Design and Construction Standards

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City of Stillwater Design and Construction Standards
Adopted:

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Section 1 - Introduction

Part 1: Introduction

A. When infrastructure is dedicated to the City, citizens are assuming perpetual responsibility for maintenance, replacement, liability, and the associated long term costs; therefore a certain level of quality, performance, and durability is expected.
B. The Design and Construction Standards contained herein are requirements for improvements designed and constructed by private enterprise that will be dedicated to the City.
C. The Design and Construction Standards contained herein are suggested guidelines for private improvements that will not be dedicated to the City or are located wholly on private property.
D. For private infrastructure, full compliance with state and federal regulatory agencies is required.
E. Standards need to be reasonable, easy to follow, consistent, flexible enough to incorporate changes in technology and materials, allow changes based on discoveries in the field, and not impose an undue economic burden on the City's continued development or the City's maintenance of infrastructure.
F. The City Manager is hereby authorized to accept an alternative design or substitute method of construction whenever it is demonstrated that such alternative or substitute method will fully achieve the intended operational and/or maintenance result as set forth in the adopted standard.
G. The City Manager is authorized to act on all requests for exceptions to these Standards. Such requests shall be submitted, in writing, with the appropriate documentation provided that justifies the request.

Section 2 - General

Part 1: Reference Documents

A. AASHTO, geometric designs
B. WEF Manual of Practice
C. AWWA Manual of Practice
D. International Plumbing Code
E. OKR10
F. Institute of Transportation Engineers, Urban Street Geometric Design Handbook
G. Oklahoma Department of Transportation; Roadway Design Manual (most current edition) and Standard Specifications
H. American Concrete Institute
I. American Welding Society
J. Concrete Reinforcing Steel Institute
K. American National Standards Institute (ANSI), B16
L. Manuals of Water Supply Practices
M. National Electric Safety Code, Part 3, Section 32 Underground Conduit System
N. ASTM International
O. NSF International
P. Oklahoma Administrative Code Title 252. Chapter 606, Chapter 626, and Chapter 656
Q. Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California
R. Uniform Manual for Traffic Control
S. Urban Drainage Criteria Manual (UDCM)
T. City of Stillwater adopted Best Management Practices (BMPs) manual

Part 2: General

A. Pre-design conference with the developer and the design engineer shall occur prior to submittal of plan set.
B. City shall approve all public improvement design prior to start of construction.
C. All designs shall be sealed by a Professional Engineer licensed in Oklahoma.
D. Plan & Profile sheets shall be prepared for all waterline, sewer line, storm sewer and street improvements.
E. Placement of utilities in the rights-of-way and easements is per details #3725 and #3726
F. As applicable, a ODEQ permit shall be issued to the City prior to start of construction of any water or sanitary sewer system.
G. Materials shall be called out on plan set.
H. Developer is responsible for obtaining all required permits and approval of all submittals, including plan for filling, flushing, disinfection, and testing.
I. Obtain all permits necessary to cross or operate in the right-of-way or easement of ODOT, county, city, railroad, or other right-of-way owners. Incorporate permit requirements into plans and specifications.
J. Ensure that ODEQ requirements are met for horizontal and vertical separation from sanitary sewer lines, water lines, other buried utilities, underground storage tanks, other petroleum facilities, and onsite sewage treatment system components.

K. Design and install materials and parts in accordance with manufacturer's recommendations.
L. Prepare and submit an Engineering Report documenting the assumptions, calculations and considerations made to meet the requirements of these standards.
M. In all cases, floodplain requirements shall be met.
N. Site Stability and Stormwater Pollution shall conform to the city's Municipal Separate Storm Sewer (MS4) permit including but not limited to:
    a. Erosion protection measures called for in SWPPP in place prior to stripping top soil/or commencement of grading operations
        i. Temporary stabilization to be implemented for any disturbed area that is inactive for 14 days or more
        ii. Final stabilization to be implemented for all disturbed areas prior to issuing Certificates of Occupancy
    b. Construction of detention ponds/areas are to receive priority in grading
        i. Outlet works to be completed as soon as practical after finished grading
        ii. Outlet works to be completed before commencement of paving operations
        iii. Accumulated sediments in detention area to be removed and design volume restored, Developer's Engineer to certify volume is restored, prior to issuing Certificates of Occupancy
O. Organic materials such as grubbed vegetation, tree branches, root masses, etc. can be buried only in areas where no improvement (building, street, utility) on site is to be made.
P. Install all waterlines, sewer lines, sidewalk, storm sewer, streets, and appurtenances that will be dedicated to the public in accordance with City Standards and approved design.
Q. City provides automatic flushing hydrants and developer pays City at final approval of waterline plans or prior to issuance of work order.
R. Install metal tracer wire on all non-ferrous pipe.
S. Best Management Practices for stormwater shall be followed.
T. Developer shall maintain an accurate record of location, size and direction of the pipelines, manholes, service connections, and other improvements, as installed in the field. Locations shall use the pipeline stationing as shown on the plans or the distance from the first downstream manhole. Provide the record for incorporation into Record Drawings for the City.
U. Contractor shall notify the City and developer immediately if conditions in the field are identified that may prevent installation of the infrastructure in accordance with the approved design.
V. Design of earth retaining structures shall follow the requirements of the adopted edition of the International Building Code and any specialty considerations particular to special wall system. Construction plans shall provide adequate detail for construction of earth retaining structure(s).
W. Earth retaining structures for private development cannot be constructed within limits of public right-of-way or utility easements without a license issued with approval by the Stillwater City Council.
X. Design all sites to drain completely. Sinks or other areas of standing water are acceptable only as part of a stormwater collection or treatment system.
Y. All parts, pieces, materials, and any item used in construction shall be clean when installed.
Z. Notify the City of Stillwater 24 hours before placing concrete.
AA. Design all improvements to provide domestic water service without booster pumping.

BB. Design improvements to the sanitary sewer collection system without pumping. Designs requiring lift stations shall first be discussed with City Engineering Director or designee.

CC. Design improvements to the distribution system as components of a complete system.

DD. New service connections shall only be made to water mains that meet ODEQ and City of Stillwater pressure standards unless an exception to the City standard pressure is granted by the City Manager.

EE. Do not cross connect stormsewer, public water supply, or sanitary sewer systems.

1. Water Service Connections for domestic taps to any existing main, the City shall make the tap.
2. For all other taps to any existing main;
    a. The City shall make tap with reimbursement made by the developer.
    b. The developer may use a licensed plumber to make the tap
    c. The developer may use a water utility contractor to make the tap per the below
        i. The contractor is approved by the City of Stillwater
        ii. The supervisor of the crew is on site and has a minimum of a C license for water distribution or waste water collection
        iii. The work done by the contractor is inspected by City Engineering inspectors
3. Do not connect a service connection to a public main greater than 12 IN nominal diameter.
4. To connect to a main greater than 12 IN, provide a main extension and tap the main extension or construct a new fire hydrant leg with hydrant and connect to the fire hydrant leg.
5. Meters will be set by the City of Stillwater upon payment for meters 1-inch or smaller.
6. Meters over 1-inch will be billed per the established fee schedule A deposit equal to the amount in schedule is required at time of water meter application. Adjustments (refunds or additional billing) will occur after installation and the actual costs for City of Stillwater time and materials has been determined.

FF. The recommendations of any traffic impact study/analysis for the adjacent system/road shall be designed and constructed by the developer.

GG. All concrete flumes shall discharge into a drainage facility, channel or storm sewer system. The minimum freeboard shall be 1 FT above the WSEL (water surface elevation level) for the 1% (100-year) flood event.

HH. All buried pipe and fittings shall be protected from corrosion.

II. When existing or proposed utilities are located in the field at a different location than is shown on the drawings, continue to maintain the horizontal and vertical clearances from other utilities and obstacles shown on the drawings.

JJ. Site shall be stabilized and maintained to ensure against deterioration during rainstorms and windstorms.

KK. Special Inspection and Structural Observation Reports, when required, shall follow the guidance and requirements of the International Building Code, as well as the specialty material requirements contained in the Building Code, and as may be further required by the City Engineering Director.

LL. Maximum slope of finished grade for ground cover within the public way or easement: 4:1 in any direction.

MM. Maximum mow-able slope of detention areas privately maintained shall be no steeper than 3:1.

Part 3: Reports and Submittals

The following reports and similar technical summaries, studies, and detailed investigations are required as identified for the specific infrastructure. All Reports, Certifications, and Supporting Documents can be submitted electronically. All reports shall include a cover letter presenting the study for review.

A. Construction Plans and Profiles for water, sewer, street, sidewalk, stormwater.
B. Erosion Control Plan.
C. OKR10 Permit Authorization. A Notice of Intent (NOI/Form 605-002A) must be filed with the Oklahoma Department of Environmental Quality (ODEQ) by the applicant BEFORE any earthwork is begun. An NOI serves as the application for coverage of the facility under the ODEQ General Permit for Stormwater Discharges from Construction Activities within the State of Oklahoma (OKR10.) A copy of the OKR10 permit authorization received from ODEQ shall be submitted to the City of Stillwater.
D. Regulatory report (ie: ODEQ Engineering report)
E. Geotechnical Investigations and Reports that include:
    1. Location of trench sites, test wells, or bore holes.
    2. Depth of fill, compaction percentage of fill.
    3. Depth of trench sites, test wells, or bore holes through fill.
    4. Trench site, test well, or bore log and photo of location.
    5. Initial water level encountered and water level after twenty-four (24) hours.
F. Drinking Water System Engineering Reports.
G. Sanitary sewer System Engineering Reports.
H. Water and Sewer Demand Analysis
I. Street Improvements Engineering Reports.
J. Grading and Drainage Plans.
K. Traffic Impact Analysis.
L. Traffic Control Plans.
M. Storm Water Pollution Prevention Plan (SWPPP). Must be kept at the project site (or at a specified location as outlined in the OKR10 permit) and is to be made available for review upon request. The SWPPP shall be maintained, updated and annotated as a working document as changes are made in the field to adjust for various conditions and potential changes in the stormwater management program for the site in accordance with OKR10.
N. Drainage Study including any Stormwater Improvements Engineering Reports.
O. Any reports that include:
    1. Parameters or Methodologies Used in Report, Data Collection, Model, etc.
    2. Existing Site Conditions
        a) Topography.
        b) Infrastructure.
        c) Easements.
        d) Structures.
    3. Analysis of Findings or Results.
    4. Conclusions and Recommendations, signed and sealed by engineer.

5. Supporting Data including analytical data, detailed results of tests, modeling documentation and results, charts, etc.

END OF SECTION

Section 3 - Surveying and Drafting

Part 1: General

A. Benchmarks
   1. All control points or benchmarks shall be tied to the City control network.
   2. Set a City-provided monument at control points and furnish data to City.
   3. At least two permanent benchmarks shall be noted on any plan set stating elevation, location and description. The nearest such benchmark shall be shown on each sheet.
   4. Temporary benchmarks shall be a minimum of every 500 feet of street, water line, sanitary sewer line, and or storm sewer length.

B. Drafting Requirements
   1. All surveying and drafting shall be of such quality as to be legible.
   2. All drawings shall be provided on paper sized as:
      a) 22 inch x 34 inch drawings, or
      b) 24 inch x 36 inch drawings.
      c) 11 inch x 17 inch drawings are allowed for individual components of a plan set (such as a joint on a waterline)

C. Plan Sets
   1. Title sheet or cover sheet on all plan sets shall include:
      a) Project Title located across the top center of the drawing sheet.
      b) Project Location Map referencing plan sheet layout, major roads and Section/Township/Range.
      c) Drawing Index of all drawings contained within the plan set.
      d) Professional Design Firm Information with each design firm's name, address, and telephone number, certificate of authorization number with expiration date, and company logo.
      e) Oklahoma One-Call System (OKIE) logo.
      f) Professional Seal as required by Oklahoma law.
      g) Title Block.
   2. Label all components for utilities providing interference information, materials, lengths, and stationing.

Section 4 - Construction Standards

Part 1: General

A. Pre-Construction meeting shall be held prior to start of construction. Attendees include designer, contractor, developer, City inspector and Director of City Engineering or their authorized representatives.
   1. Attendees shall have authority to make decisions.
   2. Representatives shall provide written delegation of authority from developer, designer, and contractor.

B. Construction shall comply with City approved construction documents.
C. Comply with all aspects of Stillwater Stormwater Management Plan.
D. Do not bury or dispose of organic materials such as grubbed vegetation, tree branches and boles, root masses, etc. within any right-of-way, utility easements, drainage easements, and building pad locations. EXCEPTION: Materials may be buried in the bottom of a detention pond outside of any structures with approval of the City.
E. Comply with current local, state and federal regulations pertaining to the removal and disposal of facilities referred to as buildings and structures.
F. Site Work:
    1. All grass vegetated areas shall be maintained to less than 12-inches in height during construction.
    2. Provide stormwater pollution prevention controls in accordance with City Code.
    3. Mark and maintain edges of temporary and permanent public rights-of-way and easements as needed.
    4. Keep the premises free of accumulations of blowing trash and debris.
G. Record Drawings. Developer is responsible for providing a record drawing, signed and sealed by the design engineer, reflecting any changes to the improvements prior to acceptance by the City.
H. Approved construction documents shall be maintained at the job site.

Section 5 - Demolition, Earth Work, and Restoration

Part 1: General

A. Obtain demolition permit for any structures being demolished.
B. If partial demolition is required, ensure remaining systems or configurations continue to function as required.
C. Properly dispose of removed material.
D. Salvage topsoil before beginning any excavation.
E. Site Stability and Stormwater Pollution: during construction, protect against erosion, land subsidence, and mass movement.
F. Establish dedicated and managed stockpile areas.
G. Replace all materials excavated below the bottom of concrete footings, slabs on grade, foundations and pavements with engineered fill.
H. Do not bury or dispose of organic materials such as grubbed vegetation, tree branches and boles, root masses, etc. in rights-of-ways, easements or pad locations.
I. Obtain burn permit from the Stillwater Fire Department.
J. Any disturbed right-of-way or public easement shall be restored to conditions equal to or better.
K. Tree, shrub, or bush replacement in the right-of-way or public easement is only allowed with permission from the City Manager.

Part 2: Materials, not utilized

Part 3: Design, not utilized

Part 4: Execution

A. When removing foundations:
    1. Completely remove wall and footings within any proposed easement and right-of-way.

2. Remove piers (drilled shafts and driven piles) to 10 feet below the finished grade or the invert of any drainage facility or utility within proposed right-of-way and easement.
3. Determine plan coordinates and depth of piers and show on record drawings furnished to City.

B. Removal of pavement, curbs & sidewalks
   1. At the limits of pavement removal, saw the joint to line and depth to prevent under-break or shatter of adjacent pavement.

C. Abandoned Structures
   1. Remove abandoned structures to four feet below grade.
   2. Remove manholes, junction boxes and similar structures completely or per construction documents.
   3. Backfill and compact voids with City approved soil materials and compaction requirements.

D. Backfill all voids with select soil materials and compact to a minimum of 95% of Standard Proctor Density unless design states different compaction requirements.

E. Demolish concrete structures to at least 18 inches below finished grade.

F. Abandonment of Underground utilities per standard details.

G. Pavement, Curb and Gutter and Sidewalk Removal and Replacement
   1. Restore all damaged pavement, including road, sidewalk and other hard surface features to current standards.
   2. Preparation for paving and surfacing:
      a) Areas to be paved or surfaced shall be clean and free of materials which are not a part of the permanent pavement.
      b) Any existing pavement, surfaces, or walks against which new pavement is to be placed shall be saw cut along straight lines prior to pavement or sidewalk replacement.
   3. Subgrade preparation shall be per the design.

H. Turf:
   1. Sod or hydro-mulch all disturbed areas.
   2. Establish temporary erosion control using appropriate grasses and methods to obtain a complete and viable coverage of the disturbed area to prevent soil erosion and stormwater pollution in accordance with the City's MS4 program. Establish permanent stabilization as the season allows.
   3. Where landscaping has been placed and maintained by the City in a public right-of-way, restore completely.
   4. Sodding
      a) Provide sod free of the reproducing parts of weeds classified as "Prohibited Noxious" and free of other legally "Restricted Noxious" plant materials as required by the Oklahoma Department of Agriculture Seed Law.
      b) Place, stabilize, and water sod in such a manner as to ensure a viable stand of grass.
   5. Seeding:
      a) Hydro-mulch only allowed in right-of-way.
      b) Water seeded areas as often as necessary to maintain optimal soil moisture for establishment of a viable stand.
   6. Fertilizing:

a) Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 234 (Fertilizing and Agricultural Liming). Exceptions: Method of Measurement, Basis of Payment.
b) If fertilizer containing phosphorous is provided for sodded areas, incorporate the fertilizer into the soil.

Section 6 - Buried, Bored, or Encased Pipe

Part 1: General

A. Alignment:
1. Terminate piping system within public rights-of-way.
2. Impact moling/thumping is not allowed.
3. Bore pits shall be excavated to lessen the interruption of traffic and lessen the potential to compromise, intercept or damage roadway.
4. Valves, manholes, and other appurtenances shall be placed outside of parking areas and free from obstructions.
5. All piping system features shall be placed so they can be accessed by operation and maintenance equipment, including vacuum and cleaning trucks, valve exercising trailers, and other heavy equipment.
6. For parallel runs, locate pipe so that the edge of a 6 foot wide excavation centered on the pipe will be at least 1.5 feet above the flowline of any adjacent bar ditch, drainage, or channel.
7. Minimum horizontal distance from centerline of pipe to edge of public right-of-way or easement shall be 5 feet.
8. Safety fencing required around excavation.

B. Bury Depth and Cover:
1. Ensure that mains are designed in coordination with other infrastructure and final grading so that driveway cuts, drainage channels, buried utilities, and other underground obstructions can be constructed without encroaching on the required minimum cover.
2. Design water mains with minimum depth of cover as established by ODEQ.
3. Maximum depth, finished grade to flowline: 12 FT.
4. Encase all lines under arterial streets. Extend encasement to minimum 2 FT beyond back of curb or toe of back slope of ditch.
5. Underground creek crossings:
   a) Completely restrain all joints between creek banks.
   b) Install pipe and encasement with minimum 5 FT of cover
   c) Stabilize creek bank.

C. Thrust Restraint (pressurized main only):
1. Provide thrust restraint in the form of mechanical restrained joints in accordance with AWWA manuals of practice for the pipe materials.
2. Thrust blocks may be used in special conditions with approval from City Engineering.
3. Pressure Pipe layout shall be designed to utilize no more than 50% of the manufacturer's recommended joint deflection.

D. Thickness Design:
   1. General:
      a) Design pipe to accommodate both internal pressures and external loads.
      b) Design flexible pipe materials to meet manufacturer's recommendation or ODEQ standards.
      c) Polyvinyl chloride (PVC), including fusible PVC shall be designed in accordance with AWWA Manual of Practice M23.
   2. Polyethylene (PE) water main and sanitary sewer main:
      a) Design pressure pipe for pressure class and external loads in accordance with AWWA Manual of Practice M55.
      b) Working Pressure Rating for pressure pipe: Surge Allowance, greater of 2 FPS or flow velocity under maximum system demand.
      c) Hydrostatic design basis: greater of 150 PSI or system pressure at zero demand.
      d) External load: For E', assume fine-grained soils with plasticity index (PI) over 19.
      e) High Density Polyethylene (HDPE) service line: AWWA C-901, PE 3408, DR 9, or DR11.
   3. All other pipe: Design in accordance with manufacturer's recommendations.

Part 2: Materials

A. General:
   1. Mechanical Joint ends shall conform to AWWA C111.
   2. Flanged ends: conform to ANSI B16.1, Class 125.
   3. T-Bolts, flange bolts, and nuts must be able to withstand the design force/pressure.
   4. Below grade: Tyler Union Cor-Blue or equivalent.
   5. Tracer wire must be solid 12 gauge copper, be rated for direct bury and be insulated per APWA.
   6. Tracer wire splice: 3M DBY or equivalent.
   7. Warning Tape shall be of a material that is non-detectable and at least 3-inches wide and must be labeled as "CAUTION [WATER/SANITARY SEWER/ STORM SEWER/ (OTHER)] LINE BURIED BELOW"
   8. Acceptable Restraint Devices shall meet the appropriate AWWA specs for the corresponding pipe material
   9. Pipe Embedment:
      a) ASTM D2321 or ODOT bedding material.
      b) Flowable fill: ODOT Controlled Low Strength Material with a 28-day compressive strength: 300 PSI maximum, 200 PSI minimum.
      c) Concrete embedment: ODOT Class C, 2,400 PSI, 28 day compressive strength.
   10. Pipe Supports: Anvil Figure 264 pipe saddle support with Figure 63 Type T pipe stanchion, all hot-dip galvanized or equivalent.
   11. Cut sheets reviewed and accepted by design engineer.
   12. Provide equipment and materials meeting AWWA specifications.
   13. All materials touching drinking water shall conform to NSF Standard 61.
   14. Gaskets: conform to AWWA C111 and NSF-61.
   15. All components shall be rated for minimum 150 psi working pressure.

