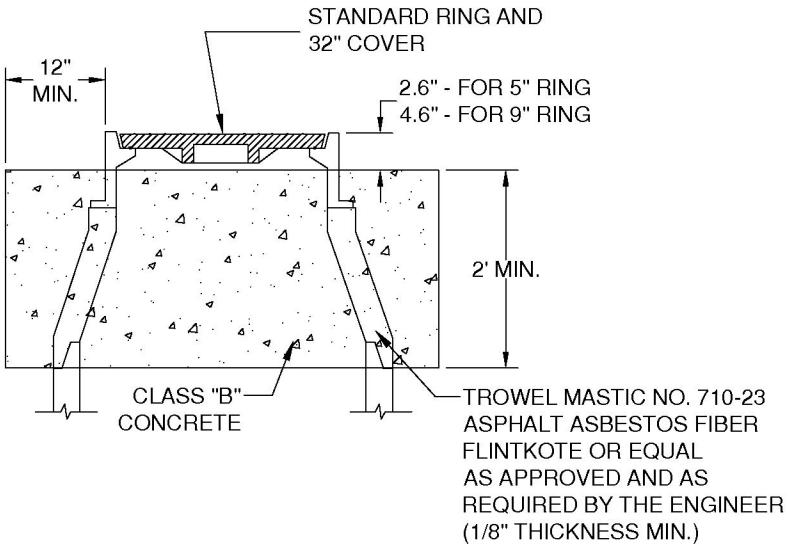
PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #328 WASTEWATER MANHOLE ON PRECAST BASE	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1

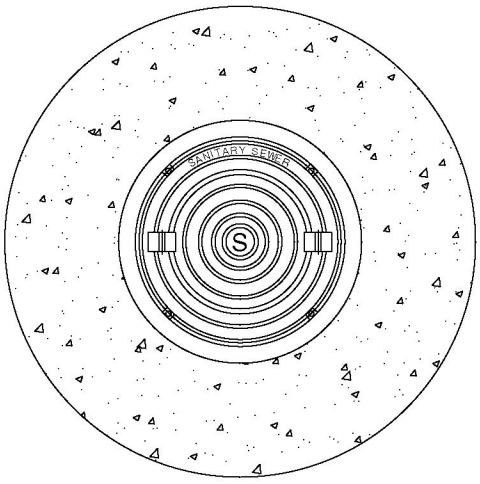


TOP VIEW



SECTION "A-A"



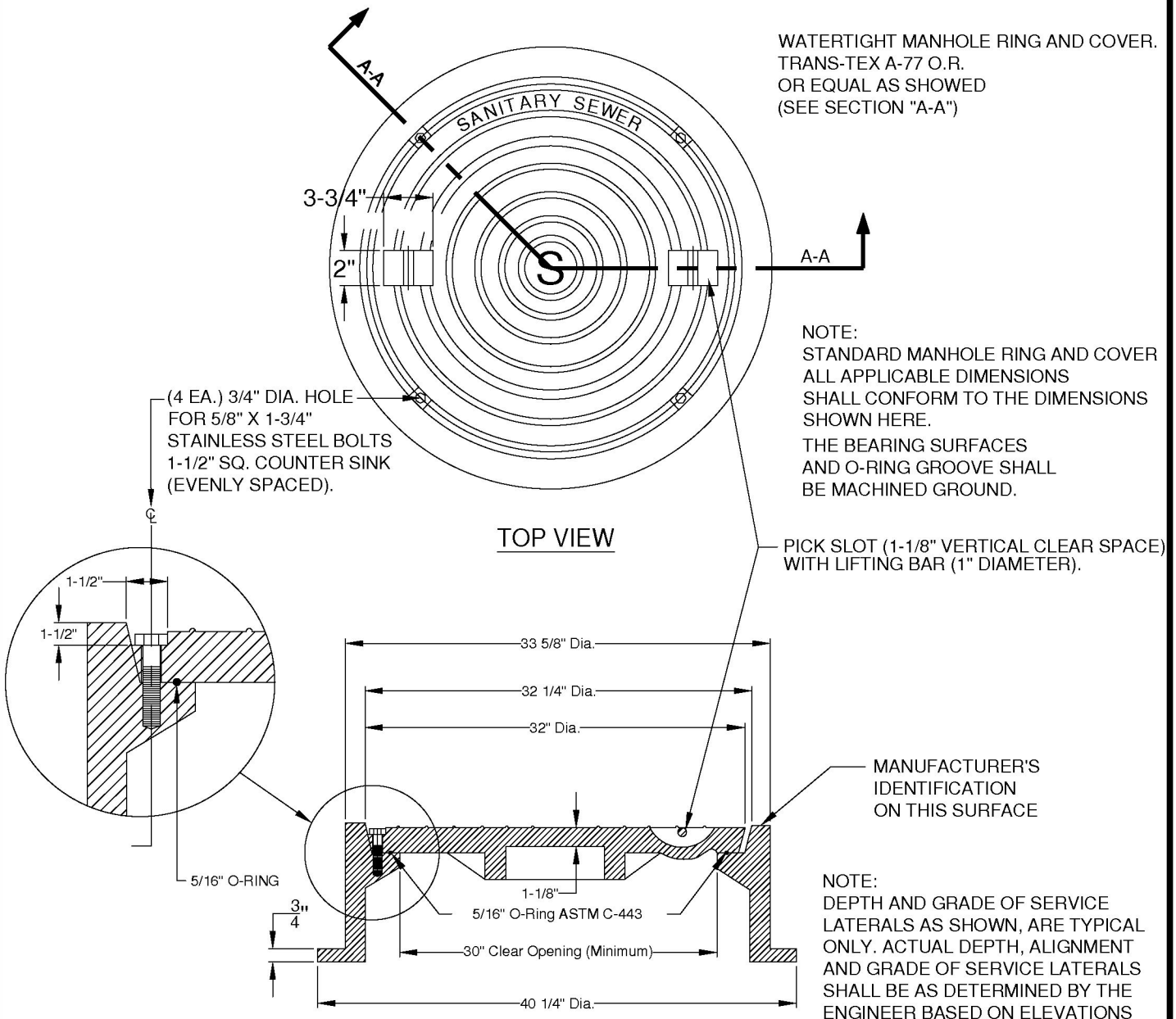


MANHOLE RING

ENCASEMENT DETAIL
(ALL MANHOLES)

NOTE:
MANHOLE RING ENCASEMENT IS REQUIRED ON ALL MANHOLES EXCEPT MANHOLES IN NEW OR EXISTING STREETS WHERE AS DIRECTED BY THE ENGINEER.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #329 MANHOLE RING & ENCASEMENT DETAIL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 07/13/06 REVISION SHEET 1 OF 2

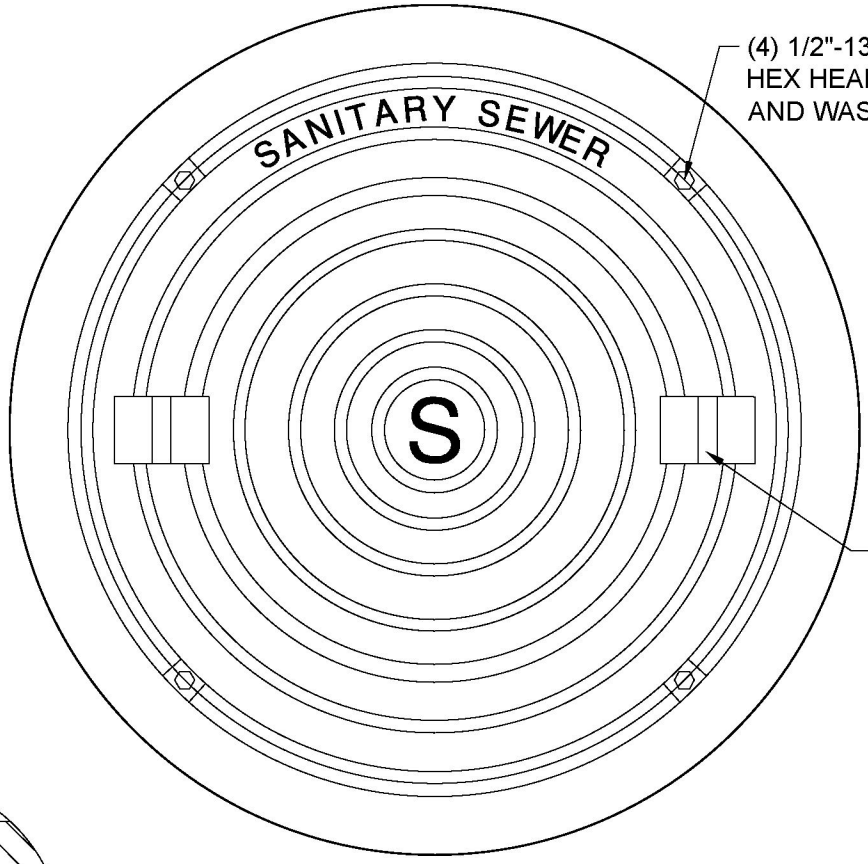


Section "A-A"