B. Drinking Water:

1. Nuts, bolts, and hardware: 304 stainless steel with anti-galling protection for threads.
2. Interior and exterior: fusion bonded epoxy, minimum 10 mil DFT, AWWA C116, C213 or C550 compliant, as applicable
3. Fire Hydrants and Flushing Hydrants Operating Nut:
    a. AWWA standard, pentagonal, 1-1/2 IN from point to flat at the base of the nut. – delete if council approves city supply FH
    b. Color: Federal Standard 595A 31105 Red
    c. Breakaway design
4. Pipe:
    a) Polyvinyl Chloride (PVC), including Fusible PVC (FPVC): Compliant with AWWA C900, DR18.
    b) High Density Polyethylene (PE): AWWA C901 or C906 compliant, DR9.
    c) Allowable joints:
        1) Butt fused.
        2) Butt fused MJ adapter acceptable for transition from PE to fittings and other pipe materials.
5. Fittings Materials:
    a) Fittings:
        1) HDPE, butt fused to HDPE pipe.
        2) Protected Ductile Iron (epoxy or approved coating).
    b) Allowable joints (AWWA C110 compliant):
        1) Mechanical joint, AWWA C111 compliant.
        2) Proprietary integrally restrained: US Pipe TR Flex, ACIPCO Flex-Ring, Griffin Snap-Lok or Approved Equal, only when compatible with pipe material.
    c) PVC fittings are not acceptable.
    d) PE and FPVC fittings:
        1) Acceptable only when butt fused to the same pipe material.
        2) Manufacture to serve same test and operating conditions as connected pipe.
        3) Fabricated fittings are acceptable with no more than 30 degrees per segment.
6. Couplings and Adapters:
    a) Meet or exceed pressure ratings of piping system.
    b) Sleeve couplings: AWWA C219 compliant.
        1) Required Features
        2) End Rings: Ductile Iron.
        3) Center Ring: ASTM A283 Grade A steel or Ductile Iron.
        4) Bridge: 304 stainless steel.
7. Gate Valves: AWWA C509 or C515 compliant.
    a) Body: ductile iron.
    b) Stem: bronze.
    c) Resilient wedge style.
8. Valve operation:
    a) Operating nut opening direction: counterclockwise.
    b) Non-rising stem.
    c) Buried: 2-IN square AWWA operating nut.

d) Exposed: hand wheel, maximum 10 LB tangential force required to operate valve under any operating condition.

9. Valve boxes for buried AWWA nut valves: (detail)
   a) Risers: single continuous length of 6-IN C-900 PVC DR 18 or Schedule 40 PVC.
   b) Valve box frame and cover:
      1) Cast iron or ductile iron.
      2) East Jordan Iron Works Type 70 or Equivalent.
      3) The word “WATER” shall be cast in each cover.
10. Valves.
   a) Ball valves for air valve isolation, test ports, sample ports, gauge isolation valves, and other small diameter exposed piping:
      1) Body: brass, less than 15% zinc.
      2) Ball: stainless steel or brass.
      3) Seal: Buna-N (nitrile) rubber
      4) Handle: stainless steel.
      5) Full port.
   b) Check valves:
      1) For mains and other large diameter pipe:
         i. AWWA C508 compliant
         ii. Single disc
         iii. Swing type, Horizontal shaft
         iv. Fill diameter passage
         v. Provide outside lever and weight or spring
         vi. Provide anti-slam trim
         vii. Disc face: bronze
11. Backflow preventer assemblies: compliant with the Plumbing Code and manufacturer’s specifications.
12. Air relief valve assemblies:
   a) Air valve:
      1) AWWA C512 compliant.
      2) Air / vacuum valves are not acceptable. Use combination air valves instead.
      3) Linkage and float: 304 stainless steel.
   b) Vent:
      1) Piping: ductile iron or cast iron, flanged outlet.
      2) Screen: 316 stainless steel.
   c) Vault: (detail)
      1) With removable lid
      2) "Water” cast into cover.
   d) Valve size 1 IN through 2 IN: Construct connection to main as service line.
   e) Valve size greater than 2 IN: If detail is not provided, notify City and Engineer immediately for direction.
13. Tapping Sleeves and Valves for Mains:
   a) Tapping sleeves less than or equal to 12 IN nominal diameter:
      1) Body: 304 stainless steel.

2) Outlet: 304 stainless steel or ductile iron, flanged ANSI B16.1, Class 125, recessed to accept tapping valve.

b) Tapping sleeves greater than 12 IN nominal diameter not allowed.

c) Tapping valves shall be as isolation valves with Exception: provide one end flanged to match tapping sleeve.

14. Fire Hydrants. City provides; contractor pays.
15. Flush Hydrants:
    a) Post Hydrant.
        1) 2-1/2 IN nozzle.
        2) MJ inlet.
16. Automatic Flushing System. City provides; contractor pays
17. Valve Vaults (detail)
18. Service Connections:
    a)
    b) Brass Fittings and Accessories:
        1) General:
            i. Minimum 2-inch penetration into the body of the fitting.
            ii. Connections to service line pipe: Grip Joint (with stainless steel insert stiffener when connecting to PE pipe).
        2) Corporation Stops:
            i. AWWA taper thread
        3) Meter setters (3/4 IN through 2 IN):
            i. Setters must be manufactured, no homemade accepted
            ii. Inlet valve: angle ball meter valve with padlock wing.
            iii. Outlet valve: none.
            iv. Bypass: none.
            v. Setter height: minimum 12 IN.
            vi. Inlet and outlet orientation: horizontal.
            vii. Backflow preventer.
        4) Customer Shut-Off Valves:
            i. Brass Ball Valve Curb Stop, Ford B-Series or Mueller 300 series.
            ii. Stop and waste feature strictly prohibited.
    c) Meter Enclosures:
        1) Paved and Non-Paved Areas, Occasional Traffic (ex: driveways, alleys, and parking lots): Armorcast A6001545 Fiberglass round FRP vault or ANSI Tier 15.
        2) Meter Size greater than 1-IN through 2-IN, Paved or Non-Paved, Occasional Traffic (ex: single family residential driveways, alleys, and parking lots): Armorcast A6001509TAX36 24”x 36” FRP box and cover assembly or ANSI Tier 15.
        3) Meter Size greater than 2-IN, Paved or Non-Paved, Occasional Traffic (ex: single family residential driveways, alleys, and parking lots):
            i. Concrete vault with hatch being Halliday Series H2R Access Door or Bilco Single Leaf Access Door type J-H20 Exterior.
            ii. ANSI Tier 15, designed for 20K loading.
    d) Any Size, Paved or Non-Paved, Continuous Traffic: not allowed.
19. Customer Side Valve Box:

a) Non-Paved, No Traffic:
   1) Box and Lid: Rainbird PVB6RND 6-IN Round Valve Box
   2) Riser: 6-IN Schedule 40 PVC.
b) Pavement or Any Motorized or Vehicular Traffic: Construct as public main meter box, without concrete apron.

C. Bored or Encased Pipe
1. Casing:
   a) Steel
      1) Minimum yield strength: 35,000 psi.
      2) Min wall thickness: ¼ inch
      3) Install straight and on grade
      4) 2 inches over outside carrier pipe diameter
   b) PVC not allowed
   c) Casing shall be vented a minimum of 2 inches. (See detail for venting)
2. Casing End Seals: GPT Model S or equivalent.
3. For bell and spigot carrier pipe in encasement longer than 36 LF, estimate the required insertion force and verify that the pipe manufacturer's maximum insertion force will not be exceeded.
4. Casing Spacers:
   a) Cascade Waterworks Manufacturing Phoenix Gold, GPT Model PE, or equivalent.
   b) Size spacers to match casing inside diameter less 1 IN of clearance (“restrained”).
   c) Casing End Seals: GPT Model S or equivalent.
5. PVC and FPVC: not allowed

D. Not Encased
1. Bell and spigot PVC may be allowed upon demonstration that the bell and spigot connection and any external or integral restraint devices are designed for bored installation and are suitable for the length and type of installation proposed.
2. Not Acceptable for Creek Crossings.

E. Sanitary sewer Manholes
1. Precast Concrete:
   a) Precast concrete sections shall be in accordance with ASTM C478.
   b) Minimum base thickness: 8 IN.
2. Cast In Place Concrete:
   a) Minimum 4000 PSI at 28 days.
   b) Minimum base thickness: 12 IN.
3. Rubber gaskets:
   a) Conforming to ASTM C443.
4. Pipe seals:
   a) Conforming to ASTM C923.
5. All concrete manholes shall be coated on the interior with an Epoxy, PVC, or Polyethylene liner meeting product manufacturer’s recommended thickness.
6. Frame and Cover:
   a) Cast iron, conforming to ASTM A48.
   b) Manholes subject to inundation by flooding shall be a watertight assembly, including neoprene gasket and gasket groove cast into lid.

c) "Sanitary Sewer" cast into the lid.
d) Lifting method: pick bar. Pick holes and vents are not acceptable.

7. Manhole ring seal shall be sealed with a sealant approved for sanitary sewer use.
8. Non-shrink grout shall be specified for sanitary sewer use.

F. Sanitary sewer Pipe: under wastewater pipe we need to add steel pipe as a casing option (RG 9.25)

1. Gravity Mains:
   a) 8-inch minimum nominal diameter
   b) Polyvinyl Chloride (PVC), including Fusible PVC (FPVC):
      1) Conforming to ASTM 3034 (gravity), ASTM 2241, AWWA C-900, or AWWA C905.
      2) Allowable joints: push-on. Gaskets: ASTM F477.
   c) High Density Polyethylene (PE):
      1) Conforming to AWWA C900/C906.
      2) Allowable joints: butt fused.
   d) City Engineering Director shall consider other materials when requested by the engineer of record.
2. Pressure Mains:
   a) Minimum nominal diameter as required by design
   b) Polyvinyl Chloride (PVC), including Fusible PVC (FPVC):
      1) Conforming to AWWA C-900.
      2) Allowable joints: push-on, butt fused FPVC.
   c) High Density Polyethylene (PE):
      1) Allowable joints: butt fused.
      2) Fittings: HDPE, butt fused.
   d) In Casing (Bored or Open Cut, Including Creek Crossings):
      1) PVC: ASTM D3034, DR26 minimum.
      2) HDPE: AWWA C901/906, DR 9 minimum.
      3) Fusible PVC: Underground Solutions FPVC or Equivalent, DR26 minimum.
   e) Fittings:
      1) Ductile iron:
         i. Allowable joints:
            - Mechanical joint, conforming to AWWA C110 or C153.
            - Proprietary integrally restrained only when compatible with pipe material.
      2) PE and FPVC:
         i. Acceptable only when butt fused to same pipe material.
         ii. Manufacture to serve same operating conditions as connected pipe.
         iii. Only molded fittings are acceptable.
      3) Couplings and Adapters Meet or exceed pressure ratings of piping system.
3. Valves
   a) Connections:
      1) Exposed: flanged, conforming to ANSI B16.1, Class 125.
      2) Buried: mechanical joint.
      3) Nuts, bolts, and other threaded hardware: A36 steel.
      4) Other hardware: Type 304 stainless steel.
      5) Flanged valves shall conform to the dimensions of ANSI B16.10.

6) Exterior and Interior coating: fusion bonded epoxy, minimum 10 mil DFT.
7) Plug Valves:
   i. 4 IN nominal diameter and larger:
   ii. Eccentric plug type only with resilient face.
      - Body: ductile iron.
      - Stem: bronze.
   iii. Port area greater than or equal to 80% of full pipe area.
   iv. Corrosion and abrasion resistant, such that exposure over a period of five years to domestic sanitary sewer, industrial sanitary sewer, domestic sludges or industrial sludges containing sulfuric acid, hydrochloric acid, acetic acid, mineral oils, vegetable oils, polymers, esters or acetones shall not result in sufficient corrosion to interfere with the serviceability of the plug valve.
   v. Seals shall be capable of being replaced while the line and valve remain in service, if under submerged conditions, thereby eliminating the need to take process units out of service.

4. Check valves:
   a) Conforming to AWWA C508.
   b) Horizontally mounted, single disc, swing type with full diameter bore.
   c) Provide anti-slam hydraulic cushion.
   d) Materials: Disc faces and seat rings: bronze.
5. Air Valves
   a) Locate vents at least 12-inches above the 100-year floodplain or as required by ODEQ, whichever is more restrictive.
   b) Provide air and vacuum relief valves at local high points.
   c) Air valve vault top slab elevation:
      1) Minimum 3-inches above highest adjacent grade
      2) Maximum 3-feet above highest adjacent grade
6. Valve boxes
   a) Risers: single continuous length of 6 IN Valve box frame and cover:
      1) Cast iron or ductile iron.
      2) The word “SANITARY SEWER” shall be cast in each cover.
      3) Concrete collar: 6 IN thick by 2 FT x 2 FT square, steel reinforced, concrete collar.
7. Service Connections
   a) Tapping Saddle: Allowable tapping saddle model: Romac CB sewer saddle or per IPC excluding flexible.
   b) Service Line Pipe and Fittings:
      1) PE:
         - DR 9.
         - Match tap diameter.
         - Provide stainless steel pipe stiffeners for compression type joints.
      2) PVC: Schedule 40 PVC within the right-of-way.

G. Stormwater System
   1. Junction boxes and manholes (copy from WW for materials)
   2. Manhole frames and covers:
      a) All manhole frames and covers shall be cast iron.

b) Lids shall be cast to identify 'Storm Sewer'.

3. Storm sewer piping:
   a) The following pipe is allowed for storm drainage within City of Stillwater rights of way and publicly maintained easements:

Description	**AASHTO**	**ASTM**
Reinforced concrete culvert and pipe	M170	C76
Reinforced concrete arch culvert	M206	C506
Reinforced concrete elliptical culvert	M207	C507
High Density Polyethylene (HDPE)	M252	D3350

   b) Preformed end sections for HDPE are not allowed for storm sewer system discharge locations within public rights-of-way or easements dedicated for public maintenance.
4. Curb Openings (Hoods)
   a) Curb openings (hoods) shall be manufactured per ODOT.
   b) Curb openings will be cast with a 'No Dumping Drains to Creeks' message, or accepted equivalent, to support stormwater quality.

Part 3: Design

A. Drinking Water:
   1. Modeling of Proposed Distribution System Improvements:
      a) Analyze system improvements by modeling the proposed improvements in accordance with methods described by AWWA M22, M31, and M32.
      b) Provide node information for insertion at each pipe junction, service connections over 2-inches, and fire hydrant.
      c) Provide node information for local highs and local lows to verify maximum and minimum pressures.
   2. At the connection point of the proposed improvements, coordinate with the City to obtain:
      a) The system's daily HGL, as predicted by the City's water system model.
      b) The design capacity as one or more pressure-demand curves.
      c) System water age at connection point of proposed improvements to the existing system.
   3. List and describe all assumptions and boundary conditions, including:
      a) Demands:
         1) Include per-connection demand patterns for highest and best use. Account for use, fire suppression system flow, and fire hydrant flow.
         2) All demand curves must be approved by the City.
         3) Determine future demands as a cooperative effort with the City.
         4) Utilize records of existing demand volumes and patterns where available. Where not available, assume demands consistent with other similar areas served by the City.
         5) Consult with the City to determine expected future growth patterns or other pertinent factors that may affect system design. Identify opportunities to partner with the City to integrate the proposed improvement with plans for overall development of the water distribution system.
   4. Scenarios:

a) Present day conditions and Highest and Best Use:
   1) Peak day peak hour (EPS).
   2) Average of peak day with fire hydrant flow and flushing hydrant flow (steady state).
   3) Zero demand (static conditions) (steady state).

5. Developer may request City Engineering Staff do the modeling per the following
   a. Developer's engineer provides preliminary layout and size of proposed improvements in a schematic form
   b. Developer's engineer provides proposed demands
   c. Developer's engineer agrees to consult with City Staff on findings and needed revisions
   d. Developer's engineer completes the design process of the system
   e. Developer agrees to reimburse City for staff's time in excess of the normal review process. Normal review consist of staff time to inputs model into the existing city model and meetings with developer's engineer to discuss inputs and results.
6. Reporting data is provided by the City and will include:
   a) Minimum and maximum pressure at each node.
   b) Maximum pipe velocity in each link.
   c) Estimated surge pressure for rapidly closed hydrants and isolation valves
   d) Fire flow at hydrant nodes.
   e) Maximum water age at each node.

B. Water Mains:
1. New water mains shall be designed to operate within the Operating Pressures:
   a) City of Stillwater Minimum Operating Pressure: 40 psi at all times, at any system condition other than fire flow or flushing.
   b) The pipe is rated for the Maximum Operating Pressure of 100 psi.
   c) Low Pressure Water Mains: the City Manager may allow a new water main to be designed to operate at less than the City of Stillwater Minimum Operating Pressure, subject to the following conditions:
      1) It has been demonstrated by the developer and confirmed by the City that the Standard Minimum Operating Pressure can't be achieved without pumping.
      2) All other requirements for new water mains are met.
      3) The proposed Low Pressure Water Main will be connected to a continuous network of public water mains from the water treatment plant.
      4) The addition of a Low Pressure Water Main and associated service connections shall not cause existing mains or service connections to fall below the Standard Minimum Operating Pressure. For existing mains and service connections that are already below the Standard Minimum Operating Pressure, the addition of a Low Pressure Water Main and associated service connections shall not cause a pressure reduction in the existing mains or service connections.
      5) A schematic plan showing the approximate proposed location of the Low Pressure Water Main and all of the properties that are adjacent to or to be served by the water main.
      6) The minimum operating pressure in a Low Pressure Water Main shall be the minimum as set by ODEQ.
2. Bury Depth and Cover:

a) When connecting to existing mains that have less than the required minimum cover, use fittings or pipe deflection per manufacture's specs to reach the required depth.

3. Fire Flow Design:
   a) Design system to deliver fire flow in accordance with ODEQ regulations, adopted I-Codes, and AWWA M31.
4. Pipe Diameter:
   a) Minimum nominal diameter: 6 IN for fire flow.
   b) Minimum nominal diameter: 2 IN for meter looping at cul-de-sacs.

C. Dead End Mains and Looping:
   1. Dead End Water Main: Any dead end that has insufficient usage to cause complete water turn over for daily demand must have a means to be flushed.
   2. Provide an automatic flush hydrant assembly at the end of all Dead End Mains.
   3. For looping purposes at cul-de-sacs, less than a 6-inch pipe may be allowed with a demonstration of adequate flow and pressure. The pipe must be looped to a minimum 6-inch main.
D. Creek Crossings:
   1. Aerial crossings are not acceptable
E. Service Connections:
   1. Meters:
      a) Meter locations shall be accessible
      b) Meters shall be located within the right-of-way or an easement
      c) Meters not to be placed in a driveway –
      d) Meters installed in sidewalk shall be per detail…#3408 allowed in sidewalk only if demonstrated there no other place for it.
      e) Meters are prohibited in drainage ways.
      f) The City will provide and install the meter.
   2. Provide an isolation valve where the service is connected to the public main.
   3. For service from a public main larger than 12-IN, either:
      a) Construct a public main extension and connect the service connection to the main extension, or
      b) Install a new hydrant leg and connect the service to the hydrant leg.
F. Backflow Prevention:
   1. Provide backflow protection in accordance with AWWA M14 and as required by the Plumbing Code.
   2. Backflow prevention devices are private property.
G. Fire Hydrant Assemblies:
   1. See Standard Detail 3402.
   2. Spacing shall meet the spacing requirements described by Appendix B of the latest adopted edition of the International Fire Code.
   3. Equip each hydrant with a gate valve so that the hydrant can be maintained without interruption of service to the rest of the distribution system, including any services that may be connected to the hydrant service line.
   4. Fire hydrant barrel drains shall not be connected to the storm drainage or the sanitary sewer.
   5. Hydrant legs are limited to maximum 5 LF length.

H. Isolation Valves:
   1. Only gate valves are acceptable for water mains 12-inches or less.
   2. Maximum spacing between valves shall be the closer of:
      a) ODEQ requirements.
      b) Existing or future residential, commercial, industrial and school zoning: 500 FT.
      c) Other Areas, including agricultural, park, and rural: 1,320 FT.
   3. Install isolation valves on all four legs of a cross and all three legs of a tee. When two lines are connected by two tees and a jumper, one valve on the jumper may be eliminated. An isolation valve is required only on the hydrant leg of a hydrant tee. A hydrant tee is a tee that serves only a hydrant. A tapping sleeve is considered a tee. Developer may install a tapping sleeve and utilize existing system valves to fulfill the above requirement for a valve on all three legs of a tee.
   4. Locate valves on each side of a highway or arterial street crossing. Locate a valve on one side of a collector street crossing. Locate valves outside of ODOT or County right-of-way wherever practical.

I. Blow-off Assemblies:
   1. Locate a blow-off assembly or fire hydrant at all creek crossings and local low points, to facilitate draining the lines.
   2. Adjust grade of lines to eliminate low points and associated required blow-off assemblies wherever possible.

J. Air Valves: detail 3404
   1. Provide air and vacuum relief valves where recommended by AWWA M51.
   2. Locate air valve vents at least 12 IN above the 100-year flood plain.
   3. Vaults located in the 100-year floodplain shall be water tight.
   4. Air valve vault top slab elevation in areas identified by the City or other regulatory body as being subject to flooding in a 100-year (1%) storm event:
      a) Minimum: 6 IN above highest adjacent grade.
      b) Maximum: the lower of:
         1) 3 FT above highest adjacent grade.
         2) 12-inches above the 100-year FEMA flood plain.
   5. Adjust grade of water main to minimize high points and associated required air valves wherever possible.
   6. Adjust grade of water main to ensure that the completed air valve assembly height will not require that the valve vault extend more than 6 IN above finished grade.

K. Rural Water System
   1. The number of domestic service connections is limited to the following maximums. Where the inside diameter of an existing main is not equal to one of the listed line sizes, the maximum number of connections is limited to the number associated with the next smaller listed line size.

Line Size (inside diameter)	**Maximum Number of Service Connections**
Less than 2”	1
2”	10
2-1/2”	25
3”	50
4”	100

6”	250
8” or greater	Per design

2. System Design:
    a) Distribution System Modeling shall meet City design requirements
    b) Provide flush hydrants at the ends of all dead end mains, at low points to serve as blow-offs. Fire hydrants are not acceptable.

L. Sanitary sewer
    a) Modeling of Proposed Collection System Improvements:
    b) General:
        1) Analyze proposed system improvements by modeling the proposed improvements in accordance with methods described by WEF Manual of Practice FD-5.
        2) For improvements including less than 1000 LF of sewer line and less than 10 new service connections at Full Urbanization, hand or spreadsheet calculations are acceptable as modeling.
        3) For all other improvements, modeling must be completed using computer software such as EPA’s SWMM (free) or other package.
        4) Provide a node for each manhole.

1. List and describe all assumptions and boundary conditions, including:
    a) Demands:
        1) All demand curves must be approved by the City.
        2) Determine highest and best use demands.
        3) Utilize records of existing demand volumes and patterns where available. Where not available, assume demands consistent with other similar areas served by the City.
    b) Inflow and infiltration contribution to flows:
        1) Minimum Peaking Factors – (peak hour flow + I/I) / (average daily flow):
            - Pipes with diameter less than or equal to 12 IN: 4.
            - Pipes greater than 12 IN: 2.5.

2. Developer may request City Engineering Staff do the modeling per the following
    a. Developer’s engineer provides preliminary layout and size of proposed improvements in a schematic form
    b. Developer’s engineer provides proposed demands
    c. Developer’s engineer agrees to consult with City Staff on findings and needed revisions
    d. Developer’s engineer completes the design process of the system
    e. Developer agrees to reimburse City for staff’s time in excess of the normal review process. Normal review consist of staff time to inputs model into the existing city model and meetings with developer’s engineer to discuss inputs and results.
    a) Scenarios and Reporting: Present day conditions and Highest and Best Use scenario: Peak day EPS or peak day peak hour steady state.
    b) For peak day peak hour scenarios, report: velocity, volumetric flow rate, and depth of flow in each pipe segment and manhole.
    c) Exposed: exposed or aerial installations may be allowed upon demonstration that aerial installation is the best or only feasible alternative. Requests shall include:
        1) A layout of alignment alternatives.

2) A design for support, insulation, and protection of the pipe from weather and damage.
3) Demonstration that the pipe can be accessed for operation and maintenance.

3. Pumped Sewage System Design
   a) Pumps in the sanitary sewer collection system are only allowed when approved by the City during pre-design conference.
   b) City will provide standards for pumped sewage systems, as applicable.

Part 4: Execution – Construction

A. Water Construction
1. Pipe Installation:
   a) Install by the open cut method (trenching) except where trenchless installation has been approved.
   b) Minimum cover:
      1) Mains: 30 inches.
      2) Service: 30 inches below paving or storm sewer, 18 inches cover otherwise
   c) Thoroughly clean each joint of pipe and fitting before installing and keep clean for the duration of the project.
   d) Seal open pipe ends of installed pipe whenever pipe laying operations are not in progress to prevent animals, sediment, and other contaminants from entering.
   e) Ensure that at least 3 FT of pipe remains between each pipe end, service connection (active or inactive), corporation (active or inactive), repair sleeve, tapping sleeve, or any other pipe connection.
   f) Backfill and compact to a minimum of 95% of standard proctor density within the right-of-way and 90% within an easement.
2. Isolation Valves:
   a) Install all water main isolation valves in the open position, unless otherwise approved as part of an approved plan for testing and connecting the new main to the existing system.
   b) Support valves so that the pipe is not required to support the valve weight. Install and support so that valve and pipe are not stressed and that the pipe at the valve/pipe connection are not deflected.
   c) Set gate valves with shaft in the vertical position, plumb.
   d) Valve boxes, see detail.
3. Tapping Sleeves and Valves:
   a) Test the installed tapping sleeve body with water or nitrogen.
   b) Size-on-size taps are not acceptable. Maximum size of tap is limited to 1 size smaller than the main.
   c) Tap hole may be no smaller than 90% of the inside diameter of the tapping tee branch.
   d) Retrieve the coupon and make it available to the inspector.
4. Fire Hydrant Assemblies shall be set per standard detail 3402.
   a) Mueller Hydro Guard Permanent Flushing System HG3 Cold Climate Model
   b) Low profile green enclosure
5. Service Connections:
   a) General:
      1) Flush service line prior to connecting meter (meter set by City only).

b) Service saddle installation:
    1) Thoroughly clean pipe exterior prior to installing service saddle.
    2) Protect locator wire from damage.
    3) Install service saddle and corporation stop no lower than horizontally from the center of the water main.
    4) Tighten bolts uniformly and to manufacturer's recommended torque.
    5) Do not cover service saddle and main until city inspector has approved the saddle installation.
c) Service line installation:
    1) Route water service lines, between the meter and the public main, perpendicular to the nearest boundary of the easement or property containing the public main.
    2) Install service line, fittings, valves, tracer wire, embedment material, and warning tape.
    3) Pressure test service line from main through curb stop.
    4) Flush service line through curb stop.
    5) Re-embed main bedding material, repair main locator wire, and (re)place warning tape.
    6) Identify service crossing by marking or branding the curb over the service line.

6. Ferrous Fittings:
    a) Factory coated with epoxy or polyurethane per AWWA C210-15 or C222-08.
    b) Inspect for coating damage and repair with like coating prior to installation.
7. Air Valves:
    a) Valve vault top minimum 6 IN above highest finish grade.
    b) Completely support valve assembly. Do not use connecting pipe to support valve.
    c) Vent to outside of vault with down facing vent and screen, minimum 12 IN above vault top.
8. Valve operation:
    a) Operating nut opening direction: counterclockwise.
    b) Buried: operating nut: 2-IN square.
    c) Exposed: provide a hand wheel with the closing direction clearly indicated.
    d) Maximum required input torque under any condition: 10 FT-LB.
    e) Provide a gear box if necessary to achieve required input torque:
        1) Provide gear box completely enclosed and lubricated to prevent entry of dirt and fluid into the actuator.
        2) Provide shaft bearings with permanently lubricated bronze bearing bushings.
        3) Provide valve position indicator on exposed gear boxes.
        4) Provide adjustable stops designed to withstand 200% of the maximum required input torque.
9. Blow-Off Assemblies: underground not allowed.
10. Filling:
    a) Provide 48 hours-notice, as directed during pre-construction conference to request filling of line.
    b) Keep all valves closed to existing connecting mains until the new main has passed disinfection testing.
    c) Ensure that hydrants and air valves on the new line are open prior to filling.
    d) Do not fill the line. City staff will operate valves to fill the line. If utilizing a method other than opening a connected main line isolation valve, provide all piping and hardware

required to connect the new main to a potable water source. Fill the line at a rate no greater than 1 FT/S.

e) Install corporation stops at high points, without ARV's, to evacuate trapped air. Remove corporation stop and plug corporation after pressure testing and disinfection are complete. Mark the locations of the corporation stops on the recorded drawings.

11. Testing:
    a) Pressure testing and leakage testing may be performed concurrently only if corporation stops or other means are provided to ensure that the water in the new main adjacent to the connected existing system is highly chlorinated
    b) Hydrostatic Testing:
        1) Test in accordance with the AWWA standards and manuals of practice applicable to the pipe material(s) installed.
        2) Test medium: drinking water. Air testing is not acceptable.
        3) Minimum test period: 2 hours.
        4) Test pressure: 150 psi. Engineer may specify a higher test pressure appropriate for the system design.
        5) Measure test pressure relative to the lowest elevation of the test section.
        6) Maximum allowable pressure gauge increment: 5 psi. Use two gauges to verify accuracy.
        7) If any visible leaks are observed or pressure drops greater than allowed, the system will have failed the test. Correct the leakage and repeat the test until the system passes the test.
        8) Disinfection Testing to be performed by City staff:
            A. Gather samples and conduct bacteriological testing to verify the sanitary condition of the installed pipeline, in accordance with AWWA C-651 and ODEQ regulations.
            B. If the tested section fails the test, take corrective measures, and repeat testing.
            C. If any tested section fails two disinfection tests, take corrective measures, perform disinfection again, and repeat testing.
12. Flushing and Disinfection:
    a) Verify that the disinfecting agent is compatible with the existing distribution system prior to beginning disinfection operations.
    b) Disinfect the line in accordance with AWWA C-651.
    c) Dispose of chlorinated water in accordance with applicable law and AWWA C651.
13. Abandonment of Existing Infrastructure:
    a) Mains: remove or leave in place and fill will flowable fill.
    b) Valves:
        1) Remove valve box and backfill appropriately.
        2) Under pavement, it is acceptable to remove only the lid and fill the valve box.
14. Meters
    a) Locations shall be unobstructed and accessible to City of Stillwater for maintenance
    b) Meters shall be located within the right-of-way or easement
    c) Meters are allowed in a driveway or sidewalk with City Manager approval and according to standard detail
    d) Meters are prohibited in any drainage way
    e) Developer installs construction can until City sets permanent can with meter set

f) Construction Enclosures shall be located no more than 18 inches from back of curb with service having curb stop.
g) Termination of service shall be below ground in a construction can with a metal lid.
h) Construction Enclosures shall be located no closer than 5 feet to the property line.

B. Sanitary Sewer Construction

1. Manhole Installation:
   a) General:
      1) Excavation outside manhole shall be minimized.
      2) Precast Manholes shall follow manufacture's specifications.
      3) Precast Bases: install on embedment material.
      4) In flood prone or drainage ways, provide sealed and locking lid (not bolt-down).
   b) Bench and Invert:
      1) Slope the bench and invert to drain completely.
      2) Smooth the transition between pipe and invert with grout. Ensure complete drainage.
   c) Grade Adjustment:
      1) Ensure all manholes are adjusted to finished grade.
      2) Adjustments shall be made with reinforced concrete adjustment rings.
      3) Seal with preformed bitumastic sealant to prevent water infiltration.
      4) Maximum height between top of cone and bottom of frame: 24 IN.
      5) If the top of an existing manhole is required to be raised to an elevation that will exceed the maximum adjustment distance or lowered more than the adjustment rings will allow, replace the corbel or a wall section.
   d) Backfill:
      1) Ensure that backfill around manhole structures is compacted to 95% within ROW and 90% within easement.
2. Connection to Existing Mains
   a) Do not connect to existing mains without a City inspector on site.
   b) Furnish and install all appurtenances and materials necessary to join existing and new mains.
   c) Locate the existing mains both horizontally and vertically and verify their exact size and material in advance of the time scheduled for making the connections.
   d) Minimize service interruptions.
3. Service Connections:
   a) Service saddle installation:
      1) Ensure that at least 3 FT remains between new service line taps and existing taps, fittings, and pipe joints.
      2) Take measures to protect locator wire from damage. Repair any damage.
      3) Install service saddle no lower than 45 degrees above horizontal from the center of the main.
      4) Do not cover service saddle and main until inspected by the City.
   b) Service line installation:
      5) Mark capped end of service line with by marking or branding the curb over the service line.
      6) Provide at least 3 FT between service line taps.

7) Document on record plan set each service line tap location measured from downstream manhole.

4. Testing:
   a) Test all gravity sewer mains (regardless of pipe material) using the low pressure air method, in accordance with ASTM F 1417
   b) Deflection test all gravity sewer mains.
      1) After the sewer line has been in place and the embedment and backfill allowed to settle for 30 days, hand pull a mandrel 95% of the pipe inside diameter through the line under the observation of the City.
   c) Pressure sewer mains:
      2) Test all pressure sewer mains (regardless of pipe material) in accordance with AWWA C900.
      3) Air test.
      4) Minimum test period: 2 hours.
      5) Test pressure: 150 psi. Engineer may specify a higher different pressure appropriate for the system design
      6) Measure test pressure relative to the lowest elevation of the test section.
      7) Maximum allowable pressure gauge increment: 5 psi.
      8) If any visible leaks are observed or if any make-up water is required, the system will have failed the test. Correct the leakage and repeat the test until the system passes the test.
   d) Manhole test.
      9) Water test fiberglass manholes.
      10) Vacuum test or water test all other manholes in accordance with ASTM C1244 and ODEQ.

END OF SECTION

Section 7 - Streets, Sidewalks, and Concrete

Part 1: General

A. All work under this section shall conform to the applicable requirements of ODOT Standard Specifications, most current edition.
B. Metal cover plates allowed for temporary patching holes.
C. Submittals:
   1. PC Concrete:
      a) Mix design: Provide mix design formula for the materials proposed for use in making concrete
      b) Strength: Provide results of three test cylinders using the proposed mix designs.
   2. AC Concrete: Prepare asphalt mix and initial job mix formula in accordance with ODOT 708.04 standard specifications, latest edition.
   3. Testing
      a) The Contractor shall escrow money with the City for construction testing as determined at the pre-construction conference. When escrow funds are 90% expended, additional funds shall be provided before further inspections are performed.
      b) City will provide copies of test results and invoices to contractor and developer.

Part 2: Materials

A. Unless specifically identified, all materials shall conform to ODOT Standard Specification Chapter 700
B. Preformed Expansion Joint Fillers shall conform to ASTM D-1751 and be non-extruding and resilient type.
C. Flowable Fill:
    1. ODOT Controlled Low Strength Material with a 28-day compressive strength: 300 PSI maximum, 200 PSI minimum
    2. Flowable Fill admixture, when utilized, shall be provided with manufacturers' instructions regarding installation requirements and strength limitations.

Part3: Design

A. Private streets shall be designed according to the following:
    1. Pavement design per geotechnical report or City standard
    2. Geometrics per City standard
    3. Signed as "Private Street"
B. Public Street Roadway Design:
    1. Pavement design per geotechnical report or City standard
    2. Geometrics per City standard
    3. Grade:
        a) Minimum: 0.4 percent concrete for curb & gutter; 1 percent asphalt
        b) Maximum: 8 percent
C. Tangent: There shall be adequate tangent length between all reverse curves for the conditions.
D. Sight Distances : All changes in street grades shall be made with vertical curves that provide minimum sight distances of not less than the following, except in cases of unusual topographic conditions:
    1. Arterial with median: 500 feet minimum.
    2. Arterial without median: 800 feet minimum.
    3. Collectors: 300 feet minimum.
    4. Local streets: 200 feet minimum.
    5. Alley** detail
E. Design speeds:
    1. Arterial: 50 mph.
    2. Collector: 40 mph.
    3. Local: 25 mph.
F. Centerline Horizontal curves:
    1. Minimum radii: The minimum centerline radii for streets shall be in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets, most current edition.
    2. Super Elevation: Super elevation is not required for local streets.
G. Centerline Vertical Curves: The lengths of crest and sag vertical curves shall be in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets, most current edition.
    1. Roadway Centerline: Design the centerline of paving to be the proposed centerline of right-of-way.
    2. Roadway Cross Slope:
        a) A minimum 2% cross slope from centerline to edge of pavement is required on all streets, except alleys.

b) Alleys may be design with an inverted crown, provided that an adequate drainage and collection system is designed and installed to spread water at the intersection in accordance with adopted drainage criteria.

H. Roadway drainage, gutter spread and roadway water depth (incorporate from UDCM):
   1. Gutter Spread:
      a) Gutter spread shall be measured from face-of-curb, and all calculations shall utilize a Manning's roughness coefficient ("n" value) of 0.016.
      b) Inlets shall be placed to limit flow spread.
      c) Local streets: the flow may spread to the crown of the street during minor storms, and the depth of water over the gutter flow line shall not exceed 12 inches during major storms.
      d) Collector streets: the flow spread must leave at least one lane free of water during minor storms, and the depth of water over the gutter flow line shall not exceed 12 inches during major storms.
      e) Arterial streets: no curb overtopping is allowed and the flow spread must leave at least one lane free of water for two-lane arterials, and one lane free of water in each direction for four-lane arterials during minor storms. For major storms, the depth of water over the gutter flow line shall not exceed 12 inches and the depth of water at the street crown shall not exceed 6 inches to allow operation of emergency vehicles.
   2. Inlets:
      a) Inlets on Grade shall be designed and spaced so that gutter spread is within the allowable limits specified for the 25-year return frequency storm.
      b) Inlets in Sag shall be designed so that gutter spread is maintained within the limits specified for the 50-year return frequency storm.
   3. Culverts and Cross Drains: Culverts and roadway cross drains shall be designed to minimize flooding of roadway and adjoining properties. These must be designed with a minimum elevation at upstream edge of pavement for the following design frequencies:
      a) Local Streets: Culverts and cross drains must be designed to pass the 25 year storm event without overtopping the roadway. The 50 year design frequency event shall be used on dead end local streets.
      b) Collector and Arterial: culverts and cross drains must be designed to pass the 50 year storm event without overtopping the roadway.

I. Intersection Design
   1. General:
      a) Streets shall intersect one another at right angles (90º) (+/- 10®) unless round-about designed.
      b) Grades for streets at intersections with arterials shall not exceed 3% within 100 FT of the nearest arterial travel lane.
      c) Grades for all legs of residential/residential intersections shall not exceed 4% within 100 FT of the nearest intersecting travel lane.
      d) The minimum radii on curb returns at intersections are as follows:
         1) At intersections of local streets, the minimum radius on curb returns shall be 25 FT.

2) At intersections of local streets with collector and arterial streets, the minimum radius of curb returns shall be 35 FT.
3) At intersections of arterial and/or collector streets, the minimum radius of curb returns shall be 45 feet.
4) Industrial and commercial areas having truck traffic shall demonstrate turning movements with AASHTO turning templates of largest design vehicles accessing the property. (look at ODOT – width re island requirement)

J. Traffic Impact of Developments
   1. A traffic impact analysis is required for any proposed development or potential adjacent proposed development that is expected to generate more than 1,000 vehicle trip ends during a single day and/or more than 100 vehicle trip ends during a single peak hour. Trip Generation rates shall be calculated using Institute of Transportation Engineers Trip Generation Rates.
   2. The roadway shall be designed in accordance with the traffic impact analysis, when required.
   3. For studies considering roundabouts, signalization or other alternatives, the study shall include analyses of both configuration alternatives with respective efficiencies of each.
   4. The Design Engineer's recommendation of final access configuration shall consider types of traffic control at adjacent intersections for corridor consistency.
   5. The traffic impact analysis shall include at a minimum the following areas:
      a) All proposed site access points, including potential flow-through from adjacent developments.
      b) All intersections bordering or adjacent to the site frontage including the closest intersecting collector or arterial street.
      c) Any street segment or intersection where the proposed development can be expected to generate more than 25 additional vehicle trips during a single hour.
      d) Any street segment or intersection where the additional traffic volumes created by the proposed development are greater than ten percent of the current traffic volume (for road segments) or the current entering volume (for intersections).
      e) The analysis shall include the study time frames of existing conditions and of full site buildout conditions.
      f) The analysis shall include the study time of University class periods (August thru May)
      g) Demonstration of coordination with Stillwater Transportation Enhancement Plan, latest adopted version

K. Geometric design criteria for traffic control improvements shall comply with AASHTO and ITE:
   1. Signalized intersection design geometry (i.e., storage, tapers, grades, etc.) shall be based on the Institute of Transportation Engineers: Urban Street Geometric Design Handbook, latest edition.
   2. Roundabout design shall be based on the FHWA publication; Roundabouts: An Informational Guide, FHWA-RD-00-67, most current edition.
   3. Auxiliary turn lanes
      a) Pavement material for widening shall be consistent with existing paving (i.e. asphalt widening adjacent to asphalt street, concrete widening adjacent to concrete street)

b) Turning Deceleration Lanes are required when the daily site development generated turn volumes (TV) based on ITE Trip Generation (assuming a reasonable distribution of entry volumes) meet or exceed the values as recommended.

L. Pavement Design

1. The minimum thickness of an asphalt street section shall be as indicated below based upon a 50-year ESAL:

Minimum Thicknesses for Asphalt Street Construction			
	Local Street	**Collector Street**	**Arterial and Industrial Street**
Surface Course	2 inches SP-3 (PG 64-22 OK)	2 inches SP-4 (PG 70-28 OK)	Per engineering design
Asphalt Base Course	4.5 inches SP-3 (PG 64-22 OK)	3 inches SP-3 (PG 64-22 OK) 4 inches SP-2 (PG64-22 OK)	Per engineering design
Compacted Aggregate Base (Type A) (w/separator fabric)	8 inches	8 inches	Per engineering design
Treated Subgrade**	Reference Geotechnical Report	Reference Geotechnical Report	Reference Geotechnical Report

** Depth and extents of treated subgrade shall be based on results of geotechnical investigation.

2. Concrete pavement design shall specify thickness to meet thirty (30) year ESAL (equivalent single axle) load.

Minimum Thickness for Concrete Street Construction			
	Local Street & Alleys	**Collector Street**	**Arterial and Industrial Streets**
Concrete	6 inches	7 inches	Per engineering design
Compacted Aggregate Base (w/separator fabric)	4 inches	4 inches	Per engineering design
Treated Subgrade**	Reference Geotechnical Report	Reference Geotechnical Report	Reference Geotechnical Report

** Depth and extents of treated subgrade shall be based on results of geotechnical investigation.

3. The minimum requirements of a street section shall be as indicated below and as shown in the Standard Thickness and Joint Details.
4. Pavement parameters:
   a) Asphalt: Asphalt pavements for roadways shall be Superpave Type in accordance with ODOT standards, most recent version.
   b) Concrete: PC Concrete for roadways shall be ODOT Class A designed and proportioned in accordance with ODOT standards, most recent version.