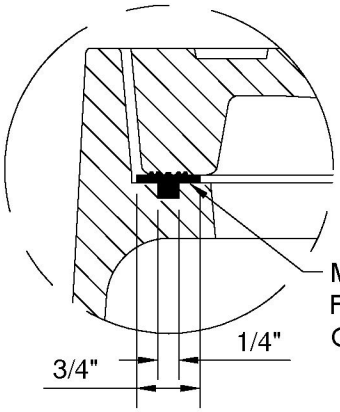
NOTE:
ALL DIMENSIONS MAY VARY EXCEPT THE DIAMETER OF THE LID, AND THE DIAMETER OF THE CENTER LINE OF THE BOLT HOLES, AND THE MINIMUM DIAMETER OF THE CLEAR OPENING. THE COMBINED WEIGHT OF THE MANHOLE RING AND COVER MUST BE AT LEAST 400 LBS.

MANHOLE RING & COVER DETAIL

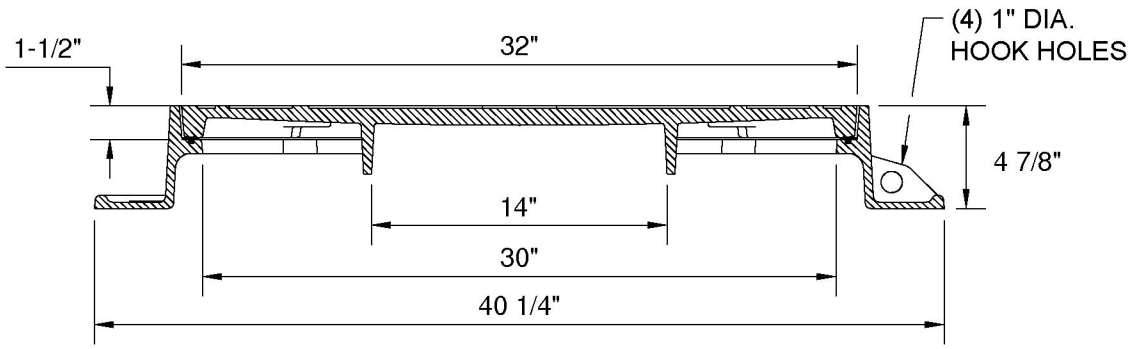
PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #329 MANHOLE RING & ENCASEMENT DETAIL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: REVISION: 12/06/10 SHEET 2 OF 2



PLAN VIEW



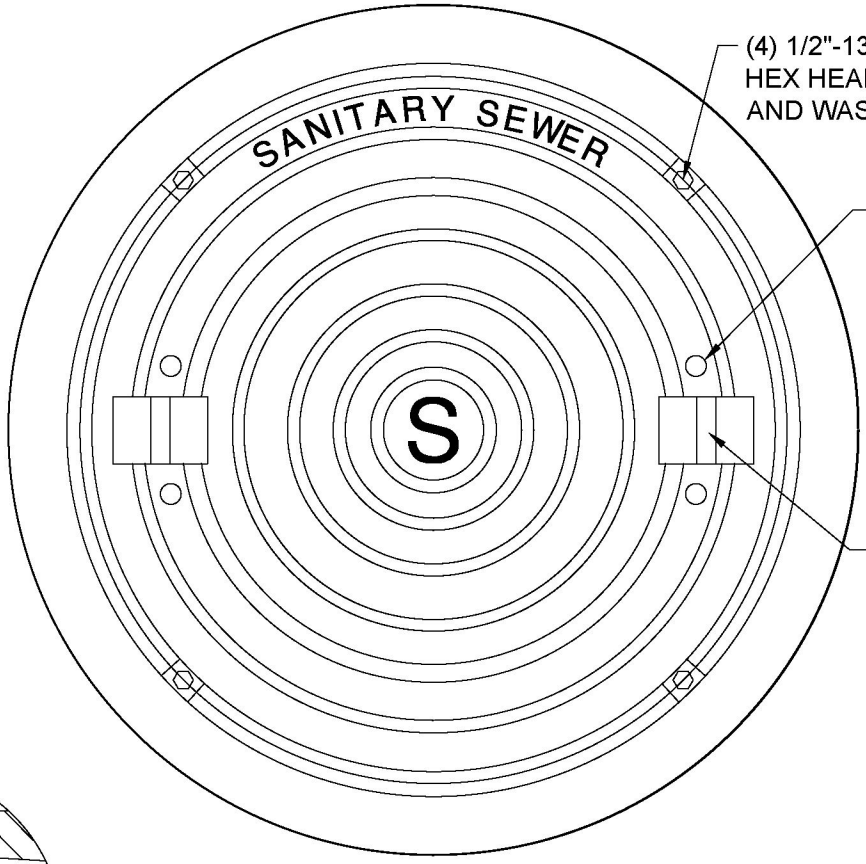
GASKET DETAIL



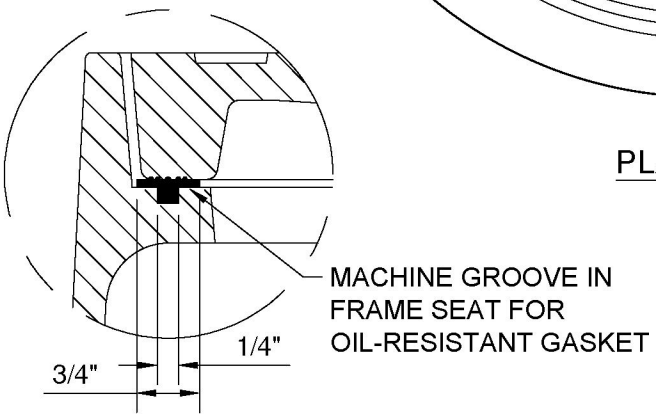
SECTION VIEW

MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B

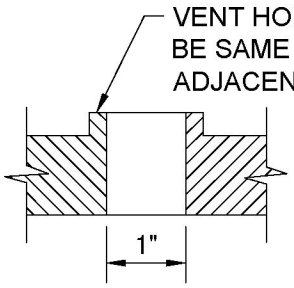
PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #331 SANITARY SEWER MANHOLE COVER	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1