5. Stabilized Aggregate Base: Aggregate shall be Type A in accordance with ODOT standard specifications, most recent version.
6. Subgrade material with a plasticity index (PI) greater than 17 shall be modified.
7. Road sections in rock cuts: A full, uniform roadway section shall extend full depth through rock cut areas. The resulting material must meet plasticity requirements.
8. Subbase Drainage System: Where saturated soil conditions exists or continuous seepage of water is present within the subgrade, a subbase drainage system is required.
9. Curb and gutter, see details
10. Construction joints, see detail

M. Street Appurtenances:
   1. Structures and Specific Details
      a) Loading: All structures subject to vehicular traffic shall be designed for H-20 loading.
   2. Drainage Outfalls and Drain Pipe Discharge Locations within publicly owned rights-of-way and easements shall be designed as follows:
      a) Storm sewer and drain pipes shall be connected through another structure such as an inlet, box structure, or manhole on existing curb and gutter streets.
      b) If the closest structure is not adjacent to the new storm sewer or drain pipe, construct the necessary structures and pipes to connect to the existing storm sewer system.
      c) For open ditch roadway sections, all storm sewer outlets and drain pipes shall be designed to tie into the flow line of existing ditch. Tie-ins to the ditch line shall include adequate structural measures to protect roadway ditch from erosion.
      d) Drain openings for pipes 4 IN (outside diameter) and smaller may be constructed through existing face of curb if adequate clearance is available at roadway edge and under adjacent sidewalk. A minimum of 2” of concrete must be placed on all sides of the drain pipe.
      e) In no case will the storm sewer outfall, drain pipe, or any other drainage structure discharge such that the flow crosses over a sidewalk, bike path, trail or any other public structure.
      f) When storm sewer is adjacent and accessible, sheet flow drainage onto roadway pavements is not allowed for flows of greater than 1 cfs or flows less than 1 cfs that exceed gutter spread requirements unless tied directly to storm sewer system.
   3. Sidewalks: see detail.
   4. Driveway Approaches: see detail

Part 4: Execution

A. Unless specifically identified herein, all construction shall conform to the appropriate ODOT Standard Specifications
B. Joint Sealing
   1. All joints shall be sealed.
   2. Sealant preparation: Sealing material shall be placed per manufacturer specs.
   3. Sealant installation:
      a) All joints shall be cleaned prior to sealing.
      b) Joints shall be completely filled from the backer rod up to the surface of the pavement. Backer rod may be omitted and joint completely filled with sealant. Surfaces shall be

free of debris, dust and materials to allow adherence. Primer shall comply with the manufacturer's recommendations.

c) Joints shall be sealed before traffic is allowed and following the concrete-curing period or as soon thereafter as weather conditions permit. The concrete walls of the joint shall be surface dry, and atmospheric and pavement temperatures shall be above 40° F at the time of application of the sealant. Open joints that cannot be sealed under the conditions specified herein shall be sealed with an approved temporary seal to prevent infiltration of foreign particles. When rain interrupts sealing operations, joints shall be re-cleaned prior to installing sealant.

C. Curb and Gutter
   1. General:
      a) Curb and gutter may be placed separate of the pavement but must be doweled to the concrete pavement section. Wet doweling not allowed.
      b) Dowelling not required for asphalt roadway
      c) The face, top, and gutter of curbs shall not have deviations or irregularities of more than ¼-inch when checked with a 10-foot straightedge.
      d) Structural concrete work may use wet mats or fog spray. The surface shall be kept moist for 36 hours following placement. Over spraying will not be allowed.
   2. Transverse joints per detail.
   3. Expansion joints per detail.
   4. Joint sealing per detail.

D. Sidewalks:
   1. Generally
      a) Compact subbase to not less than 95% of maximum dry density.
      b) Sidewalks shall have a broom surface finish.
      c) Expansion joints shall be placed around all abutting structures and appurtenances such as driveways, manhole, utility poles, hatches, and hydrants.
      d) Joint spacing shall be no greater than the width of the sidewalk.

E. Cast-in-place concrete:
   1. Forms for exposed concrete:
      a) The Contractor shall provide sharp, clean corners at intersecting planes, without visible edges or offsets.
      b) Maintain true, square intersections.
      c) There shall not be a bowed appearance in visible finished concrete.
   2. Corner treatment:
      a) The chamfers shall be formed accurately and surfaced to produce uniformly straight lines and tight edge joints.
   3. Control joints:
      a) Concrete shall be placed so that the unit will be monolithic in construction. Joints not indicated shall be made and located to least impair strength and appearance of the structure. Placement of concrete shall be at such rate that surfaces of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon.
   4. No wood device of any kind shall be permitted to remain in the finished work.
   5. Form coatings

a) Steel forms may be coated to allow release.

6. Placing reinforcement:
   a) All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil or grease.
   b) All reinforcing shall be placed so as to not be displaced during the placement and consolidation of the concrete.
   c) The City of Stillwater will verify dimensions and materials before any concrete is placed.
7. Pre-placement inspection:
   a) Subgrades shall be moist and free of debris.
8. Finish of concrete surfaces: All surfaces exposed to view shall be free from conspicuous lines, affects or other irregularities caused by defects in the forms. Any defective concrete shall be cut out to a depth sufficient to expose the reinforcement and to afford a key for the concrete replacing the cut out.
   a) Protection from mechanical injury:
      1) Protect all finished concrete surfaces from damage by subsequent construction operations

Section 8 - Stormwater Collection Systems

Part 1: General

A. Unless otherwise specified below, construct storm sewers as described in buried, bored, or encased pipe section.
B. Minor Storm: 2-year to 10-year events
C. Major Storm: up to 100-year event
D. Drainage easement language shall state on the plat that the drainage easement is provided for stormwater flow and that the area shall be maintained by the property owner.
E. A drainage study, which compares pre-project conditions to proposed conditions, shall be developed and submitted as a report as part of the design submittals.
F. For new construction projects, “pre-project conditions” refers to the natural state.
G. Regulatory Requirements:
   1. Develop all stormwater design plans to ensure all applicable regulations are met:
      a) City of Stillwater MS4 Permit, Stormwater Management Plan, and applicable sections of Chapter 23 and Chapter 35 of City Code
   2. Develop all stormwater system plans with applicable Oklahoma Department of Environmental Quality (ODEQ) design standards and to ensure proper permits are obtained.
   3. Designed condensate water flow discharge to a public way is prohibited.
   4. Discharge flows associated with underground stormwater detention to a public way may not exceed 1 cubic foot per second.
H. Rainfall Depth-Duration Relationship – National Oceanic and Atmospheric Administration (NOAA)

   1. NOAA Atlas 14, Precipitation-Frequency Atlas of the United States, Volume 8, Version 2.0 provides total rainfall depths for 50% (2-year) through 0.2% (500-year) storms with storm durations of 5-minutes to 24-hours for the City of Stillwater and are presented in the table below. These rainfall depth-duration data are for the STILLWATER 2 W Station ID: 34-8501 and

shall be used in all models to calculate existing and future development discharges for frequency storms. The latest rainfall adopted by NOAA can be obtained on the NOAA website for the STILLWATER Station.

Source: Online NOAA Atlas 14, Volume 8, Version 2 Point Precipitation Frequency Estimates for Stillwater 2 W Station ID: 34-8501 (2020)

PDS-based point precipitation frequency estimates with 90% confidence intervals (in inches)[1]										
Duration	Average recurrence interval (years)									
	1	2	5	10	25	50	100	200	500	1000
5-min	**0.428**(0.376-0.498)	**0.499**(0.437-0.581)	**0.615**(0.537-0.717)	**0.710**(0.616-0.832)	**0.842**(0.704-1.01)	**0.944**(0.770-1.15)	**1.05**(0.822-1.30)	**1.15**(0.864-1.46)	**1.29**(0.927-1.68)	**1.39**(0.975-1.84)
10-min	**0.627**(0.550-0.729)	**0.731**(0.640-0.850)	**0.900**(0.786-1.05)	**1.04**(0.903-1.22)	**1.23**(1.03-1.48)	**1.38**(1.13-1.68)	**1.53**(1.20-1.91)	**1.68**(1.26-2.14)	**1.88**(1.36-2.46)	**2.03**(1.43-2.70)
15-min	**0.765**(0.671-0.889)	**0.891**(0.781-1.04)	**1.10**(0.958-1.28)	**1.27**(1.10-1.49)	**1.50**(1.26-1.81)	**1.69**(1.38-2.05)	**1.87**(1.47-2.32)	**2.05**(1.54-2.62)	**2.30**(1.66-3.00)	**2.48**(1.74-3.29)
30-min	**1.14**(0.997-1.32)	**1.33**(1.16-1.54)	**1.64**(1.43-1.91)	**1.89**(1.64-2.21)	**2.24**(1.87-2.68)	**2.50**(2.04-3.04)	**2.77**(2.17-3.44)	**3.03**(2.28-3.86)	**3.38**(2.44-4.41)	**3.64**(2.56-4.83)
60-min	**1.51**(1.32-1.75)	**1.76**(1.54-2.05)	**2.17**(1.90-2.53)	**2.51**(2.18-2.94)	**2.97**(2.48-3.57)	**3.33**(2.71-4.05)	**3.68**(2.89-4.58)	**4.04**(3.04-5.14)	**4.51**(3.25-5.88)	**4.86**(3.41-6.44)
2-hr	**1.88**(1.66-2.17)	**2.19**(1.93-2.54)	**2.71**(2.38-3.13)	**3.13**(2.73-3.64)	**3.71**(3.12-4.43)	**4.16**(3.41-5.02)	**4.60**(3.64-5.68)	**5.05**(3.82-6.38)	**5.63**(4.09-7.31)	**6.08**(4.30-8.01)
3-hr	**2.09**(1.85-2.41)	**2.44**(2.16-2.81)	**3.01**(2.65-3.47)	**3.49**(3.05-4.04)	**4.14**(3.50-4.93)	**4.66**(3.83-5.61)	**5.17**(4.10-6.36)	**5.69**(4.32-7.18)	**6.38**(4.65-8.25)	**6.91**(4.90-9.07)
6-hr	**2.45**(2.18-2.80)	**2.85**(2.53-3.26)	**3.51**(3.11-4.03)	**4.08**(3.59-4.70)	**4.89**(4.16-5.81)	**5.53**(4.59-6.64)	**6.19**(4.95-7.60)	**6.88**(5.27-8.65)	**7.82**(5.74-10.1)	**8.54**(6.10-11.1)
12-hr	**2.81**(2.51-3.19)	**3.24**(2.90-3.68)	**4.00**(3.56-4.55)	**4.66**(4.12-5.33)	**5.64**(4.85-6.69)	**6.45**(5.39-7.72)	**7.30**(5.88-8.93)	**8.20**(6.33-10.3)	**9.46**(7.01-12.1)	**10.5**(7.52-13.6)
24-hr	**3.20**(2.87-3.60)	**3.68**(3.30-4.14)	**4.53**(4.05-5.11)	**5.30**(4.71-6.01)	**6.46**(5.59-7.63)	**7.43**(6.26-8.86)	**8.46**(6.88-10.3)	**9.58**(7.46-12.0)	**11.2**(8.34-14.3)	**12.5**(9.01-16.0)
2-day	**3.65**(3.30-4.09)	**4.20**(3.79-4.70)	**5.17**(4.65-5.81)	**6.06**(5.42-6.83)	**7.40**(6.45-8.70)	**8.53**(7.23-10.1)	**9.73**(7.96-11.8)	**11.0**(8.65-13.7)	**12.9**(9.70-16.4)	**14.4**(10.5-18.4)
3-day	**3.96**(3.58-4.41)	**4.56**(4.12-5.08)	**5.63**(5.08-6.29)	**6.60**(5.92-7.41)	**8.07**(7.05-9.44)	**9.30**(7.91-11.0)	**10.6**(8.71-12.8)	**12.0**(9.47-14.9)	**14.1**(10.6-17.8)	**15.7**(11.5-20.0)
4-day	**4.21**(3.82-4.68)	**4.86**(4.40-5.40)	**6.01**(5.43-6.69)	**7.05**(6.33-7.89)	**8.61**(7.54-10.0)	**9.92**(8.46-11.7)	**11.3**(9.31-13.6)	**12.8**(10.1-15.8)	**15.0**(11.3-18.9)	**16.7**(12.3-21.2)
7-day	**4.88**(4.45-5.39)	**5.62**(5.12-6.21)	**6.93**(6.29-7.68)	**8.11**(7.32-9.02)	**9.86**(8.67-11.4)	**11.3**(9.69-13.2)	**12.9**(10.6-15.4)	**14.5**(11.5-17.8)	**16.9**(12.8-21.1)	**18.8**(13.8-23.7)
10-day	**5.49**(5.02-6.04)	**6.29**(5.74-6.93)	**7.69**(7.00-8.49)	**8.94**(8.09-9.91)	**10.8**(9.50-12.4)	**12.3**(10.6-14.3)	**13.9**(11.5-16.5)	**15.6**(12.4-19.0)	**18.1**(13.8-22.5)	**20.0**(14.8-25.1)
20-day	**7.26**(6.68-7.94)	**8.19**(7.52-8.96)	**9.77**(8.94-10.7)	**11.1**(10.1-12.3)	**13.1**(11.6-14.9)	**14.7**(12.7-16.9)	**16.3**(13.6-19.2)	**18.1**(14.4-21.8)	**20.4**(15.7-25.2)	**22.3**(16.6-27.9)
30-day	**8.71**(8.03-9.48)	**9.78**(9.01-10.7)	**11.6**(10.6-12.6)	**13.1**(11.9-14.3)	**15.2**(13.4-17.1)	**16.9**(14.5-19.2)	**18.5**(15.5-21.6)	**20.3**(16.2-24.3)	**22.6**(17.4-27.8)	**24.4**(18.3-30.4)
45-day	**10.5**(9.70-11.4)	**11.8**(10.9-12.8)	**14.0**(12.9-15.2)	**15.7**(14.4-17.2)	**18.1**(16.0-20.3)	**20.0**(17.3-22.7)	**21.8**(18.2-25.3)	**23.7**(19.0-28.1)	**26.1**(20.1-31.8)	**27.9**(20.9-34.5)
60-day	**12.0**(11.1-12.9)	**13.6**(12.6-14.7)	**16.1**(14.9-17.4)	**18.2**(16.7-19.8)	**20.9**(18.5-23.3)	**23.0**(19.9-25.9)	**25.0**(20.9-28.8)	**27.0**(21.7-31.9)	**29.5**(22.8-35.8)	**31.4**(23.7-38.8)

[1] Precipitation frequency (PF) estimates in this table are based on frequency analysis of partial duration series (PDS). Numbers in parenthesis are PF estimates at lower and upper bounds of the 90% confidence interval. The probability that precipitation frequency estimates (for a given duration and average recurrence interval) will be greater than the upper bound (or

less than the lower bound) is 5%. Estimates at upper bounds are not checked against probable maximum precipitation (PMP) estimates and may be higher than currently valid PMP values.
Please refer to NOAA Atlas 14 document for more information.

Part 2: Materials

A. Manhole:
   1. Lids shall be cast to identify 'Storm Sewer'.
   2. Coating specified for sanitary sewer not required.

B. Storm sewer piping:
   1. Acceptable materials, in addition to those listed in bored, buried, or encased pipe section:
      a) Reinforced concrete.
      b) Corrugated aluminized pipe.
      c) Corrugated high density polyethylene pipe (HDPE):
         1) Manufactured in conformity with the latest AASHTO M 294, Type S specification.
         2) Meet the requirements of ASTM D 3350 Cell Classification 324420C, or ASTM D 1248, Class C, Category 4, Grade P33.

C. Frames, Grates and Hoods, see details.

Part 3: Design

A. Stormwater Drainage System Design Capacity
   1. The stormwater drainage system shall be designed to receive and pass the runoff from a 1% (100-year) frequency rainstorm. The entire flow shall be confined within the stormwater drainage system and shall include easements and drainage facilities within the public rights-of-way.
   2. Street Encroachment for Minor Runoff: (where curbs are absent, flow may not encroach the property line):

Street Classification	Encroachment Limits
Local	No curb over-topping; flow may spread to the crown of the street
Collector	No curb over-topping; flow spread must leave at least one lane free of water
Minor Arterial	No curb over-topping; flow spread must leave at least one lane free of water for a 2-lane road and one lane in each direction free of water for a multi lane road
Principal Arterial	No curb over-topping; flow spread must leave at least one lane in each direction free of water
Freeway	No encroachment is allowed on any traffic lane

   3. Street Encroachment for Major Runoff:

Street Classification	Encroachment Limits
Local / Collector / Minor Arterial	The depth of water over the gutter flow line shall not exceed 12 inches. Residential dwellings, public commercial, and industrial buildings shall not be inundated at the ground line unless buildings are flood proofed.

Principal Arterial / Freeway	Depth of water at the street crown shall not exceed 6 inches to allow operation of emergency vehicles. The depth of water over the gutter flow line shall not exceed 12 inches. Residential dwellings, public commercial, and industrial buildings shall not be inundated at the ground line unless buildings are flood proofed.

B. Stormwater Flow
   1. The stormwater flow of a collector system shall be designed within the confines of dedicated rights-of-way or restricted drainage easements to ensure that stormwater runoff can pass through a project site without inundating the lowest level of any building, dwelling, or structure.
   2. When stormwater drainage system features are located between buildings or lots rather than within the right-of-way of a street, designs shall include restricted drainage easements. City code prohibits structures, including fences and accessory buildings, from being located within any part of drainage easements.
   3. The water surface elevation produced from a 1% (100-year) storm shall be 1 foot lower than the finished floor of any adjacent habitable structure.

C. Bridges, Culverts, and Swales
   1. All bridges within arterial streets shall be designed to pass the flow produced by the regulatory 1% (100-year) storm with 2 FT of freeboard from the water surface to the low chord of the span bridge.
   2. All bridges within local and collector streets shall be designed to pass the flow produced by the regulatory 2% (50-year) storm with 1 FT of freeboard from the water surface to the low chord of the span bridge.
   3. Culverts and roadway cross drains shall be designed to minimize flooding of roadway and adjoining properties. These must be designed with a minimum elevation at upstream edge of pavement for the following design frequencies:
      a) Local Streets: Culverts and cross drains must be designed to pass the 25-year storm event without overtopping the roadway. The 50-year design frequency event shall be used on dead end local streets.
      b) Collector and Arterial: Culverts and cross drains must be designed to pass the 50-year storm event without overtopping the roadway.
   4. Maximum upstream headwater allowed shall be 1.5 times the vertical interior dimension of the culvert; the culverts shall be designed to have overland relief in a restricted drainage easement or right-of-way assuming 100% blockage of the culvert.
   5. Culverts, gutter lines, and associated longitudinal street grades for all streets shall be designed without street overtopping for floods produced by all storms up to and including the regulatory 1% (100-year) storm. Where overtopping will occur, the design shall include roadside swales, storm sewers or other stormwater appurtenances.
   6. Culverts shall be designed such that backwater from the culvert does not inundate any structure.
   7. Provide protective measures for culverts and embankments to minimize embankment damage during overflow.

8. When roadside swales without storm sewers are to convey stormwater, the swales shall convey the flow and have a maximum depth to limit traffic and pedestrian safety hazards, regardless of right-of-way width, slope or paved bottom.
9. Roadside swales shall be designed to prevent erosion.

D. Rainfall: The design rainfall data shall be used for runoff hydrograph calculations. All hydrological analyses for projects within the City of Stillwater shall utilize the rainfall data presented herein for calculation of stormwater runoff. The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 rainfall, or most current edition, shall be utilized.

E. Runoff:

1. Rational Formula
   a) The Rational Method shall only be used to determine pipe sizes for street stormwater drainage systems. It shall not be used for any routing calculations for stormwater storage facilities.
   b) The Rational Method, using the Wright-McLaughlin modifier (correction factor) is based on the formula:

$$\mathbf{Q = C_f * CIA}$$

Where:
Q = peak discharge, (cubic feet per second, cfs)
C_f = Wright-McLaughlin modifier
C = runoff coefficient (dimensionless) (see Table Below)
I = rainfall intensity for a duration equal to the time of concentration, (inches/hour)
A = watershed area (acres)

Where: Wright-McLaughlin modifier for the Rational Method is:

Recurrence Interval	**C_f**
1-10 Year	1.0
25 Year	1.1
50 Year	1.2
100 Year	1.25

   c) Runoff coefficients for different land use or surface characteristics. If the sub basin is not homogeneous in its land use type, then a composite runoff coefficient should be calculated by averaging the areas of different runoff coefficients.

Runoff Coefficients/Percent Imperviousness for Rational Method		
Land Use or Surface Characteristic	**Percent Imperviousness**	**Runoff Coefficients**
BUSINESS:		
Commercial Areas	70 to 95	0.70 to 0.95*
Neighborhood Areas	60 to 80	*

RESIDENTIAL:		
Single Family	35 to 50	0.47 to 0.64*
Multi-unit (detached)	45 to 55	*
Multi-unit (attached)	65 to 75	*
½ acre lot or larger	30 to 45	*
Apartments	65 to 75	*
INDUSTRIAL		
Light uses	70 to 80	*
Heavy uses	80 to 90	
PARKS, CEMETERIES	to 8	*
PLAYGROUNDS	40 to 60	*
RAILROAD YARDS	35 to 45	*
STREETS		
Paved	90 to 100	0.95
Gravel	50 to 70	0.65
DRIVES AND WALKS	90 to 100	0.95
ROOFS	85 to 95	0.95
LAWNS		
Sandy Soils	5 to 10	0.10 to 0.20
Clayey soils	10 to 30	0.13 to 0.35
* Runoff coefficient to be calculated using actual impervious area and soil groups.		

d) Rainfall Intensity: The rainfall intensity is the average rainfall rate in inches per hour for the period of maximum rainfall of a given frequency having a duration equal to the time of concentration. The most current ODOT Intensity-Duration-

Design Storm	Parameter		
	a	b	c
2 Year	46	10	0.79
5 Year	59	11	0.78
10 Year	69	12	0.78
25 Year	81	12	0.78
50 Year	106	15	0.80
100 Year	116	15	0.80

2. NRCS (SCS) Unit Hydrograph Method
   e) The method of runoff analysis that shall be used for the design of storm drainage system components is the NRCS Method.
   f) Soil-Cover Complex Number (CN) Determination
   g) When using the NRCS unit hydrograph method for a sub-basin, the NRCS basin lag time shall be used in conjunction with the CN value to determine runoff.

h) Table 2-2a. from NRCS TR-55, Runoff Curve Numbers (CN) for Selected Urban Land Use[1]

Cover description		Curve numbers for hydrologic soil group			
Cover type and hydrologic condition	**Average impervious area***	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)					
Open Space (lawns, parks, golf courses, cemeteries, etc)					
Poor condition (grass cover <50%)		68	79	86	89
Fair Condition (grass cover 50% to 75%)		49	69	79	84
Good condition (grass cover >75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc (excluding ROW)		98	98	98	98
Streets and roads:					
Paved curbs and storm sewers (excluding ROW)		98	98	98	98
Paved open ditches (including ROW)		83	89	92	93
Gravel (including ROW)		76	85	89	91
Dirt (including ROW)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (pervious areas only)		63	77	85	88
Artificial desert landscaping (impervious wood barrier, desert shrub with 1-2 inch sand or gravel mulch and basin borders)		96	96	96	96
Urban districts:					
Commercial and business	85	89	92	94	95
Industrial	72	81	88	91	93
Residential districts by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
¼ acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
½ acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	45	65	77	82
Developing urban areas:					
Newly graded areas (pervious areas only, no vegetation)	77	86	91	94	

*Average percent impervious area shown was used to develop the composite CNs. Other assumptions are as follows: impervious areas are directly connected to the drainage system, impervious areas have a CN of 98, and pervious areas are considered equivalent to open space in good hydrologic condition.

** CNs shown are equivalent to those of pasture. Composite CNs may be computed for other combinations of open space cover type.

*** Composite CNs for natural desert landscaping should be computed based on the impervious area percentage (CN = 98) and the pervious area CN> The pervious area CNs are assumed equivalent to desert shrub in a poor hydrologic condition.

***Composite CNs to use for the design of temporary measures during grading and construction should be computed based on the degree of development (impervious area percentage) and the CNs for the newly graded pervious areas.

F. Basin Characteristics

1. Sub-basin characteristics needed for the SCS Unit Hydrograph Method are:
   a) Drainage area of the sub-basin;
   b) Longest flow path length;

c) Characteristics of individual flow paths that make up the longest flow path (e.g., overland, grassed channel, gutter);
d) Slope of individual flow paths; and
e) Land use types and areas throughout the basin (e.g., agricultural, residential, business)

H. Criteria for Street Drainage
1. Inlet Design Table: An inlet design table, including drainage areas in acres, runoff coefficients, peak flows from 4% (25-year) and 1% (100-year) frequency rainstorms, times of concentration, and capacity of each inlet shall be summarized and tabulated on plans. This summary table shall also be a part of the drainage calculations.
2. Depth of Stormwater in Streets
a) Where sump collection systems are used, a permanent overflow route shall be contained in a concrete lined swale, located in a dedicated drainage easement, providing an emergency bypass in the event of complete blockage of the sump inlets.
b) Driveway to street transition shall be designed to prevent gutter flow from flowing down the driveway.

I. Drainage Impact on Streets
1. Allowable Cross Flow:

Street Classification	Type	Allowed Depth
Local Street	Minor Major	6-inches of depth at the crown or cross pan 12-inches of depth above the gutter flow line
Collector/Minor Arterial	Minor Major	6-inches of depth where cross pans are allowed 12-inches of depth above the gutter flow line
Principal Arterial	Minor Major	None 6-inches or less over the crown
Freeway	Minor Major	None 6-inches or less over the crown

J. Hydraulic Evaluation
1. Curb and gutter capacity shall be designed with an “n” value of 0.016.

K. Roadside Swale Capacity, see details
1. The capacity of a roadside swale shall be computed using Manning's equation.
2. The depth of flow shall be designed for the 1% (100-year) storm with one foot (1’-0”) minimum of freeboard below the roadway shoulder.
3. Roadside swales shall be developed upstream and downstream of the project to a point where it can be assured by design that the flow from the project under consideration will properly drain to a point of catchment or disposal whether this is on the property or off the property.
4. Design of the receiving swale shall be evaluated for its capacity to properly and adequately receive the entrant flows without causing flooding and shall account for stormwater runoff coming from surrounding sites and upstream of the project location.

L. Storm Sewer Inlets

1. Inlet types shall be in accordance with the ODOT standards.
2. Arterial streets shall use offset type inlets provided in the City standards.
3. Location of inlets:
   a) Inlets shall be located, on side streets at intersections to prevent runoff from flowing onto an arterial street or highway, and in the upgrade of bridges to prevent runoff from flowing onto the bridge deck.
   b) Inlets at intersections shall be located in such a manner that no part of the inlet encroaches upon a curb return.
   c) No drainage structure shall be permitted within a wheelchair ramp or crosswalk.
   d) The actual T_c is used up to a maximum T_c of 5 minutes. Inlets with T_c less than 2 minutes shall be properly sized.
   e) Spacing between inlets shall be such that depths of flow and widths of spread requirements are not violated.
4. Interception and Bypass:
   a) Design no more than 10% of street runoff to bypass an inlet on a continuous grade and the remaining flow shall be intercepted at the next inlet.
   b) Hydraulic design of inlets shall be in accordance with the HEC-22 most current edition.
   c) Design of emergency overflow at sump inlet locations shall be in consultation and approval of City Engineering Director.
5. Clogging Factors shall be applied to inlet designs.
   a) Hydraulic design charts presented in this document were developed with the assumption that all openings are clear (i.e., no portion of the curb or grate opening is clogged with any sort of debris.)
   b) The clogging factors have been developed to deduce the theoretical interception given by the hydraulic design charts. A clogging factor of 0.8 is interpreted to mean that the intercepted discharge obtained from the charts is multiplied by 0.8 to obtain the allowable capacity (i.e., the allowable capacity of the inlet is 80% of the theoretical capacity).

INLET TYPE	**INLET LOCATION**	**CLOGGING FACTOR**
Curb opening only	Continuous grade	0.8
Curb opening only	Sump	0.8
Combination curb and grate	Continuous grade	1.0
Combination curb and grate	Sump	0.65
Median	Sump(1)	0.8
Grate only(2)	Continuous grade	0.6
Grate only(2)	Sump	0.5

   1) Because of the grading required around a median inlet, the inlet only operates in a sump condition during design flows.
   2) Inlets with grates only shall not be permitted, but are included in the table for evaluation of pre-project conditions.
6. Grated Inlets
   a) Curb/grate inlet capacities shall be in accordance with the HEC-22, Third Edition or most current.
   b) All grates shall be bicycle safe.

c) Grate interception capacities shall be determined for the specific grate to be used in the project.

M. Design Criteria
1. Design Storm Frequency:
a) The storm sewer system, beginning at the upstream end with inlets, is required when the allowable street capacity or overflow capacity is exceeded for the design storm.
b) The storm sewer system shall be designed for the larger of the following two events:
1) The flow equal to the difference between the 4% (25-year) storm and the allowable street capacity, or
2) The flow equal to the difference between 1% (100-year) storm event and the capacity within the street right-of-way.
3) Note: The intent of the design shall be to intercept the entire flow produced by the 4% (25-year) storm event and shall convey it in a storm sewer. However, it is impractical to intercept all of the runoff in the street at the inlet and some "carry-over" flow will occur. This procedure puts a limit on the amount of carry-over flow that can be allowed in the street.

N. Design Requirements
1. Minimum Cover Requirements per details
a) It is not acceptable for the pipe to encroach into the street base section without permission from the City Engineering Director.
2. Manholes or junction boxes
b) Manholes or junction boxes shall be required whenever there is a change in size, alignment, elevation grade, slope, and/or where there is a junction of two or more storm sewers.
c) For storm sewers equal to or larger than 60 inches in diameter, provide pre-formed smooth transitions.
d) The maximum spacing between manholes for various pipe sizes shall be as shown in the Storm Sewer Alignment and Size Criteria table below.

Storm Sewer Alignment and Size Criteria		
Manhole Spacing		
Pipe Size	**Maximum Spacing of Manholes**	**Minimum Manhole Size**
15 to 24 inches	300 feet	4 feet
27 to 42 inches	400 feet	5 feet
48 inches	500 feet	6 feet
54 to 66 inches	500 et	8 feet
>66 inches	500 feet	Junction Structure
Minimum Radius For Pipe (per 75% of manufacturer's maximum deflection)		
Minimum Pipe Diameter		
Type	**Minimum Equivalent Pipe Diameter**	**Minimum Cross-Section**
Main Trunk	15 inches	1.23 SF
Lateral from Inlet	15 inches	1.23 SF

e) Siphons or inverted siphons are not allowed in the storm sewer system.

O. Grade Lines
1. The hydraulic grade line (HGL) shall be shown on stormwater profile sheets.
2. The HGL shall be at or above the level of normal pool elevations for permanent pool (wet) stormwater storage basins or ponds.
3. The hydraulic grade line (HGL) shall be shown on all profiles of storm sewers including more than one pipe section.
4. The hydraulic grade at discharge points shall begin at the top of the outlet pipe, at the 1% (100-year) water surface elevation if discharging into an open swale or channel, or at the hydraulic grade of the downstream storm sewer system, whichever is higher.
5. Horizontal Alignment shall be the centerline of pipe.

P. Pipe Size
1. The minimum allowable pipe size for storm sewers shall be 15 IN in diameter. If site conditions do not physically allow for the use of a minimum 15 IN diameter storm sewer pipe based on design, then a design with maximum, achievable pipe diameter size shall be submitted by the engineer for evaluation.

Q. Storm Sewer Capacity and Velocity:
1. The maximum full flow velocity shall be less than 20 feet/sec.
2. The minimum velocity in a pipe based on full flow shall be 2.5 feet/sec to avoid excessive accumulations of sediment.

R. Miscellaneous Criteria
1. No pipe shall be installed downstream having a smaller capacity than the upstream pipe or combination of upstream pipes.
2. Pipes discharging into drainage ways and stormwater storage facilities shall be provided with a headwall, wing walls, and base outlet (splash pad). Designs shall be in accordance with ODOT standards. When the outlet velocity exceeds six feet per second (6 fps), energy dissipaters shall be provided for energy dissipation and the prevention of local erosion.

N. Open Channel Types
1. Slope: unless noted otherwise, all naturally vegetated channels shall maintain a 4:1 slope; special conditions allow the slope to be 3:1.
2. Depth: Maximum depth of 4 feet. Where good maintenance is expected and durations of peak flows are short-lived, 5 feet of depth is acceptable.
3. Bottom Width: minimum bottom width shall be 6 to 8 times the depth of flow.
4. Trapezoidal Channels per details
5. Rectangular Channels
   a) All rectangular channels are to be concrete on all sides and designed for applicable structural loads.
6. Trickle Channels
   a) Trickle channels or underdrain pipes are required for urban grassed channels flatter than 2%.
   b) All trickle channels shall be constructed per standard details
   c) Trickle channels shall be sloped to drain a minimum 0.5%.
   d) Placement of sod or mature seeded grass, or other accepted methods of erosion control shall be required adjacent to the paved channel.

O. Channel Design Criteria

1. Concrete Flumes
   a) Concrete flumes are required for emergency overflow protection for storm sewer systems at sump locations.
2. Concrete Channels
   a) Concrete channels shall be designed to withstand lateral earth and hydrostatic pressures and up-lift, to avoid floatation while the channel is empty.
   b) Manning's n-value: Manning's equation in the calculations of hydraulic characteristics of channels is acceptable.

Channel Type	**n-Value**
Grass-lined, not maintained (dependent upon grass type and soil conditions)	.045 to .10
Natural Streams	Note (1)
Riprap Lined	
1. Ordinary riprap	.038
2. Gabions	.038
3. Grouted riprap	.026
4. Slope mattress	.029
Concrete Lined	
1. Float finish or slip formed	.015
2. "Gunite" or "Shotcrete"	.023

Source: Chow, V.T., Open Channel Hydraulics, McGraw-Hill Book Company, 1959, and pictures

3. Minimum Longitudinal Slope: Channels shall have minimum slopes of 0.5% for concrete-lined channels and 2% for grass lined channels and cross-slopes.
4. Minimum Velocity: Minimum velocity in a drainage system shall be 2.5 feet/sec to avoid sedimentation.
5. Maximum Velocity:
   a) Velocities shall not exceed 6 feet/sec for sections sodded in grass. Maximum Froude Number shall be 0.8.
   b) Velocities in concrete lined or paved sections shall not exceed 15 feet/sec. Minimum Froude Number shall be 1.2.
6. Energy Dissipation: The dissipation of energy shall be required at the confluence of improved channels with natural channels through the use of dissipaters, stilling basins, etc. which shall be designed in accordance with FHWA HEC #14 *Hydraulic Design of Energy Dissipaters for Culverts and Channels*
7. Freeboard:
   a) For subcritical flow, the straight-channel freeboard requirement is 1 FT above the water surface elevation.
   b) Freeboard requirements at bends in the channel shall be 1 FT above the channel depth plus the height of super elevation. The freeboard at a channel bend shall be calculated with the following equation:

$$H_{FB} = 2.0 + (V^2 \times T_w)/(g \times r_c)$$

Where: H_{FB} = freeboard height (feet)
V = channel velocity
T_w = top width of design flow
g = acceleration of gravity = 32.2 ft/sec2
r_c = centerline radius of curvature

8. Alignment: The centerline radius of a curve on an improved channel shall be a minimum of three (3) times the maximum top width at the design flow depth.

P. Vertical Wall Channel Protection
   1. Areas with channel depths greater than 3 FT shall be fenced a minimum distance of 8 FT upstream and downstream of the section of channel on both sides.
   2. Fencing shall be a minimum of 6 FT high chain link fence in compliance with the National Chain Link Fence Institute.
   3. Fence Posts shall be embedded in concrete a minimum of 1.5 FT in depth.
   4. Floatable debris screens or trash racks shall be placed at upstream end where open channels transition to a closed (pipe or box culvert/storm sewer) system.
   5. Access into and out of channel shall be constructed per detail.
   6. End walls shall be made in such a manner as to not impede flow of stormwater.

Q. Channel Erosion Protection
   1. Conditions Requiring Protection: Where erosive channel velocities or conditions can occur, the engineer shall design protection against deterioration of surfaces and channel structures.
   2. Velocity Limitations
      a) The velocity limitations through the channel at a bridge crossing are to be controlled by the potential for abutment scour; subsequent erosion protection shall be provided.
   3. Intermediate Bridge Support Configuration
      a) Design shall include measures to ensure that normal flows and necessary flood capacity requirements of the channel will continue to be met during all phases of construction.
      b) Intermediate bridge supports shall be designed to limit debris entrapment at the supports.
      c) All temporary modifications to the channel to accommodate construction activities shall be removed and/or undone, and the channel shall be returned to the final design configuration.

R. Culvert Size
   1. Sizing Method:
      a) Culvert shall be sized using the methodology presented in *Hydraulic Design of Highway Culverts*, Hydraulic Design Series HDS No. 5, FHWA, U.S. Department of Transportation and *Drainage Manual*, Oklahoma Department of Transportation, 1992, or most current edition.
   2. Culvert Design
      a) Design of all culverts shall be in accordance with ODOT standards or accepted equal. ODOT standard details may be specified by the engineer. When an ODOT standard culvert detail is selected, the standard detail shall be shown on and identified on the construction drawings.
      b) Pipe discharge end sections shall comply with ODOT PCES-4 (R-30): Prefabricated Culvert End Sections.

c) Culverts which are to be located where vehicular traffic will cross the culvert shall be designed to withstand an HS-20 loading in accordance with the design procedures of AASHTO *Standard Specifications for Highway Bridges* and with the pipe manufacturers' recommendations.
d) In all cases, depth of cover shall be dictated by proper distribution of forces to prevent damage to the pipe and surrounding area.
e) All inlets and outlets to concrete culverts shall be provided with headwalls, slope walls, wing walls, or accepted, pre-fabricated end-sections.
f) All inlets and outlets to culverts shall be provided per detail.
g) Headwalls, slope walls and wing walls shall be uniformly reinforced in such a manner which ties all parts of the inlet or outlet structure together.
h) When wing walls are greater than 2 FT high, wing walls shall be designed to meet overturning considerations from lateral, saturated soil pressures. Wing walls and headwalls shall be designed with a thickened footing in accordance with national design standards.
i) A base outlet (splash pad) with erosion protection shall be provided for all outlets. In lieu of placement of or embedment of riprap on or in the splash pad, formed baffle blocks or other appropriate, permanent, designed, energy-dissipaters are required.

S. Storage and Infiltration General Design Considerations
1. Designs shall support reduction of stormwater pollutants and minimize erosion and sediment transport.
2. Designs shall support infiltration, as soil conditions and other factors allow.

T. Stormwater Storage Features
1. The stormwater storage facility shall consist of the storage basin itself, the basin inlet structure(s), the basin outlet structure(s), spillway(s), and any feature designed to accommodate receipt, detention, and disbursement of stormwater.
2. Designs shall store stormwater in a manner which protects the basin and does not cause adverse impacts to stormwater drainage system features, structures, or properties connected with the feature, both upstream and downstream.
3. Stormwater storage facilities shall be designed so that the peak rate of discharge does not exceed that of the pre-development conditions for the 5-, 10-. 25-, 50-, and 100-year (1%) storm events under full urbanization.
4. Storage within stormwater storage facilities shall be restored within 24 hours of the end of the storm event.
5. Designs shall demonstrate that discharge is conveyed downstream in a system and in a manner which does not create adverse impacts.
6. Freeboard Requirements

Requirements for Stormwater Storage Facilities			
Embankment or Excavated Pond	**Max. Depth for Volume Collected During 1% (100-year) Storm Event**	**Easement or Platted Outlot Required**	**Freeboard Requirement**
Embankment or Excavated	< 18-inches	Restricted Easement required at a minimum.	No freeboard required.

Embankment	18-inches to 6 feet	Platted Outlot Required.	(1'-0'') Freeboard above the 1% chance (100-Year) storm event water surface.
Embankment	> 6 feet	Platted Outlot Required.	(1'-0'') Freeboard above the 0.2% chance (500-Year) storm event water surface.
Excavated	>18-inches	Platted Outlot Required.	(1'-0'') Freeboard above the 1% chance (100-Year) storm event water surface.

7. Restricted Platted Outlots shall restrict storage facility to stormwater use only. Habitable structures are prohibited.
8. Inlets into stormwater storage areas with permanent pools collecting discharges from the local stormwater collection system (i.e., pipes, channels) shall be designed such that no inlet is below the normal water surface elevation of the pool.
9. Design of each facility shall incorporate methods which minimize bank erosion and support facilitation of future maintenance.
10. Stormwater storage facilities shall be located outside of existing channel storage.
11. Stormwater storage facilities shall be designed for construction within the project area from which stormwater runoff is to be collected.
12. Any dam or berm shall be designed in accordance with the dam safety criteria of the Oklahoma Water Resources Board.
13. The post-development discharge rate shall not exceed the pre-development discharge conditions for all storm events up to and including the 1% (100-year) event.
14. The permanent pool arrangements shall be designed to ensure stability of the structure and surroundings.
15. An access way at least 10 feet wide shall be provided to any required stormwater storage area.