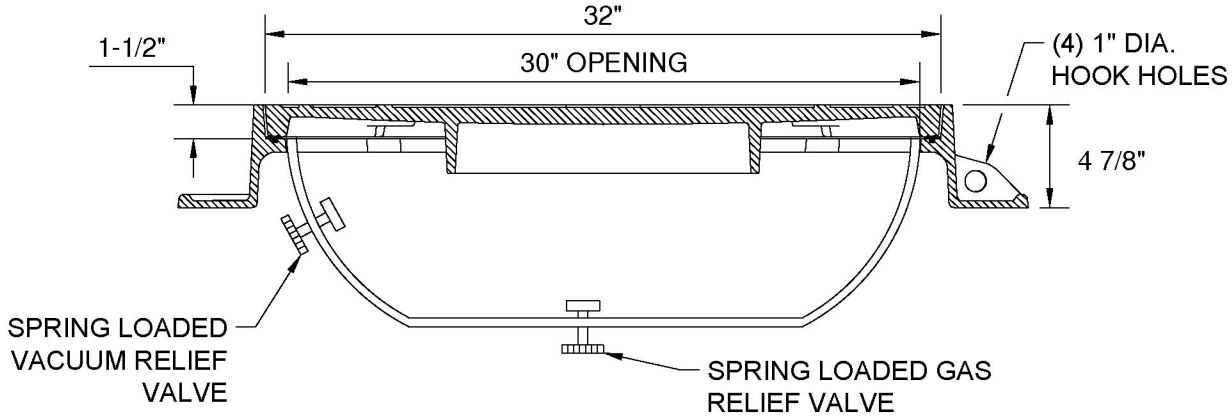
PLAN VIEW



GASKET DETAIL



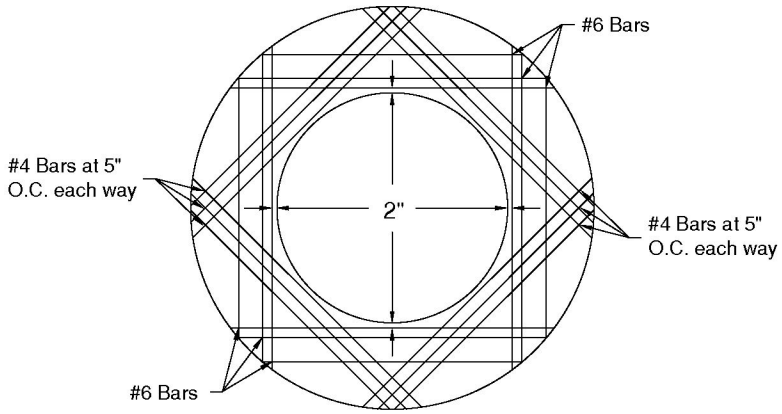
VENT HOLE DETAIL



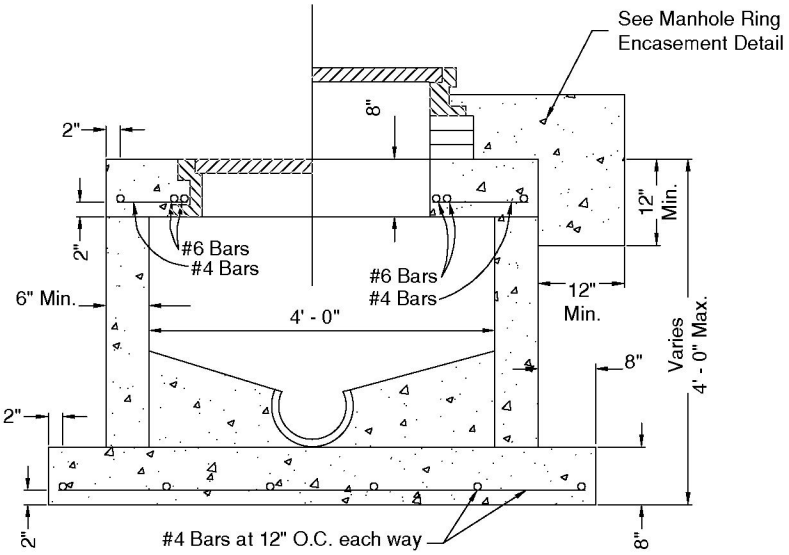
SECTION VIEW

MATERIAL: CAST GRAY IRON ASTM A-48, CLASS 35B

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #334 VENTED SANITARY SEWER MANHOLE COVER	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1



TOP SLAB



SHALLOW MANHOLE
PRECAST OR MONOLITHIC

SIZE	A	B*	MANDREL O.D. PVC (SDR-35)	MANDREL O.D. PVC (SDR-26)	RING O.D. PVC (SDR-35)	RING O.D. PVC (SDR-26)
6"	4.0"	4.5"	5.62	5.50	4.91	4.79
8"	5.5"	6"	7.52	7.37	6.81	6.66
10"	7.0"	7.5"	9.41	9.21	8.70	8.50
12"	8.0"	9"	11.19	10.96	10.48	10.25
15"	10.0"	11"	13.70	13.42	12.99	12.71
18"	12.0"	13.5"	16.75	------	16.04	------
21"	14.0"	16"	19.74	------	19.03	------
24"	16.0"	18"	22.21	------	21.50	------
27"	18.0"	20"	25.03	------	24.32	------

* MINIMUM LENGTH

Note:
PVC pipes and fittings six inches (6") to fifteen inches (15") in diameter shall conform to ASTM D-3034.
PVC pipes and fittings eighteen inches (18") to twenty-seven (27") in diameter shall conform to ASTM F-679.

This information is provided as a reference. All deflection testing shall be done in accordance with TCEQ Chapter 317.

CHART

PROPERTY OF
CRYSTAL CLEAR SPECIAL UTILITY DISTRICT

DTL #335

SHALLOW MANHOLE: PRECAST OR MONOLITHIC, TOP SLAB & CHART

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

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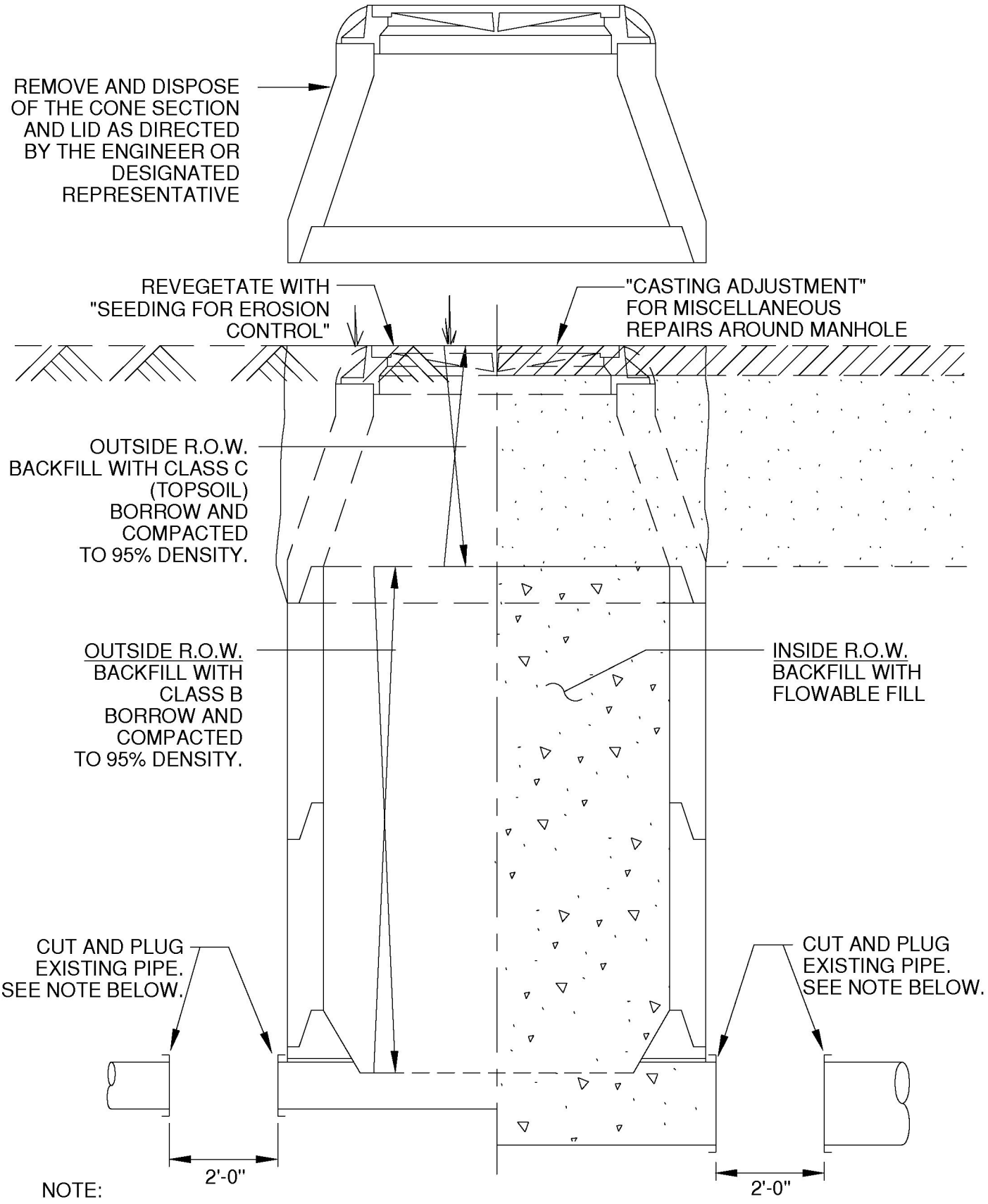
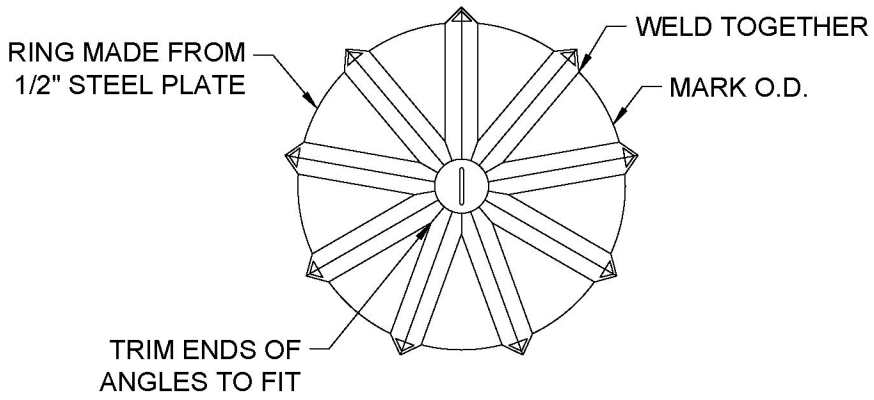


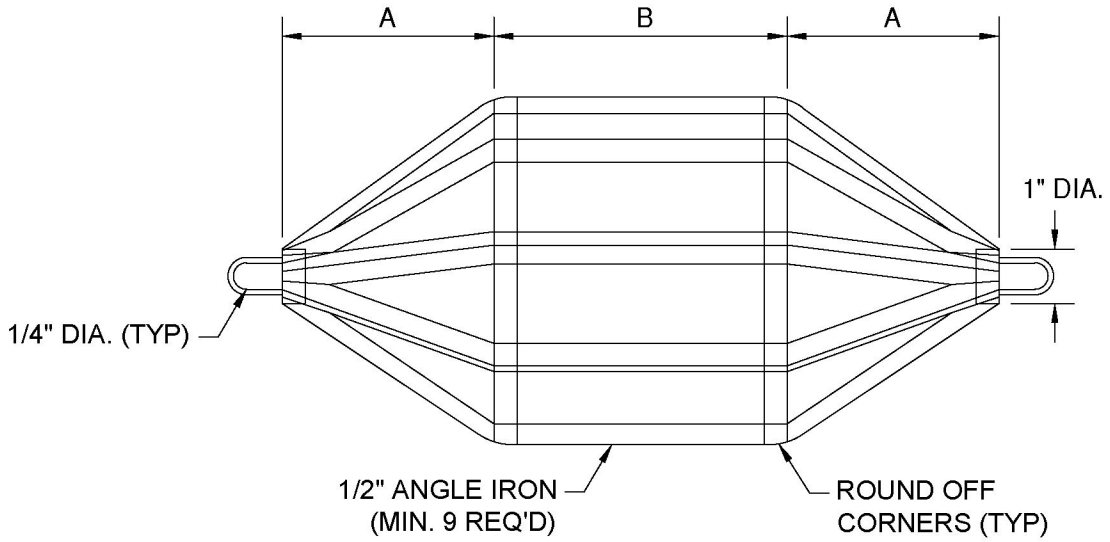
NOTE:
THE PLUG SHOULD BE COMPOSED OF A MATERIAL SIMILAR TO THE EXISTING PIPE AS INSTRUCTED BY THE ENGINEER OR DESIGNATED REPRESENTATIVE.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #340 ABANDONED MANHOLE	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 04/24/03 REVISION SHEET 1 OF 1



END VIEW

DIMENSIONS
A - 67% OF PIPE I.D.
B - 75% OF PIPE I.D.



SIDE OR TOP VIEW

MANDREL REQUIREMENTS:

1. O.D. NOT LESS THAN 95% OF THE I.D. OF THE PIPE, AS SPECIFIED BY THE ASTM, AWWA, UNI-BELL OR ANSI.
2. ABLE TO WITHSTAND 200 PSI WITHOUT BEING DEFORMED.
3. ODD NUMBER OF RUNNERS OR LEGS.

*THIS INFORMATION IS PROVIDED AS A REFERENCE. ALL DEFLECTION TESTING SHALL BE DONE IN ACCORDANCE WITH TCEQ CHAPTER 217.

PROPERTY OF CRYSTAL CLEAR SPECIAL UTILITY DISTRICT	DTL #350 GO, NO GO DEFLECTION TESTING MANDREL	M&S ENGINEERING ELECTRICAL | CIVIL | MEP TXENG FIRM # F-1394 | TBPELS FIRM #10169800 WWW.MSENGR.COM | (830) 228-5446	APPROVED: 08/17/21 REVISION: SHEET 1 OF 1

Date: Feb 15, 2022, 2:05pm User ID: kvogler
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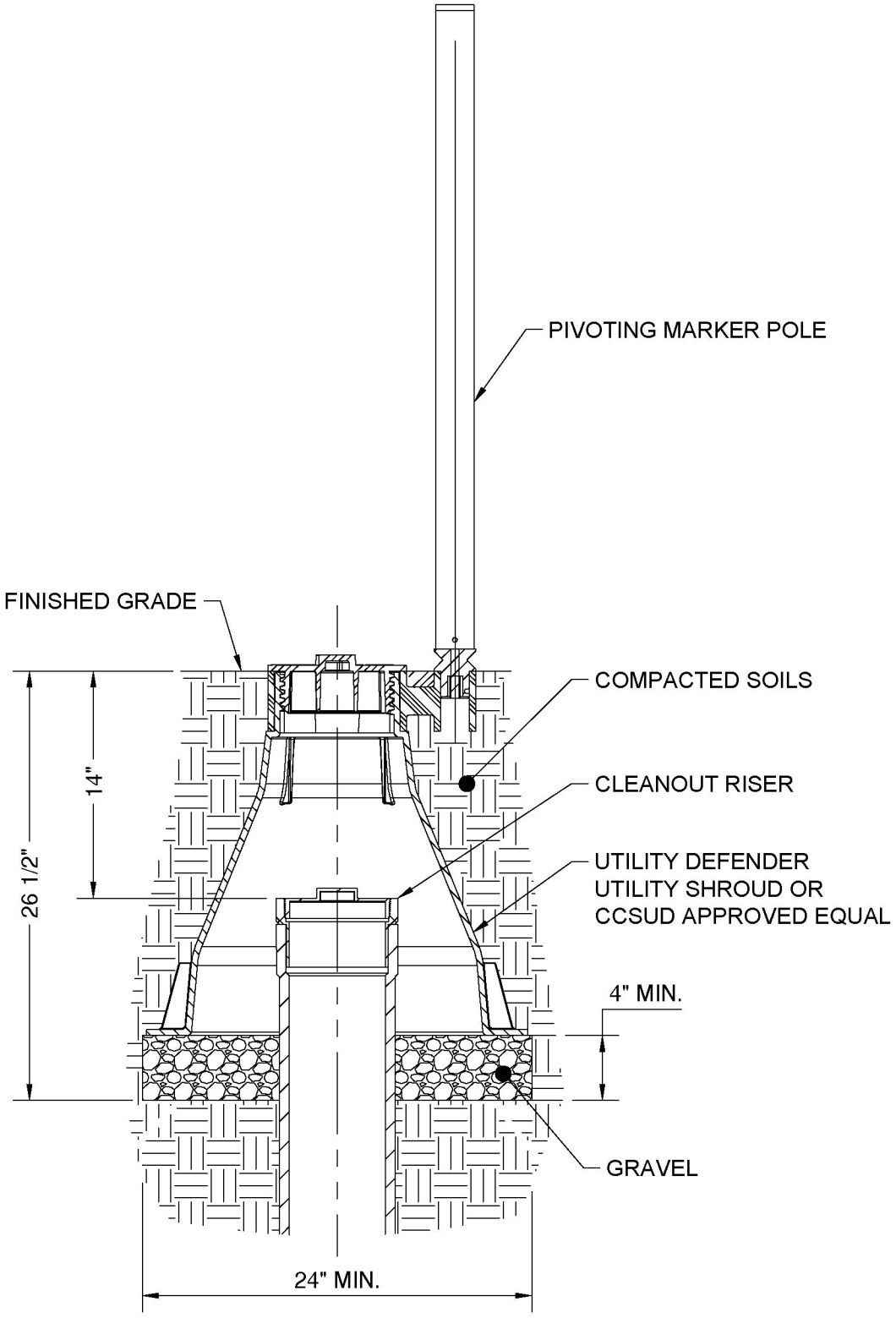