Part 4: Execution

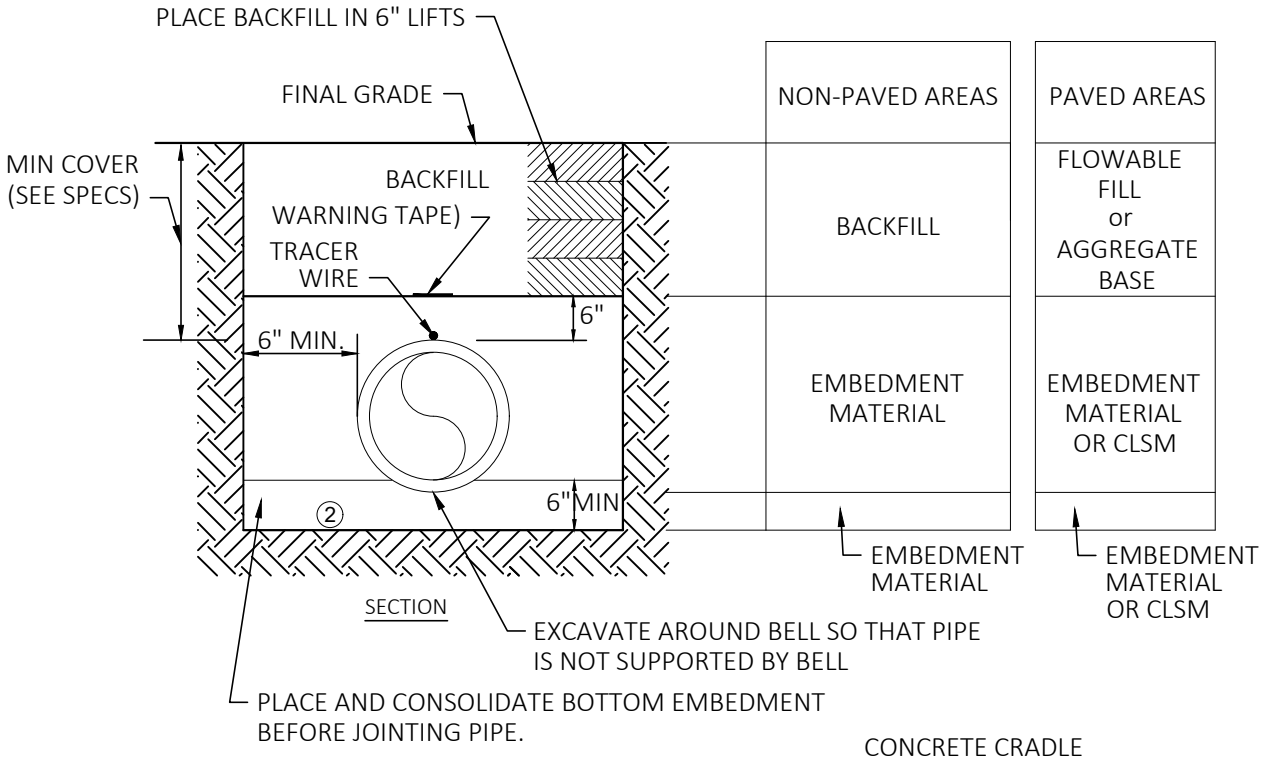
A. General:
   1. Employ temporary and permanent Best Management Practices (BMPs) to ensure compliance with the City's MS4 permit, to ensure that all earth changes are controlled in such a manner to support stormwater management through appropriate erosion and sediment control techniques and other sources of stormwater pollution associated with construction activities such as, but not limited to, floatable debris and chemicals.
      a) All temporary BMPs that are not incorporated into the final construction shall be removed once work is completed and disposed of in an appropriate manner.
      b) BMPs for control of erosion, sediment and construction-related stormwater pollutants shall be established to control stormwater runoff and the transportation of sediment and other pollutants off site, into streams and waterways prior to the commencement of any construction.

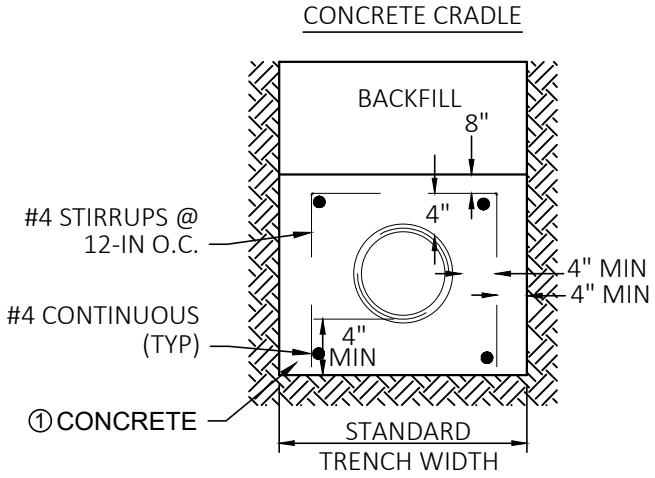
B. An ODEQ Notice of Intent (NOI) for properties disturbing an area of land (1) acre or more must be filed and permit authorization must be obtained. Construction site activities shall not start before an ODEQ authorization is issued.

C. SWPPPs for sites disturbing 1 acre or more shall be kept on-site or at a specified location as defined by the ODEQ General Permit for Stormwater Discharges from Construction Activities.
D. All construction sites shall be prepared using quality construction techniques and in such a manner as to minimize exposure of bare earth. Depending on site shape and extent of work limits, several control zones may be established to segment the influences of runoff.
E. Pipe shall be fitted with concrete wing walls and apron or slope walls.
F. All storm sewer under local or collector roadway pavement shall be reinforced concrete pipe or HDPE.
G. Refer to Section 2 Part 2 item N for construction sequencing of stormwater detention facilities and management of the site during construction of improvements.

SCHEDULE A

METER SIZE	DEPOSIT
1-1/2”	$900
2”	$1,200
3”	$1,600
4”	$4,000
6”	$5,300





① PROVIDE TRENCH OF SUFFICIENT WIDTH TO ENSURE THAT INSTALLED CONCRETE / PIPE UNIT IS NOT BOUYANT. PROVIDE ENGINEERED DOCUMENTATION OF REQUIRED WIDTH.

② DO NOT LAY PIPE ON TRENCH BOTTOM.

REV	DATE	DESCRIPTION	BY

Pipe Embedment

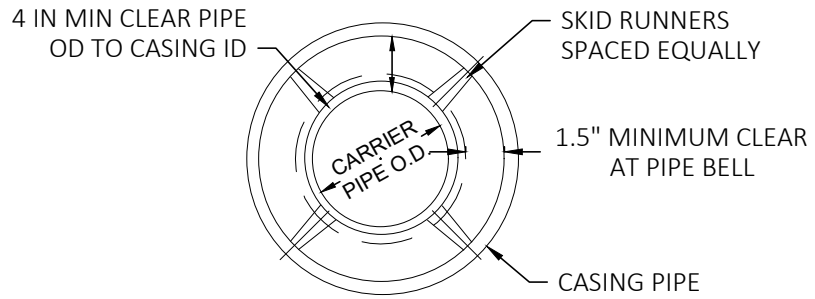
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

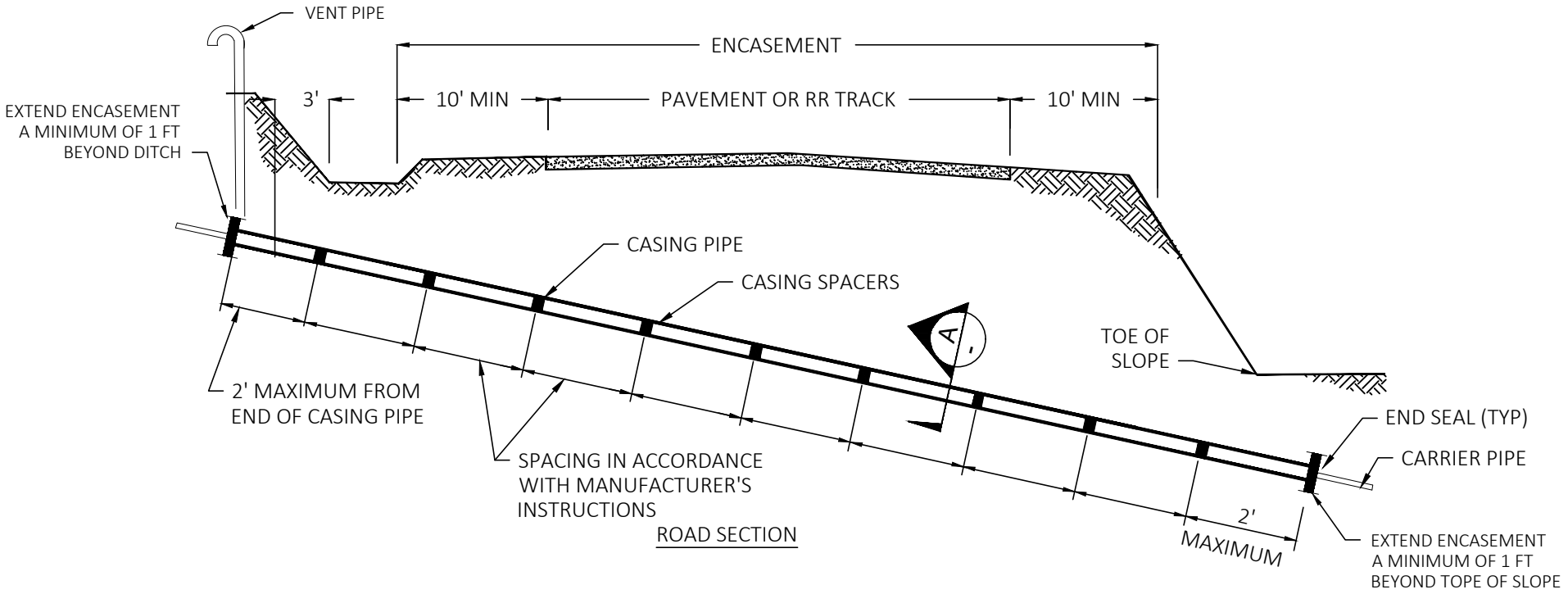
Adopted: 7/30/2012

Issued: 8/02/2021

Detail No. 3101



SECTION A-A



ROAD SECTION

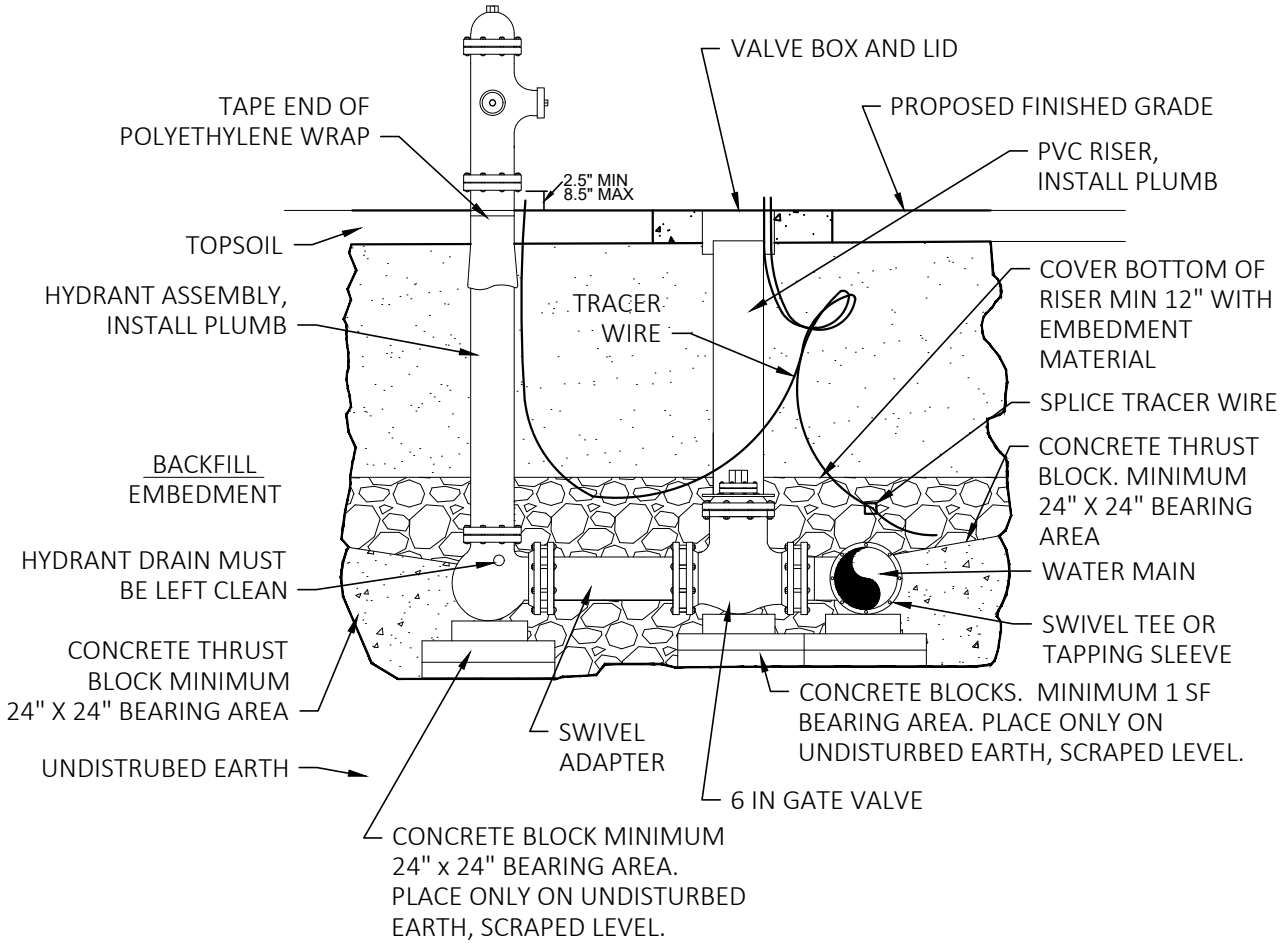
Detail No.	Issued:	Adopted:
3103	8/02/2021	3/20/2017

The City of Stillwater OKLAHOMA

Pipe Encasement

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY



NOTES:

1. ALL VERTICAL JOINTS: USE FLANGE CONNECTIONS.
2. HYDRANT, PIPING, AND VALVE NOMINAL DIAMETER: 6-INCH
3. POSITION HYDRANT SO THAT PUMPER OUTLET FACES STREET AND IS NOT OBSTRUCTED BY OTHER SURFACE FEATURES.
4. WRAP ALL BURIED PIPE, VALVES, AND FITTINGS WITH POLYETHYLENE.

REV	DATE	DESCRIPTION	BY

Hydrant Assembly

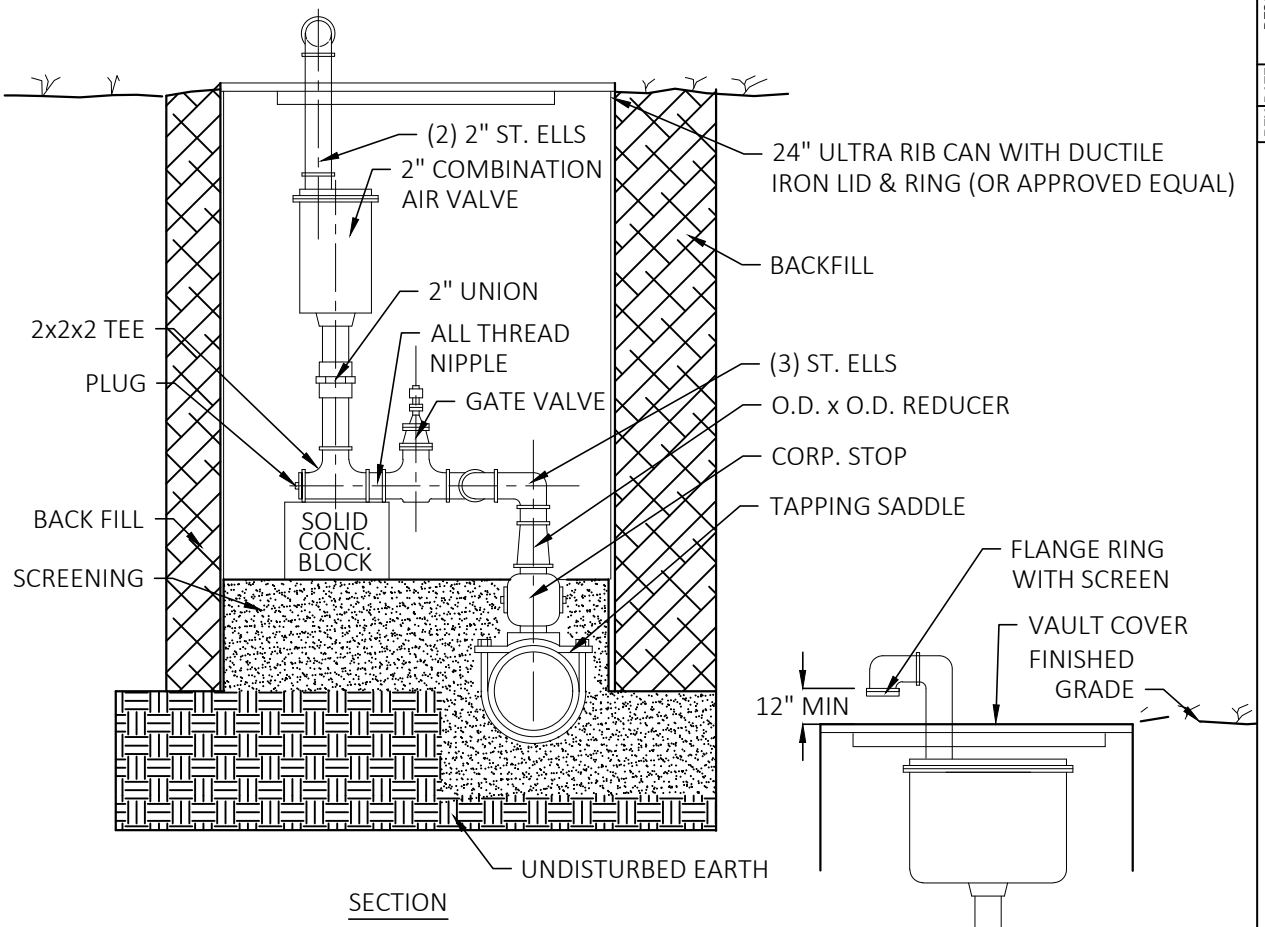
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

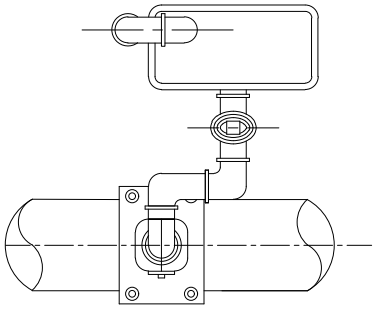
Adopted: 3/20/2017

Issued: 8/02/2021

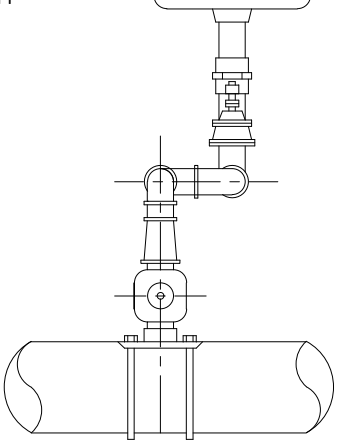
Detail No. 3402



SECTION



TOP VIEW



SIDE VIEW

NOTES:

1. ALL PIPING AND CONNECTORS SHALL BE BRONZE, INCLUDING TAPPING SADDLE.
2. FRAME AND LID FOR VAULT SHALL BE AS SHOWN ON STANDARD.
3. PROVIDE PROTECTION (BARRIER) TO PREVENT DAMAGE TO THE ABOVE-GROUND RISER PIPE.
4. MUST BE LOCATED IN UNPAVED AREA, BOLLARDS OTHERWISE.
5. ARV INSTALLATION ON A WATER LINE LARGER THAN 8 INCHES, CONTACT WATER RESOURCES DEPARTMENT

REV	DATE	DESCRIPTION	BY

Air Relief Valve and Vault: 6-8 IN Water Line

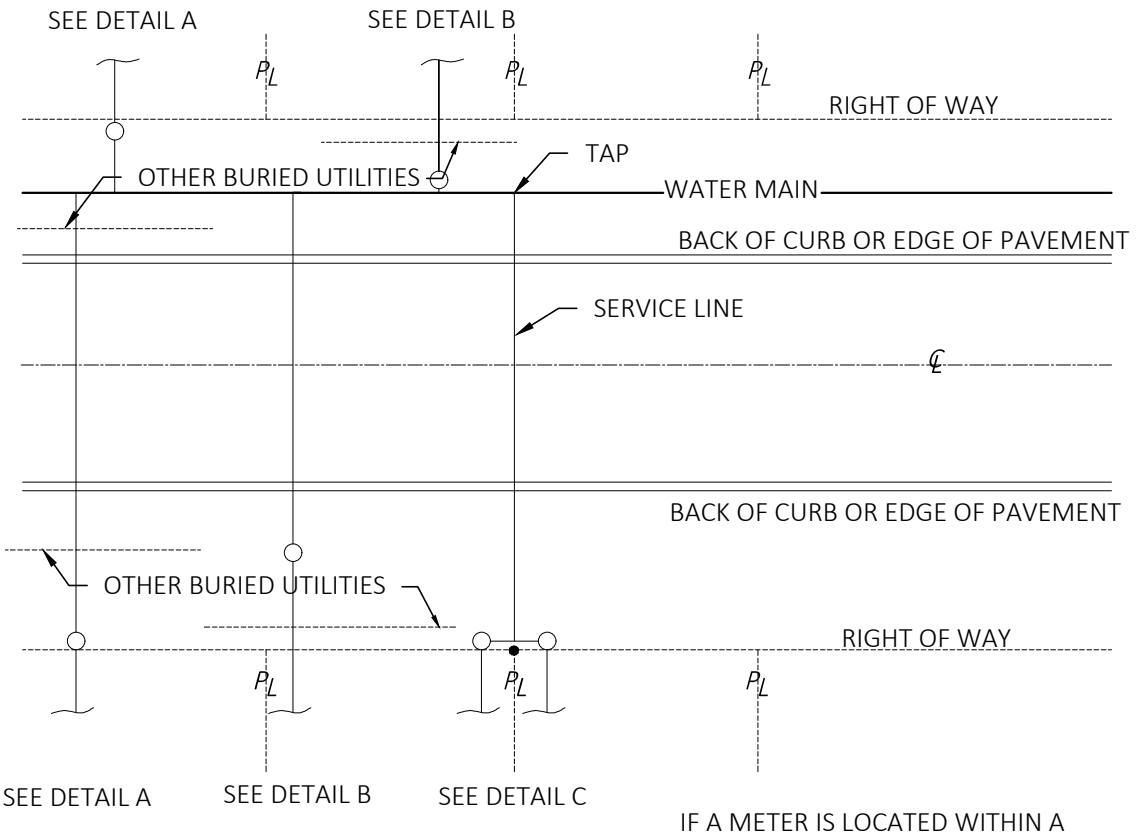
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