PROPERTY OF
CRYSTAL CLEAR
SPECIAL UTILITY DISTRICT

DTL #360

UTILITY SHROUD FOR SEWER
CLEANOUT ASSEMBLY

M&S ENGINEERING
ELECTRICAL | CIVIL | MEP
TXENG FIRM # F-1394 | TBPELS FIRM #10169800
WWW.MSENGR.COM | (830) 228-5446

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08/17/21	

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1 OF 1

CRYSTAL CLEAR SPECIAL UTILITY DISTRICT (CCSUD) WASTEWATER NOTES

1. THE CONTRACTOR SHALL MAINTAIN SERVICE TO EXISTING WASTEWATER SYSTEM AT ALL TIMES DURING CONSTRUCTION.

2. A MINIMUM OF 8" WASTEWATER PIPE AND FITTINGS (P.V.C. SDR-26, ASTM, D3034, D-3212, F-477) ARE REQUIRED ON NEW INSTALLATION.

3. ALL RESIDENTIAL WASTEWATER SERVICE LATERALS SHALL BE EXTENDED TO THE PROPERTY LINE AND A CLEANOUT SHALL BE INSTALLED AT THE PROPERTY LINE. SERVICES TO LOTS WILL EXTEND FOUR (4) FEET PAST THE UNDERGROUND ELECTRIC CONDUIT IF ELECTRIC IS INSTALLED IN THE FRONT EASEMENT. ALL SEWER CLEANOUTS THAT LEAD TO CCSUD MAINS SHALL BE INSTALLED WITH A PROTECTIVE UTILITY SHROUD AND PIVOTING MARKER POLE DURING TIME OF CONSTRUCTION.

4. PIPE BEDDING MATERIAL OF WASTEWATER MAINS SHALL BE COMPOSED OF WELL-GRADED, CRUSHED STONE, OR GRAVEL PER SECTION 01230 OF CCSUD'S SPECIFICATIONS.

5. SECONDARY AND GENERAL BACKFILL OF WASTEWATER MAINS SHALL BE APPROVED SOIL MATERIALS FOR BACKFILL AND FILL, FREE OF CLAY, ROCK, OR GRAVEL LARGER THAN 2-INCHES IN ANY DIMENSION, DEBRIS, WASTE, FROZEN MATERIALS, VEGETABLE, AND OTHER ORGANIC MATTER AND DELETERIOUS MATERIALS. PREVIOUSLY EXCAVATED MATERIALS MEETING THESE REQUIREMENTS MAY BE USED FOR BACKFILL.

6. ALL WASTEWATER MAINS SHALL HAVE COMPRESSION OR MECHANICAL JOINTS AS PER 30 TAC §217.53 (C) (2).

7. FOR WASTEWATER LINES LESS THAN 24" IN DIAMETER, SELECT INITIAL BACKFILL MATERIAL SHALL BE PLACED IN TWO LIFTS.

    a. THE FIRST LIFT SHALL BE SPREAD UNIFORMLY AND SIMULTANEOUSLY ON EACH SIDE AND UNDER THE SHOULDERS OF THE PIPE TO THE MID POINT OR SPRING LINE OF THE PIPE.

    b. THE SECOND LIFT SHALL BE PLACED TO A DEPTH AS SHOWN ON THE PIPE BACKFILL DETAIL. MAINS LARGER THAN 24", 12" MAXIMUM LIFTS SHALL BE USED.

8. ALL MANHOLES MUST BE WATERTIGHT, EITHER MONOLITHIC, CAST-IN-PLACE CONCRETE STRUCTURES OR PREFABRICATED MANHOLES SPECIFICALLY APPROVED BY CCSUD. THE MANHOLES SHALL HAVE WATER-TIGHT RINGS AND COVERS. WHEREVER THEY ARE WITHIN THE 100 YEAR FLOODPLAIN, THE MANHOLE COVERS SHALL BE BOLTED. EVERY THIRD MANHOLE IN SEQUENCE SHALL HAVE AN ALTERNATE MEANS OF VENTING. 30 TAC §213.5 (C) (3) (A) AND 30 TAC §217.55 (O).

9. ALL MANHOLES SHALL BE CONSTRUCTED SO THAT THE TOP OF THE RING IS TWO INCHES (2") ABOVE SURROUNDING GROUND EXCEPT WHEN LOCATED IN PAVED AREA. IN PAVED AREAS, THE MANHOLE RING SHALL BE FLUSH WITH PAVEMENT.

10. ALL NEW MANHOLES, UNLESS APPROVED BY CCSUD, ARE TO HAVE COVERS WITH 32" OPENINGS.

11. WASTEWATER MAIN CONNECTIONS TO PRE-CAST MANHOLES WILL BE COMPRESSION JOINTS OR MECHANICAL "BOOT TYPE" JOINT AS APPROVED BY CCSUD.

12. WASTEWATER MAINS SHALL BE TESTED FROM MANHOLE TO MANHOLE.

13. IN AREAS WHERE A NEW WASTEWATER MANHOLE IS TO BE CONSTRUCTED OVER AN EXISTING WASTEWATER SYSTEM, IT SHALL BE THE CONTACTOR'S RESPONSIBILITY TO TEST THE EXISTING MANHOLES BEFORE CONSTRUCTION. AFTER THE PROPOSED MANHOLE(S) HAS BEEN BUILT, THE CONTRACTOR SHALL RE-TEST THE EXISTING SYSTEM TO THE SATISFACTION OF THE CONSTRUCTION INSPECTOR. (NO SEPARATE PAY ITEM).

14. WHERE THE MINIMUM 9 FOOT SEPARATION DISTANCE BETWEEN WASTEWATER LINES AND WATER LINES CANNOT BE MAINTAINED, THE INSTALLATION OF WASTEWATER LINES SHALL BE IN STRICT ACCORDANCE WITH TCEQ. THE WASTEWATER LINE SHALL BE CONSTRUCTED OF CAST IRON, DUCTILE IRON OR PVC MEETING THE ASTM SPECIFICATION FOR BOTH PIPES AND JOINTS OF 160 PSI AND SHALL BE IN ACCORDANCE WITH 30 TAC § 217.53 (D) AND 30 TAC § 290.44 (E).

15. NO TESTING WILL BE PERFORMED PRIOR TO 30 DAYS FROM COMPLETE INSTALLATION OF THE WASTEWATER LINES. THE FOLLOWING SEQUENCE WILL BE STRICTLY ADHERED TO:

    a. PULL MANDREL

    b. PERFORM AIR TEST

    c. CLEANING OF ANY DEBRIS

    d. FLUSHING OF SYSTEM

    e. TV INSPECTION (WITHIN 72 HOURS OF FLUSHING)

16. A MINIMUM OF 3 FEET OF COVER IS TO BE MAINTAINED OVER THE WASTEWATER MAIN AND LATERALS AT SUBGRADE, OTHERWISE CONCRETE ENCASEMENT WILL BE REQUIRED.

17. TCEQ AND EPA REQUIRE EROSION AND SEDIMENTATION CONTROL FOR CONSTRUCTION OF WASTEWATER COLLECTION SYSTEMS. DEVELOPER OR AUTHORIZED REPRESENTATIVE SHALL PROVIDE EROSION AND SEDIMENTATION CONTROL AS NOTES ON THE PROJECT'S PLAN AND PROFILE SHEETS. ALL TEMPORARY EROSION AND SEDIMENTATION CONTROLS SHALL BE REMOVED BY THE CONTRACTOR AT FINAL ACCEPTANCE OF THE PROJECT BY CCSUD.