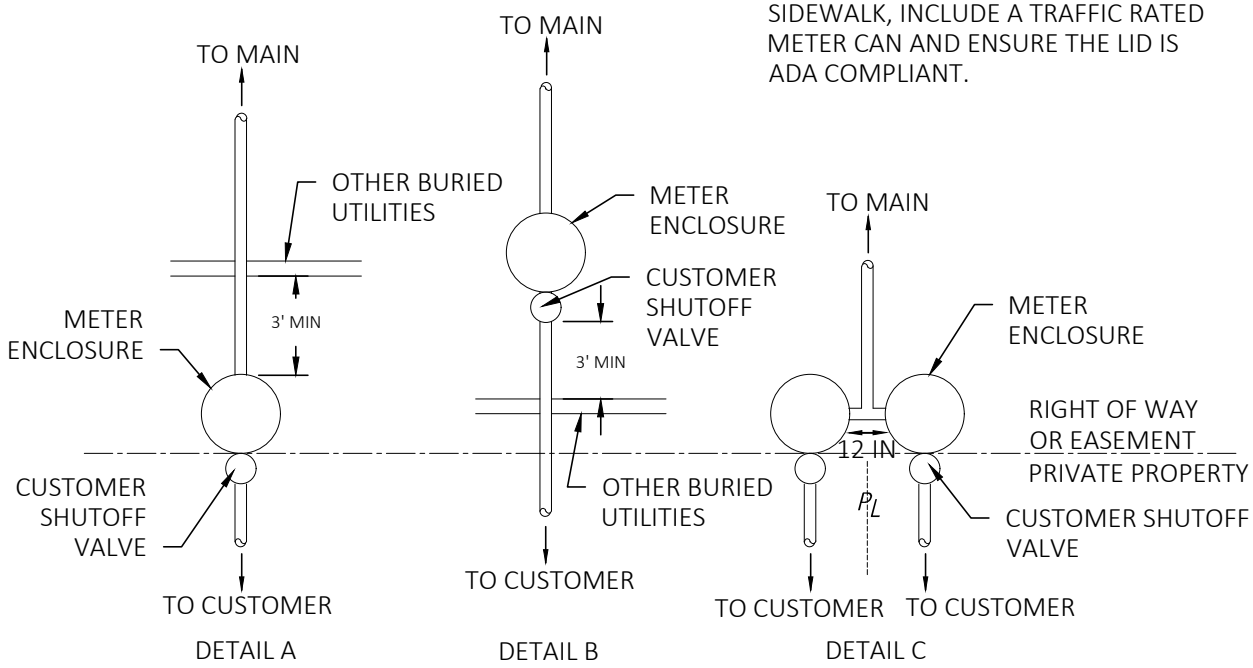
Adopted: 4/29/2011

Issued: 8/02/2021

Detail No. 3404



IF A METER IS LOCATED WITHIN A SIDEWALK, INCLUDE A TRAFFIC RATED METER CAN AND ENSURE THE LID IS ADA COMPLIANT.



REV	DATE	DESCRIPTION	BY

Service Line and Meter Locations

CITY OF STILLWATER STANDARDS

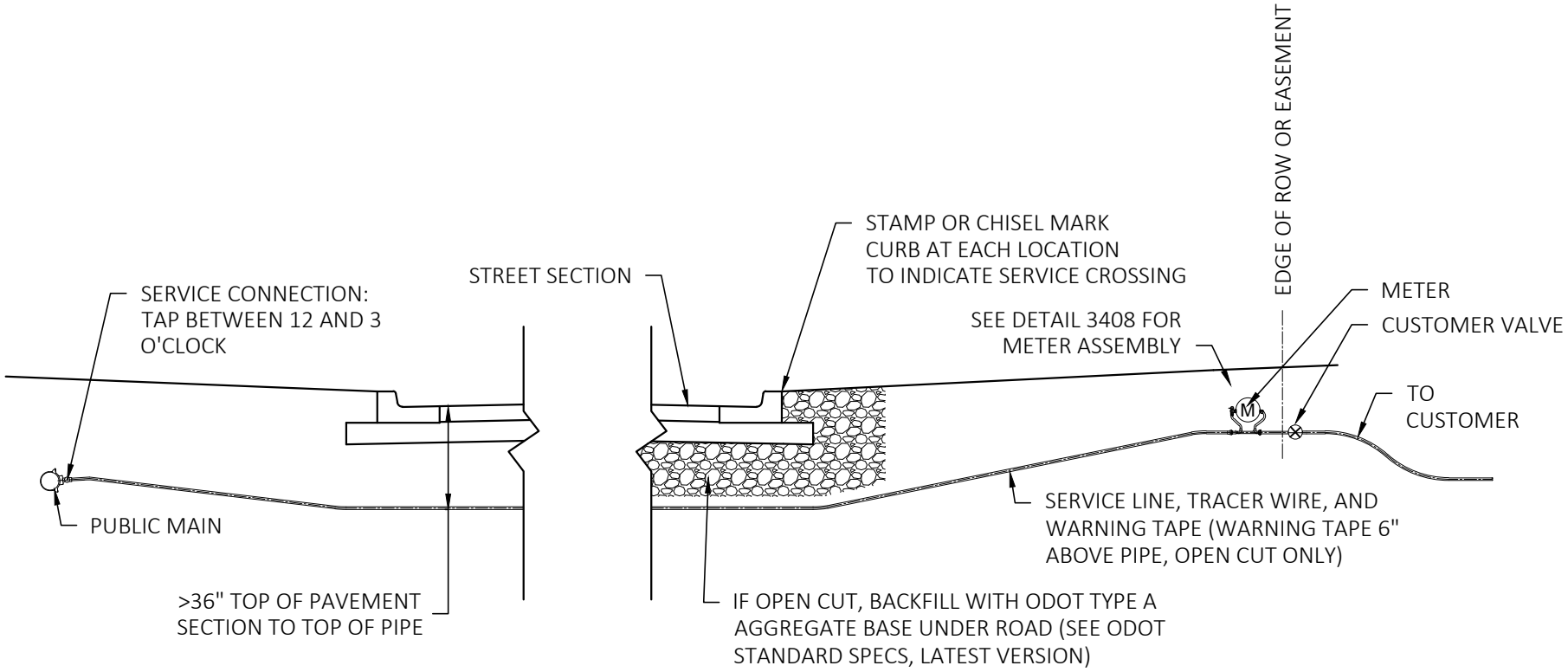
The City of Stillwater OKLAHOMA

Adopted: 3/20/2017

Issued: 8/02/2021

Detail No. 3406

NOTE:
ADDITIONAL REQUIREMENTS MAY APPLY BY JURISDICTION. SEE PERMIT.



Detail No. 3407

Issued: 8/02/2021

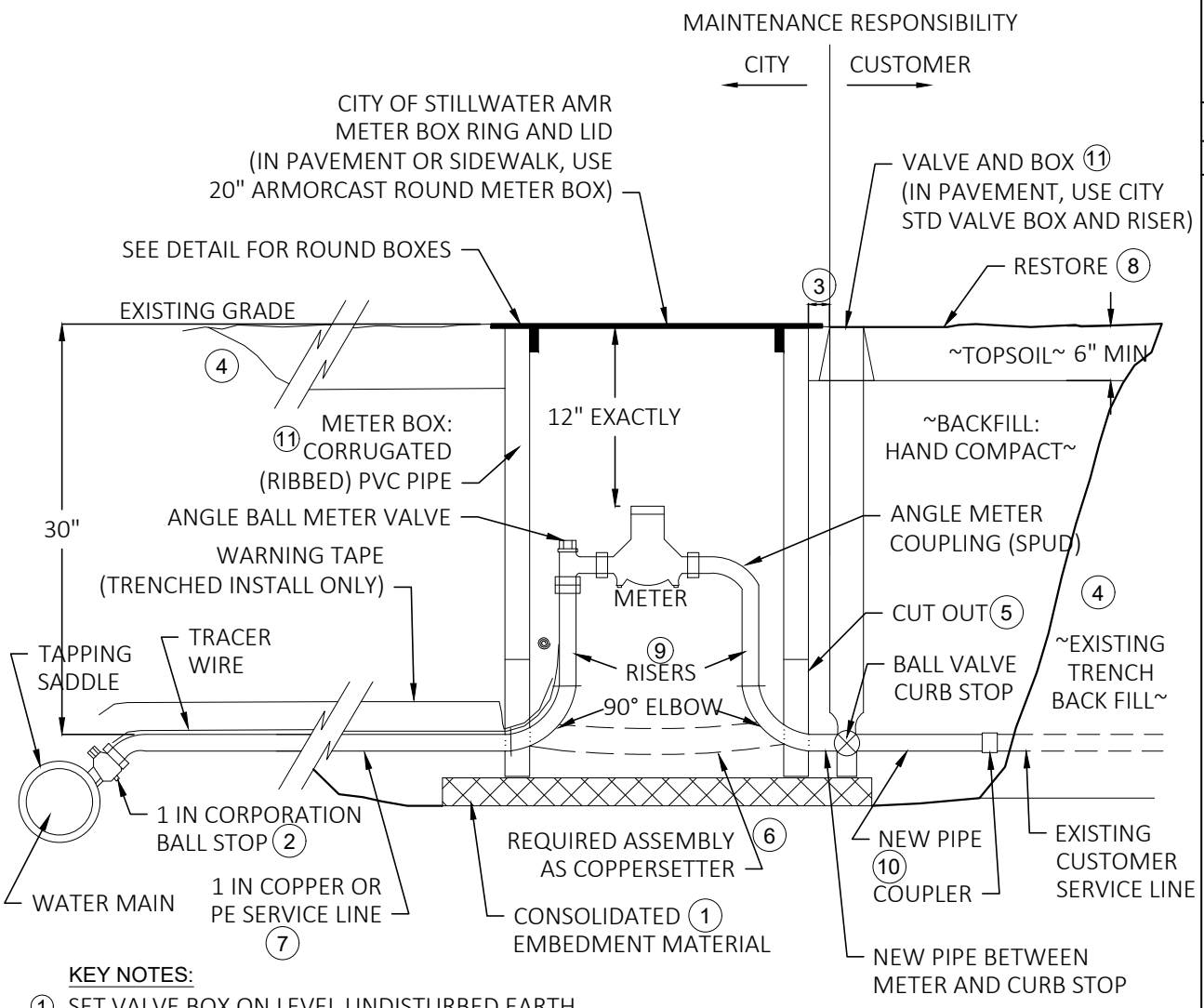
Adopted: 3/20/2017

The City of Stillwater OKLAHOMA

Service Line Street Crossing

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY



KEY NOTES:

① SET VALVE BOX ON LEVEL UNDISTURBED EARTH. USE LEVELING COURSE OF COMPACTED EMBEDMENT MATERIAL AS NEEDED.
② DO NOT TAP BELOW 3-O-CLOCK OR 9-O-CLOCK.
③ SET CUSTOMER VALVE BOX AS CLOSE TO METER BOX AS POSSIBLE. DO NOT SET IN PAVEMENT.
④ COMPACT EXISTING TRENCH BACKFILL AND BOTTOM AND SIDES OF EXCAVATION.
⑤ CUT OUT BOX TO ENSURE VALVE BOX DOES NOT REST ON SERVICE LINE.
⑥ SET BOX ON COMPACTED EMBEDMENT MATERIAL TO LEVEL AND ADJUST.
⑦ USE SINGLE CONTINUOUS PIPE FROM CORPORATION STOP TO METER FITTINGS.
⑧ RESTORE FINISHED GRADE TO EQUAL OR BETTER CONDITION THAN EXISTING.
⑨ SET PLUMB.
⑩ MINIMUM 2 LF OF NEW PIPE ON CUSTOMER SIDE OF CURB STOP.
⑪ METER WILL BE PROVIDED, INSTALLED, AND MAINTAINED BY THE CITY. "CUSTOMER VALVE" AND BOX WILL BE PROVIDED AND INSTALLED BY THE CITY, THEN OWNED AND MAINTAINED BY THE CUSTOMER.

GENERAL NOTES:

1. DO NOT USE FLARE CONNECTIONS.
2. USE SINGLE CONTINUOUS PIPE FROM CORPORATION STOP TO METER FITTINGS.
3. USE SS INSERTS FOR ALL PE CONNECTIONS.

METER BOX TABLE		
CONNECTION SIZE	SIZE OF BOX	BOX TYPE
<1"	18"	ROUND
1"	24"	ROUND

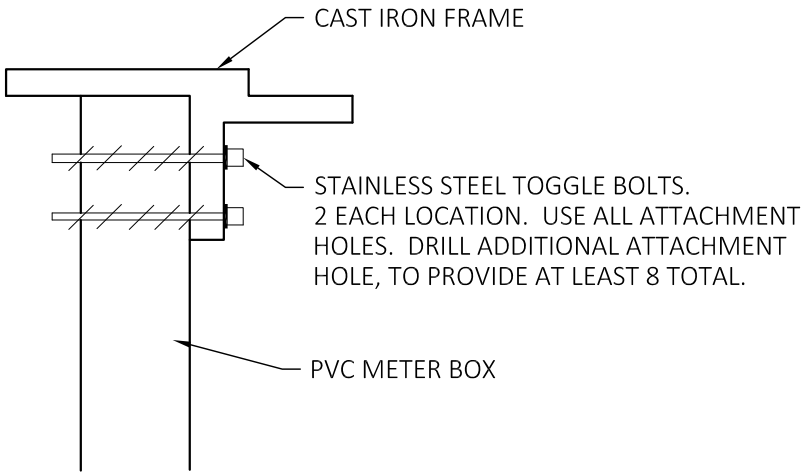
REV	DATE	DESCRIPTION	BY

Meter Assembly: 3/4-IN and 1-IN

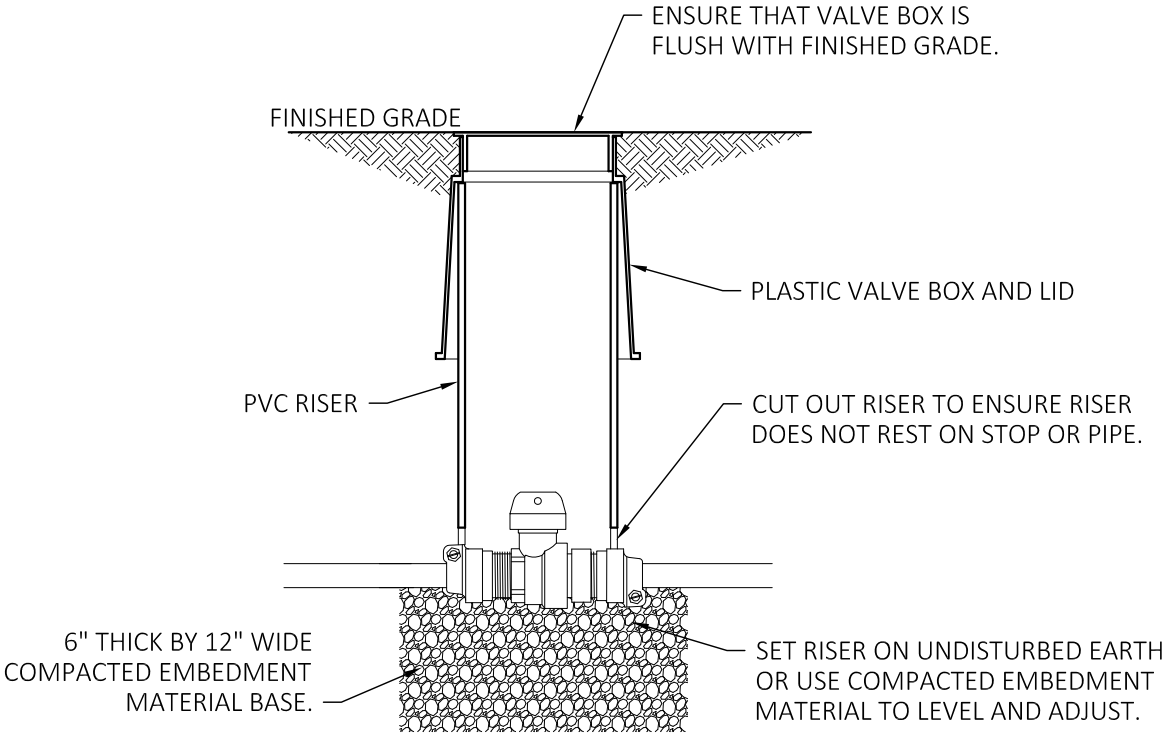
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 2/21/2013
Issued: 8/02/2021
Detail No. 3408



FRAME ATTACHMENT DETAIL



CUSTOMER VALVE BOX DETAIL

REV	DATE	DESCRIPTION	BY

Meter Box and Customer Valve Box

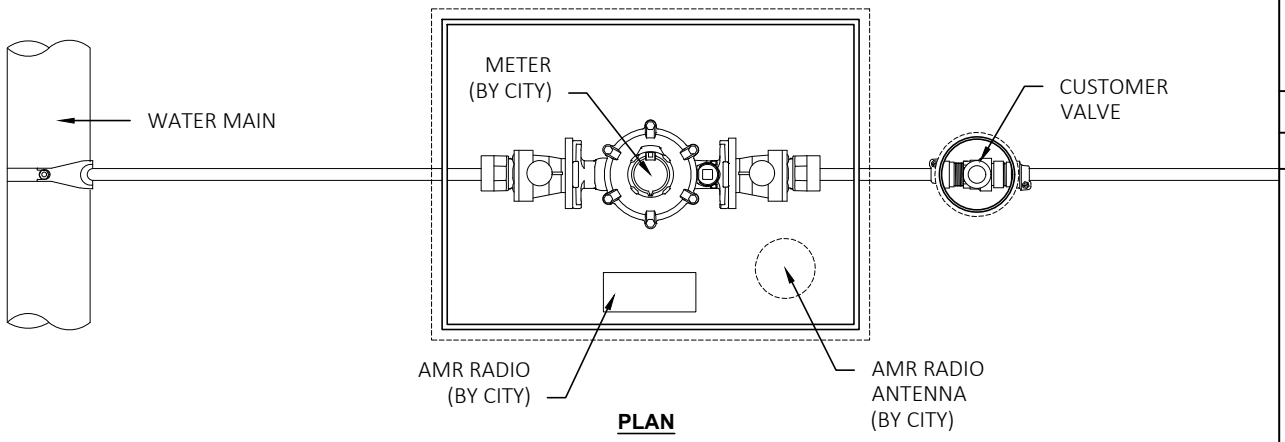
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

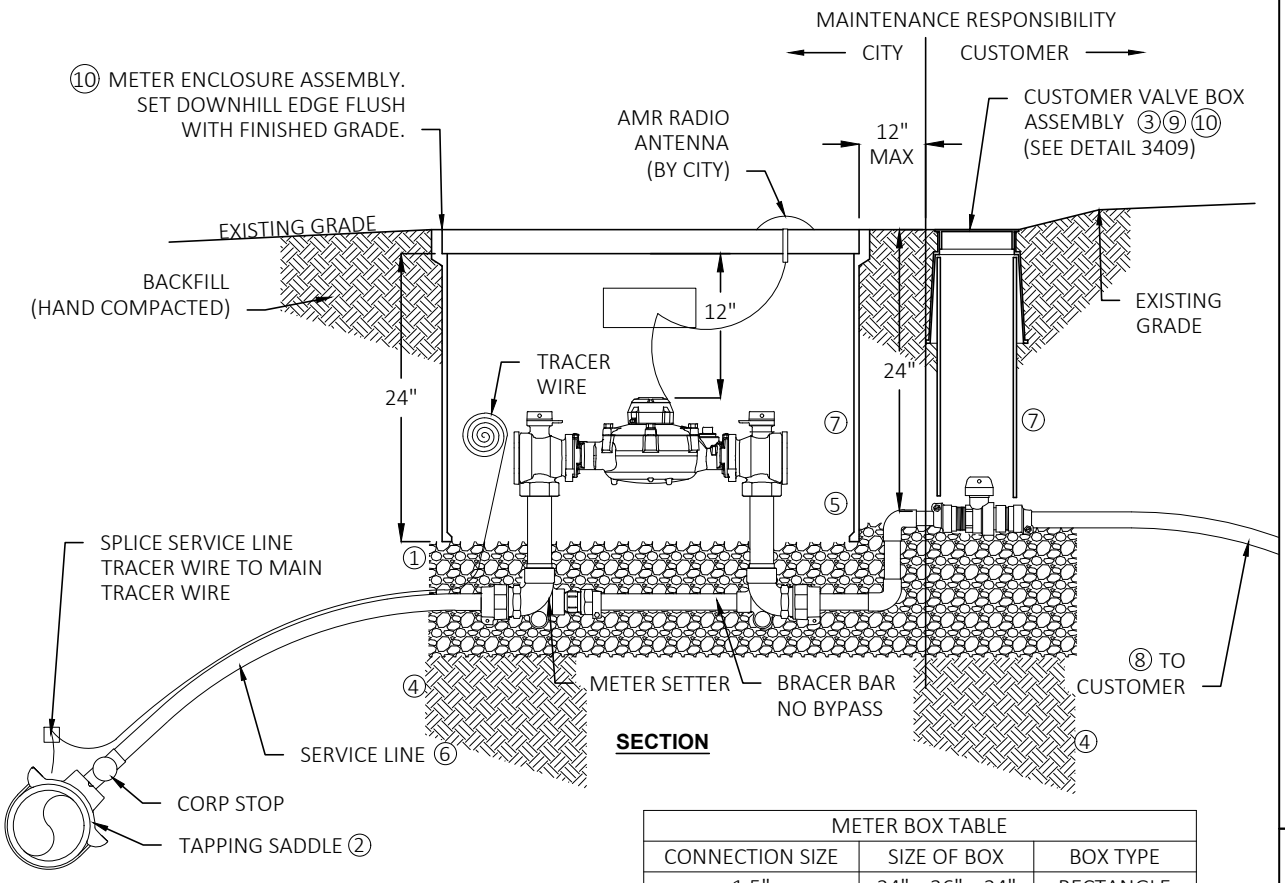
Adopted: 3/20/2017

Issued: 3/20/2017

Detail No. 3409



PLAN



SECTION

METER BOX TABLE		
CONNECTION SIZE	SIZE OF BOX	BOX TYPE
1.5"	24" x 36" x 24"	RECTANGLE
2"	24" x 36" x 24"	RECTANGLE

KEY NOTES:

① USE LEVELING COURSE OF COMPACTED EMBEDMENT MATERIAL AS NEEDED.
② TAP AT 2-O-CLOCK.
③ SET CUSTOMER VALVE BOX AS CLOSE TO METER BOX AS POSSIBLE ON CUSTOMER'S PROPERTY. DO NOT SET IN PAVEMENT.
④ COMPACT SUBGRADE.
⑤ CUT OUT BOX TO ENSURE BOX DOES NOT REST ON SERVICE LINE.
⑥ USE SINGLE CONTINUOUS PIPE FROM CORPORATION STOP TO METER FITTINGS.
⑦ SET PLUMB.
⑧ INSTALL MINIMUM 2 LF OF NEW PIPE ON CUSTOMER SIDE OF SHUT-OFF VALVE.
⑨ IF CUSTOMER VALVE NOT LOCATED ADJACENT TO METER BOX, CUSTOMER RESPONSIBILITY BEGINS 12" FROM EDGE OF METER BOX.
⑩ METER WILL BE PROVIDED, INSTALLED, AND MAINTAINED BY THE CITY. "CUSTOMER VALVE" AND BOX WILL BE PROVIDED AND INSTALLED BY THE CITY, THEN OWNED AND MAINTAINED BY THE CUSTOMER.