18. ALL MANHOLES NOT WITHIN PAVED STREETS SHALL HAVE LOCKING CONCRETE COLLAR TO SECURE RING AND COVER TO MANHOLE CONE PER CCSUD DETAIL DRAWING #329.

19. ALL MANHOLES OVER THE EDWARDS AQUIFER RECHARGE ZONE SHALL HAVE LOCKING CONCRETE COLLAR TO SECURE RING AND COVER TO MANHOLE CONE PER CCSUD DETAIL DRAWING #329.

CRYSTAL CLEAR SPECIAL UTILITY DISTRICT (CCSUD) WATER MAIN NOTES

1. THE CONTRACTOR SHALL COORDINATE PRESSURE TESTING OF NEW WATER MAINS WITH OWNER AND ENGINEER AT LEAST TWO BUSINESS DAYS PRIOR. PRESSURE TESTING REQUIREMENTS ARE INCLUDED IN THE SPECIFICATIONS.
2. ALL WATER MAINS SHALL BE DISINFECTED PER AWWA AND TCEQ STANDARDS.
3. THE CONNECTION LOCATIONS LISTED IN THE PLANS ARE BASED ON BEST AVAILABLE INFORMATION. THE CONTRACTOR SHALL FIELD LOCATE EXISTING WATER MAIN LOCATIONS AT ALL TIE-IN LOCATIONS TO VERIFY SIZE, ELEVATION, AND MATERIAL PRIOR TO ORDERING MATERIALS FOR CONNECTION.
4. THE CONTRACTOR SHALL MAINTAIN MINIMUM SEPARATION BETWEEN UTILITIES PER TCEQ STANDARDS.
5. WATER MAINS SHALL BE RESTRAINED WITH RESTRAINT LENGTHS OF FITTINGS SHOWN IN PLANS.
6. UNLESS OTHERWISE SPECIFIED, ALL PVC WATER MAINS SHALL BE C900/C905 DR 18, COLORED BLUE.
7. UNLESS OTHERWISE SPECIFIED, ALL DUCTILE IRON WATER MAINS SHALL BE PRESSURE CLASS 350 CONFORMING TO AWWA C150 AND AWWA C151 AND CEMENT LINED.
8. LOCATIONS OF COMBINATION AIR VALVES SHOWN ARE APPROXIMATE. INSTALL AIR RELEASE VALVES AT THE HIGH POINT IN THE WATER MAIN FOR THE LOCATIONS GIVEN.
9. THRUST BLOCKING IS REQUIRED AT ALL FITTINGS AND BENDS IN ACCORDANCE WITH THE THRUST BLOCKING DETAIL PROVIDED AND SPECIFICATION SECTION 02680 - JOINT RESTRAINTS AND THRUST BLOCKING.
10. THE OWNER SHALL SUPPLY ALL WATER NEEDED FOR CONSTRUCTION TESTING AND DISINFECTION. THE CONTRACTOR SHALL NOT BE REQUIRED TO PAY FOR THIS WATER.
11. UNLESS NOTED OTHERWISE, ALL WATER MAIN P.I.'S SHALL BE ACHIEVED USING THE WATER MAIN MANUFACTURER'S ALLOWABLE JOINT DEFLECTION.
12. WATER MAINS AND VALVES THAT ARE ABANDONED IN PLACE SHALL BE CUT AND PLUGGED PER SPECIFICATION SECTION 02500 – ABANDONMENT OF WATER INFRASTRUCTURE.
13. REMOVE ONLY VEGETATION, TREES, STUMPS, RUBBISH, AND OTHER MATERIAL NECESSARY FOR CONSTRUCTION AND DISPOSE OF OFF SITE.
14. CONSTRUCTION OF ALL CCSUD WATER UTILITY INFRASTRUCTURE MUST ADHERE TO CCSUD'S TECHNICAL SPECIFICATIONS, DETAILS AND APPROVED EQUIPMENT LIST.

Orenco® *Changing the Way the World Does Wastewater®*

Orenco Sewer Equipment Specifications

Table of Contents

PART 1 GENERAL

1.01 DEFINITIONS

A. Wherever used in these specifications and printed with initial bold capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof.

1. *Bid* – The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the work to be performed.
2. *Bidder* – The individual or entity who submits a Bid directly to the Owner.
3. *Contractor* – The individual or entity with whom Owner has entered into the agreement.
4. *Engineer* – The individual or entity named as such in the agreement.
5. *Inspector* - The specific individual designated by the Owner, Engineer, Contractor, and Manufacturer to ensure quality control by inspecting and certifying that each STEP/STEG unit is in compliance with the Manufacturer's recommendations and requirements.
6. *Manufacturer* – A supplier, fabricator, distributor, materialman, or vendor having a direct contract with Contractor or Owner to furnish materials or equipment to be incorporated in the work by contractor.
7. *Owner* – The individual or entity with whom Contractor has entered into the agreement and for whom the work is to be performed.

1.02 GENERAL DESCRIPTION

The **MANUFACTURER** shall furnish a complete factory built and tested STEP pump package(s), each consisting of a pump vault, effluent screen, discharge assembly, anti-siphon valve, ball valve, check valve, splice box, and controls.

1.03 SUBMITTALS

The **MANUFACTURER** shall furnish six (6) sets of shop drawings and technical data sheets. The submittals shall clearly specify the materials of construction, equipment compatibility, along with drawings for each unique package being supplied.

1.04 OR-EQUAL EVALUATIONS

A. Throughout the equipment specifications you will find the term "or approved equal." For this project, this term "approved equal" shall mean equal in the judgment of the **ENGINEER**. Should the **CONTRACTOR** seek approval of a product other than the brand or brands named in the specifications, it shall furnish written evidence that such product conforms in all respects to the specified requirements, and that it has been used successfully elsewhere under similar conditions. It will not be the responsibility of the **ENGINEER** to research, review, or determine equality, nor the responsibility of the **MANUFACTURER** specified within these specifications to provide research, documentation, or data supporting the difference between the "or equal" and the specified product. This will be the sole responsibility of the **CONTRACTOR** seeking the approval.

B. Where the specified requirements involve conformance to recognized codes or standards, the **BIDDER** shall furnish evidence of such conformance in the form of test or inspection reports, prepared by a recognized agency, and bearing an authorized signature. Manufacturer's standard data and catalog cut sheets will not be considered sufficient in themselves, and the **ENGINEER** will not be responsible for seeking further data from the manufacturer, or for otherwise researching the product. Failure to provide complete data will be cause for rejection of the product. The submission shall include any impacts that could be expected from the

alternative product and shall also indicate any product that would require a license or royalty, the actual fees, and a note that these fees would be handled by the **BIDDER**. The **BIDDER** shall provide submissions; meeting the above parameters no less than TWO WEEKS prior to **BID** opening for review by the **ENGINEER**. **CONTRACTORS** seeking approval of "or equal" products or systems shall provide, at minimum, the following.

C. Product/System submittals, including, but not limited to;

The number of years the **MANUFACTURER** has been in business of manufacturing relevant products/systems.

a. Size of company, including
    1) Number of employees related to relevant products/systems
    2) Number of engineers on staff related to relevant products/systems
b. Product specifications and a detailed description of how each product or component is "equal" to the specified product, system, or component. A side by side comparison is required.
    1) Equipment/system warranty along with exclusions
    2) Performance claims, including, but not limited to;
        a) Effluent filter design
            - Flow area
            - Surface area
            - Maintenance frequency
        b) Pump motor description
            - Manufacturer and origin
            - Length of service
            - Number of units in operation
            - Life-cycle cost (repair and replacement frequency)
            - Warranty
        c) Pump liquid end description
            - Manufacturer and origin
            - Length of service
            - Number of units in operation
            - Life-cycle cost (repair and replacement frequency and cost). Note liquid ends must be removeable, repairable, and cleanable.
            - Warranty
        d) Corrosion resistance
        e) Pump Lead description
            - Lead must be SOOW, extra heavy duty cord (600V) CSA approved.
        f) Control panel components
            - Manufacturer and origin
            - Length of service
            - Number of units in operation
            - Warranty
            - Enclosure description
c. Evidence of successfully obtaining approval for a system with similar permit requirements with the regulating authority
d. Summary of product/system track record and history, including, but not limited to;
    1) Number of similarly sized systems
    2) Detailed summary of, at minimum, ten (10) similarly sized systems, at least five (5) years old, including, but not limited to;
        - Project name, location, and application
        - Years in operation
        - Current average daily flows and design flows

- Operator name and contact information

1. **BIDDER** shall specify and furnish documentation related to manufacturer (or representative) support services, including, but not limited to;
    1) Installation training program and support material
    2) Installation oversight program and support material
    3) Operator training program and support material
    4) Startup services program and support material

D. Engineer's Cost Reimbursement: **ENGINEER** will record Engineer's costs in evaluating a substitue or "or equal" proposed or submitted by **CONTRACTOR**. Whether or not **ENGINEER** approves an "or equal" or substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of **ENGINEER** for evaluating each proposed "or equal" or substitute. **CONTRACTOR** shall reimburse Owner for the reasonable charges of **ENGINEER** for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed "or equal" or substitute.

E. **CONTRACTOR** may not knowingly contract with a supplier or manufacturer if the individual or entity who prepared the plans and specifications has a corporate or financial affiliation with the supplier or manufacturer. Owner's officers, employees, or agents shall not engage in the award or administration of this Contract if a conflict of interest, real or apparent, would be involved. Such a conflict would arise when: (i) the employee, officer or agent; (ii) any member of their immediate family; (iii) their partner or (iv) an organization that employs, or is about to employ, any of the above, has a financial interest in **CONTRACTOR** . Owner's officers, employees, or agents shall neither solicit nor accept gratuities, favors or anything of monetary value from **CONTRACTOR** or subcontractors.

F. During the bidding process, any approved "or equal" or substitute shall be accepted by the **ENGINEER** and released in as an addendum to the Contract Documents.

1.05 EXPERIENCE CLAUSE

The equipment furnished shall be manufactured and supplied by a company experienced in the design and manufacture of effluent sewer systems. **MANUFACTURERS** shall have at minimum ten (10) years experience in the design and manufacture of effluent sewers systems of similar size and equipment specified. **MANUFACTURERS** shall have at minimum of twenty-five (25) successful installations of effluent sewer systems, with each installation having a minimum of ten (10) pumps discharging into a common force main.

1.06 MANUFACTURER

The **MANUFACTURER** shall be Orenco Systems®, Inc. or approved equal. The **MANUFACTURER** shall furnish a complete factory built STEP pump package(s), each consisting of a pump vault, effluent screen, discharge assembly, anti-siphon valve, ball valve, check valve, splice box, and controls. The **MANUFACTURER** shall supply detailed installation and O&M instructions**.** The **MANUFACTURER** shall also provide the following support personnel:

- Professional engineer or personnel under the direct supervision of a professional engineer dedicated to supporting the project through design, construction, and O&M.
- Asset Management Department dedicated to assisting operators with operational and maintenance activities.

1.07 WARRANTY

The effluent system pump **MANUFACTURER** shall provide a warranty of five (5) years to include, but not limited to the pump vault, hose and valve assembly, control panel, splice box and a separate warranty of ten (10) years for the effluent pump. Warranty term shall ensue after **OWNER'S** acceptance and system startup procedures are complete. The **MANUFACTURER**

shall submit detailed exclusions from the warranty or additional cost items required to maintain the equipment in warrantable condition. The warranty shall be documented in product literature.

1.08 SERVICABILITY

The STEP package(s) shall be completely serviceable, with easy access to the pump(s), effluent screen, and floats. The pump shall be designed for removal without removing the effluent screen and floats.

1.09 PUMPS

The pump must be approved for use in pump vault as described in these specifications. Pump shall be 1/2 to 1.5 hp, 115/230 VAC, single phase, 60 Hz, two-wire motor, with 10 foot long extra heavy duty (SOOW) electrical cord with ground. The pumps must be submersible High-Head Effluent pumps. Pumps shall be UL and CSA listed for use with effluent. The pumps must have a minimum 24-hour run dry capability without water lubrication. The pumps shall have a 1/8-inch bypass orifice to ensure flow circulation for motor cooling and to prevent air bind. The pump shall have a floating impeller design to protect against up thrust and increase pump life. The pump liquid ends must be repairable (by replacing impellers and/or diffusers) for better long-term cost of ownership. The motor must be rated for continuous use and frequent cycling, at least 100 cycles per day. The motor cable must be suitable for Class 1, Division 1 and 2 applications. The pumps shall be lightweight for easy removal and maintenance. The pump intake screen must be 1/8-inch mesh polypropylene. The pump shall have internal thermal overload protection and internal lightning protection. All pumps shall undergo 3-point (Dead head, Design Flow, and Design Flow + 30%) wet testing at the factory to confirm performance.

1.10 BUILDING SEWER

Building side sewers shall be watertight and installed by a Contractor licensed to such work as per the local and state licensing requirements. Building sewer materials, installation and testing shall be per the current local plumbing code.

PART 2 TANKS

2.01 GENERAL REQUIREMENTS

A. The **MANUFACTURER** shall provide the structural design and certification to the **ENGINEER** for review. The design shall be in accordance with accepted engineering practice. Precast concrete or fiberglass or polyethylene tanks shall have been designed by a registered engineer and approved by state or local regulatory agencies or authorities. To achieve effective performance and minimize pump-out occurrences, residential interceptor tanks shall have a nominal liquid capacity of 1,250 gallons for up to 4 bedrooms, 1,500 gallons for up to 5 bedrooms, and, for more than 5 bedrooms, the sizing shall be determined based on an occupancy assessment and shall be in accord with Figure 1.

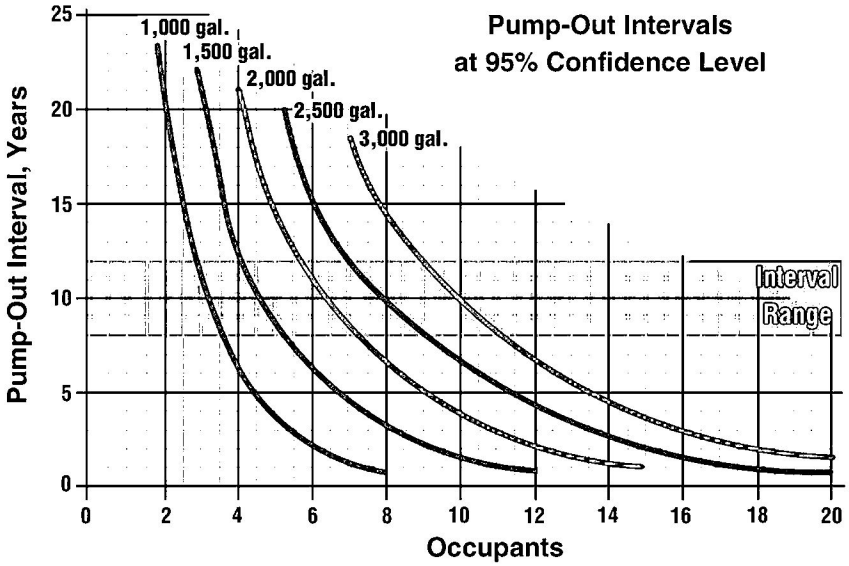

Figure 1. Interceptor Tank Pump-Out Intervals

B. Average flow (Q_a) is based upon typical weekly discharges. Wastewater flows for single-family dwellings typically range from *40 to 60 gallons per capita per day (gpcd)*; **50 gpcd** is a commonly used design parameter and is the value used in calculations herein. The number of individuals (capita) is assumed to average three per dwelling. Typical occupancies and flow relationships are shown in Table 1.

a.Table 1: Relationship between Number of Bedrooms, Occupancies, and Flow

Bedrooms	Q_p[a]	Occupants[b]	Q_c	Q_a
	gpd/DU	*capita*	*gpcd*	*gpd/DU*
1	200	2	55	110
2	300	3	50	150
3	375	4	50	200
4	450	5	45	225

a. Peak day bedroom flows (Q_p) are based on typical administrative rules.

b. Occupancy is based on typical usage of two occupants for the first bedroom and one occupant per additional bedroom.

C. Loading Criteria:

a. There shall be 140 lbs./cu.ft. for minimum weight of saturated backfill, or 127 lbs./cu.ft. for unsaturated backfill (500 lbs./sq.ft. minimum).
b. Minimum lateral loading shall be 62.4 lbs./cu.ft. Lateral loading shall be determined from ground surface.
c. The tank shall also support a concentrated wheel load of 2500 lbs.

D. There are four (4) typical loading conditions that should be analyzed:

1. 4 ft. Bury + Full Exterior Hydrostatic Load
2. 4 ft. Bury + Full Exterior Hydrostatic Load + 2500 lb. Wheel Load.
3. 1 ft. Bury + 2500 lb. Wheel Load.
4. Tank Full, Interior Hydrostatic Load and Unsupported by Soil.

Load Case 4 represents the tank full of liquid at 62.4 lbs/cu.ft. This condition addresses seam and haunch stress-strain relationships that occur during watertightness testing, as well as poor soil bedding conditions that provide inadequate support.

E. Tanks requiring deep burial (>48") or subject to truck or heavy traffic loading require special consideration. (A minimum soil cover of 12" shall be used, unless specified otherwise by **MANUFACTURER**.)

F. All tanks shall be structurally sound and watertight and shall be guaranteed in writing by the tank **MANUFACTURER** for a period of two years from the date of final acceptance. **MANUFACTURER'S** signed guarantee shall accompany **BID**. The tank guarantee/warranty shall be furnished at the time of submittal. Tank warranty shall not be limited liability to replacement cost of the tanks. The interceptor tank shall be capable of withstanding long-term hydrostatic loading, in addition to the soil loading, due to a water table maintained at ground surface.

G. Tanks shall be manufactured and furnished with access openings 20" in diameter and of the configuration shown on the manufacturer's drawings. Modification of completed tanks will not be permitted.

H. Inlet plumbing shall include an inlet tee that penetrates 18" into the liquid from the inlet flow line. (The depth may vary depending on the tank's height; in all cases, though, the inlet should extend to a level below the bottom of the maximum scum depth.) The inlet plumbing shall allow for natural ventilation back through the building sewer and vent stack.

I. Tanks shall be capable of successfully withstanding an aboveground static hydraulic test and shall be individually tested.

J. All tanks shall be installed in strict accordance with the **MANUFACTURER'S** recommended installation instructions

2.02 CONCRETE TANKS

A. All concrete tanks will be pre-approved by the ENGINEER. Walls, bottom and top of reinforced concrete tanks shall be designed across the shortest dimension using one-way slab analysis. Stresses in each face of monolithically constructed tanks may be determined by analyzing the tank cross-section as a continuous fixed frame.

B. The walls and bottom slab shall be poured monolithically; alternatively, water stops may be provided. Mid-seam or clamshell tanks are not acceptable.

C. Reinforcing steel shall be ASTM A-615 Grade 60, fy = 60,000 psi. Details and placement shall be in accordance with ACI 315 and ACI 318.

D. Concrete shall be ready-mix with cement conforming to ASTM CI50, Type II. It shall have a cement content of not less than six (6) sacks per cubic yard and maximum aggregate size of 3/4". Water/cement ratio shall be kept low (0.35±), and concrete shall achieve a minimum compressive strength of 4000 psi in 28 days. The Contractor shall submit a concrete mix design to the **ENGINEER** for review and approval. Three (3) concrete sample cylinders shall be taken and tested for each tank manufactured until the **MANUFACTURER** and **ENGINEER** are satisfied that the minimum compression strength is being obtained. To ensure compliance, the **MANUFACTURER** shall then make and set three (3) sample cylinders for a minimum of 20% of the remaining tanks at the discretion of the **ENGINEER** . If the minimum compressive strength is not being obtained, the **MANUFACTURER** shall be required to make and test sample cylinders for each tank manufactured. Calcium chloride will not be allowed in the mix design. The cost of testing cylinders shall be the tank **MANUFACTURER'S** responsibility. The tank manufacturer may supply a Swiss hammer for compressive testing in the field in lieu of sample cylinders.

E. Tanks may be protected by applying a heavy cement-base waterproof coating, on both inside and outside surfaces, in compliance with Council of American Building Officials (CABO) report #NRB-168; 6181; however, the tank should be watertight without the addition of seal coatings.
F. Form release used on tank molds shall be Nox Crete™ or approved equal. Diesel or other petroleum products are not acceptable.
G. Tanks shall not be moved from the manufacturing site to the job site until the tank has cured for seven (7) days or has reached two-thirds of the design strength.
H. Tanks shall be manufactured and furnished with access openings of the size and configuration to accommodate individual packaged pump systems. The risers can be cast into the tanks.
I. The septic tank and the top slab shall be sealed with a preformed flexible plastic gasket. The flexible plastic gasket shall be equal to the flexible butyl resin sealant congeal CS-102 or CS-202 as manufactured by Concrete Sealants, Inc. of New Carlisle, Ohio, and shall conform to federal specification SS-S-00210(2iOA) and AASHTO M-198. A mechanical fastening method shall be used if the seasonal groundwater level may reach the top slab seam of the tank.
J. In order to demonstrate watertightness, tanks shall be tested at the factory and again on-site prior to acceptance. Inlets to the septic tank will be watertight pipe seal Cast-A-Seal™ (Manufactured by Press-Seal Gasket Corporation) or approved equal. Each tank shall be tested at the factory, prior to shipping, by filling with water to the soffit and letting stand. After 24 hours, the tank shall be refilled to the soffit and the exfiltration rate shall be determined by measuring the water loss during the next two (2) hours. Any leakage shall be cause for rejection. After installation is completed and before backfilling, each tank shall be filled with water to a point 2" above the top of the tank and the water loss measured after a twenty four-hour period. After it has been determined that there is no leakage, test the access riser seam. Backfill to a minimum depth of 2" above the riser seam to prevent damage from hydrostatic uplift. Fill the tank to a point 2" above the riser seam (the field test period may be reduced to not less than two (2) hours). No tank will be accepted if there is any leakage over the two (2) hour period.

PART 3 TANK ACCESS EQUIPMENT

3.01 RISERS

Risers **MANUFACTURER** shall be Orenco Systems®, Inc. Risers shall be required for access to internal vaults and access into the septic tanks for septage pumping. All risers shall be constructed watertight. The risers shall be attached to the tanks such that a watertight seal is provided. Risers shall extend 3" above original grade to allow for settlement and to ensure positive drainage away from the access. Risers for inspection ports shall be a minimum of 18" in nominal diameter. Risers containing pumping assemblies or electrical splice boxes shall be a minimum of 24" in diameter and shall be of sufficient diameter to allow removal of internal vaults without removing splice boxes, etc. Risers shall be a minimum of 30" in nominal diameter when the depth of bury is 36" or greater or duplex pumping assemblies are used. All other risers shall be a minimum of 24" in nominal diameter and shall vary in height depending on the depth of bury on the various tanks. Adhesive required to adhere the PVC or fiberglass risers to either fiberglass or ABS tank adapters shall be a two-component methacrylate structural adhesive or approved equal. To ensure product compatibility, a single manufacturer shall supply risers, lids, and attachment components.

3.02 INLET RISERS

Inlet risers shall be Orenco Systems®, Inc. Model Ultra-Rib, KOR FLO or **ENGINEER**-approved equal. The material shall be PVC as per ASTM D-1784 and tested in accordance with AASHTO M304M-89. The risers shall be constructed of non-corrosive material and designed-to-be buried in soil. Risers shall have a minimum stiffness of 10 psi, when tested according to ASTM D2412. Risers shall be capable of withstanding a truck wheel load (54 square inches) of 2,500 pounds for 60 minutes with a maximum vertical deflection of a 1/2 an inch. Risers shall extend to 3 inches above the ground surface to allow for settlement and shall have a minimum nominal diameter of 18