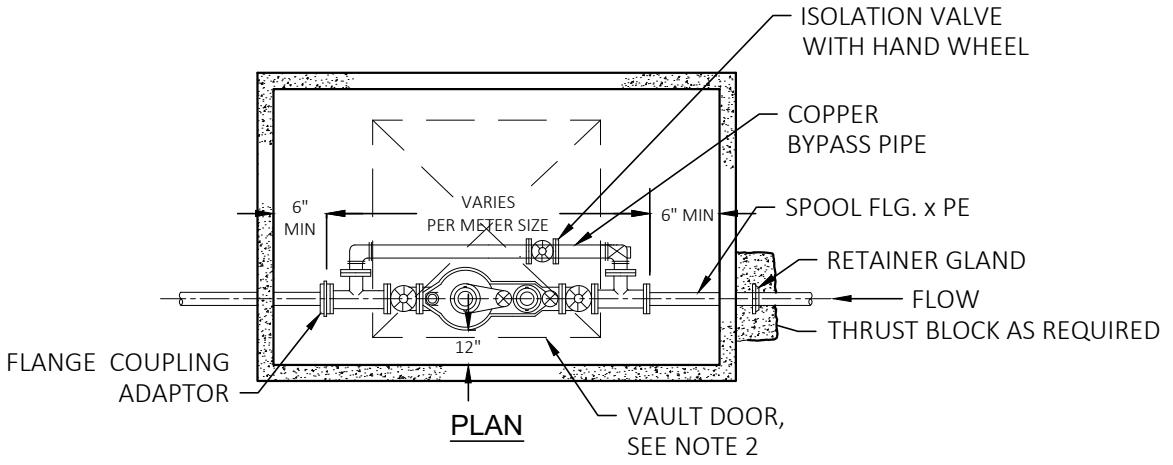
REV	DATE	DESCRIPTION	BY

Meter Assembly: 1.5-IN and 2-IN

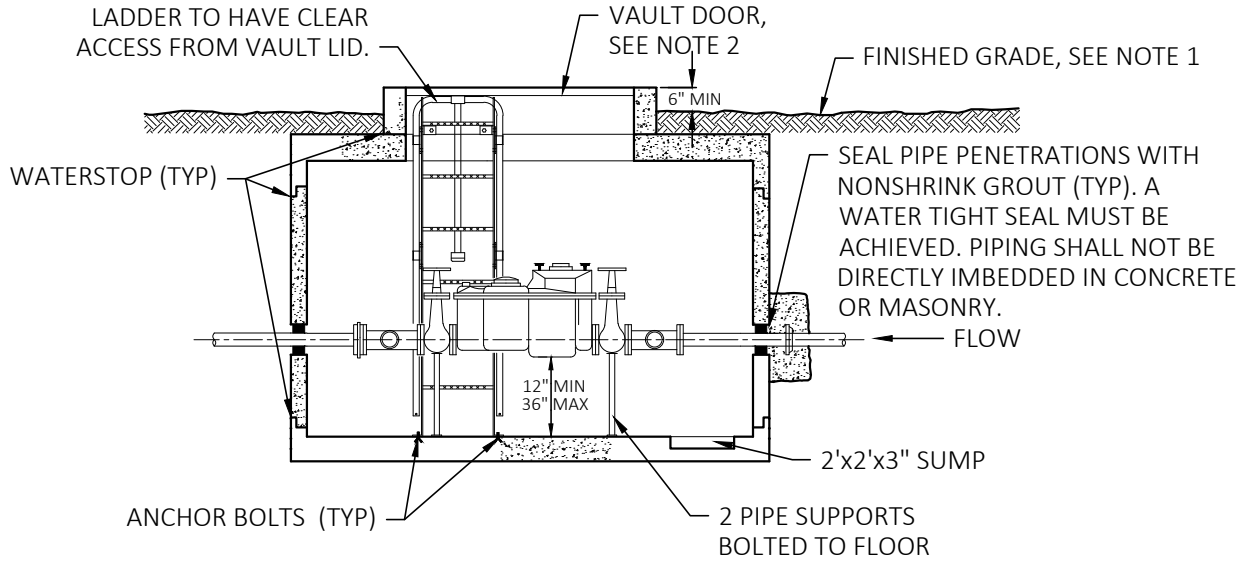
CITY OF STILLWATER CONSTRUCTION STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/02/2021
Issued: 8/02/2021
Detail No. 3410



PLAN



ELEVATION

NOTE:

1. FINISH GRADE SHALL SLOPE AWAY FROM THE VAULT COVER SO AS TO PREVENT PONDING.
2. VAULT DOOR MECHANISMS SHALL NOT PROJECT BELOW THE CEILING OF THE VAULT INTERIOR. THE VAULT DOOR SHALL HAVE A 1 5/16" Ø HOLE FOR THE AUTO READ ASSEMBLY.
3. HATCH SHALL BE HALLIDAY H1C ACCESS COVER OR APPROVED EQUAL.

WATER METER SIZE:	
3" COMPOUND WATER METER:	17 1/4-IN
4" COMPOUND WATER METER:	20 1/4-IN
6" COMPOUND WATER METER:	20 1/4-IN
6" X 8" COMPOUND WATER METER:	55 9/16-IN
3" TURBINE WATER METER:	12 1/4-IN
4" TURBINE WATER METER:	14 1/4-IN
6" TURBINE WATER METER:	18 1/4-IN
8" TURBINE WATER METER:	20 1/4-IN
10" TURBINE WATER METER:	26 1/4-IN

REV	DATE	DESCRIPTION	BY

Meter Assembly: 3-IN and Larger

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

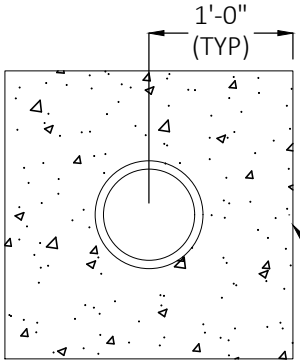
Adopted: 4/29/2011

Issued: 8/02/2021

Detail No. 3411

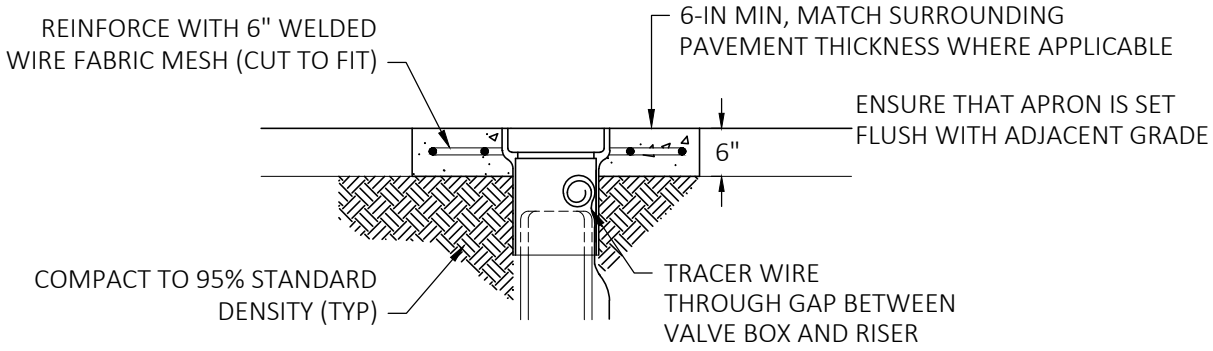
NOTES:

1. PRECAST CONCRETE APRONS ONLY ACCEPTABLE WHEN NOT USED IN PAVING.

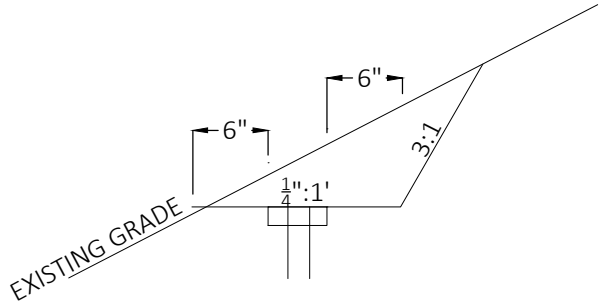


PLAN

IN PAVEMENT, SEAL EDGE W/RUBBERIZED ASPHALT PROVIDE EXPANSION JOINT FOR CONCRETE PAVEMENT. USE PREFORMED EXPANSION JOINT FILLER. HAND TOOL ROUND EDGE FOR NEW CONCRETE. USE ZIP STRIP OR EQUAL TO CAST VOID FOR SEALANT. PROVIDE HOT POURED JOINT SEALANT IN EXISTING ACC PAVEMENTS.



SECTION



REV	DATE	DESCRIPTION	BY

Valve Box

CITY OF STILLWATER STANDARDS

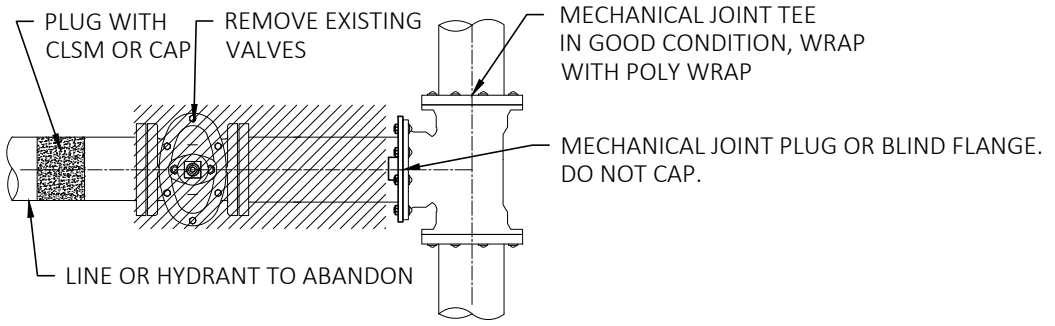
The City of Stillwater OKLAHOMA

Adopted: 3/20/2017

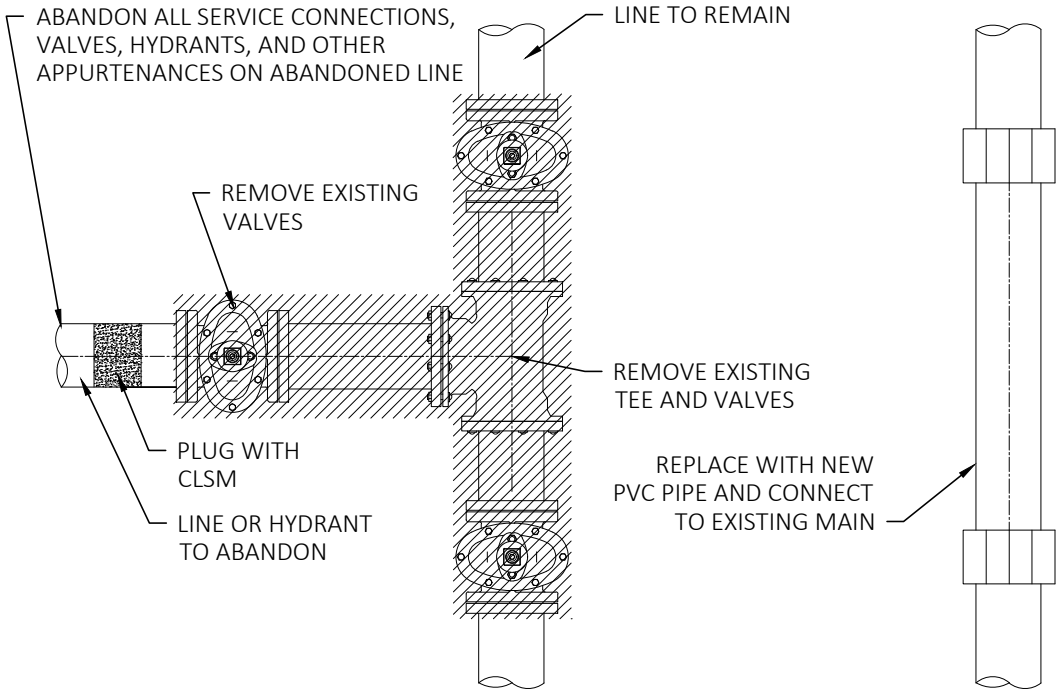
Issued: 8/02/2021

Detail No. 3412

ABANDON EXISTING WATER MAIN OR HYDRANT



- CASE 1: TEE TO REMAIN
(MJ OR FLANGED TEE ONLY. CITY ENGINEERING DIRECTOR APPROVAL REQUIRED)



- CASE 2: REMOVE TEE AND VALVES

NOTES:
FOR ALL CASES, THE ABANDONED LINE TO REMAIN SHOULD BE PLUGGED. WHEN UNDER PAVEMENT, PLUG TO REFUSAL WITH THIN GROUT. OTHERWISE, PLUG WITH 24" OF NONSHRINK GROUT.

REV	DATE	DESCRIPTION	BY

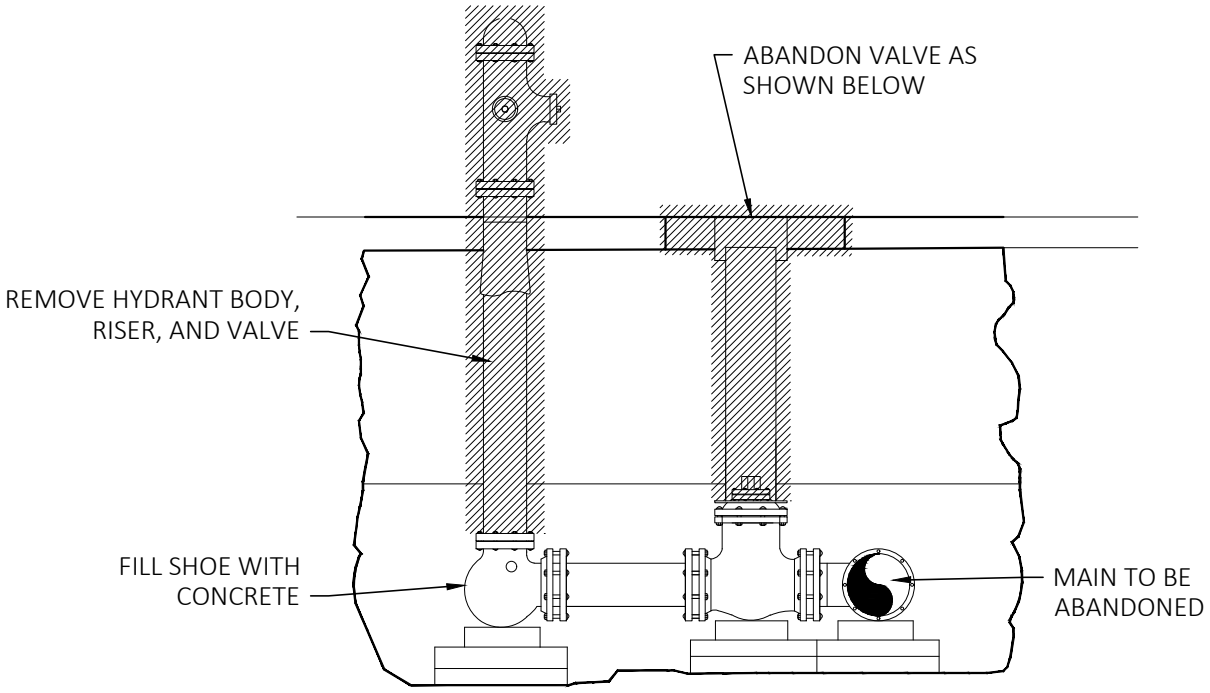
Abandonment of Water Line

CITY OF STILLWATER CONSTRUCTION STANDARDS

The City of Stillwater OKLAHOMA

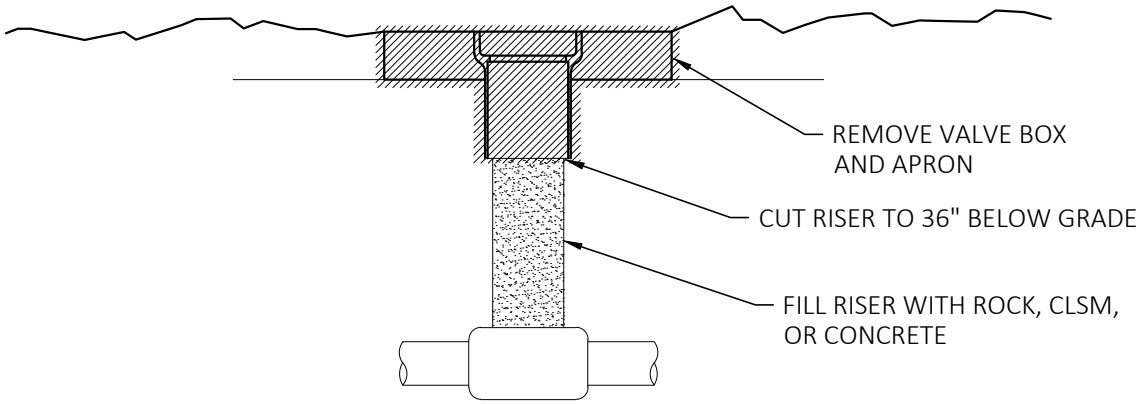
Adopted: 8/02/2021
Issued: 8/02/2021
Detail No. 3419

HYDRANT TOPSIDE REMOVAL FOR ABANDONED WATER LINE

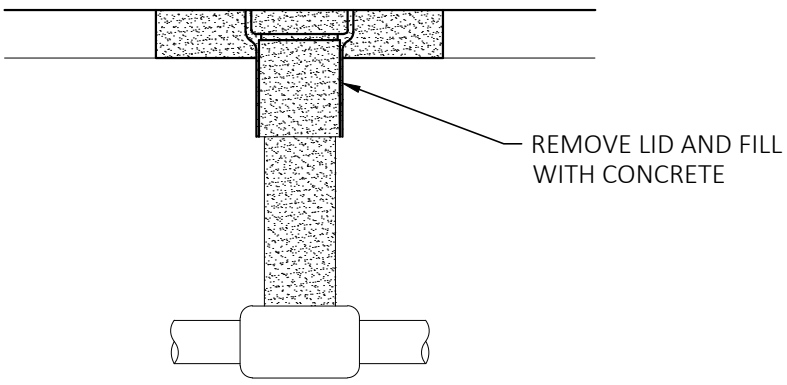


VALVE TOPSIDE REMOVAL FOR ABANDONED WATER LINE

IN GRASS, GRAVEL, OR SIDEWALK



IN PAVEMENT OR DRIVEWAY



REV	DATE	DESCRIPTION	BY

Abandonment of Hydrants and Valves

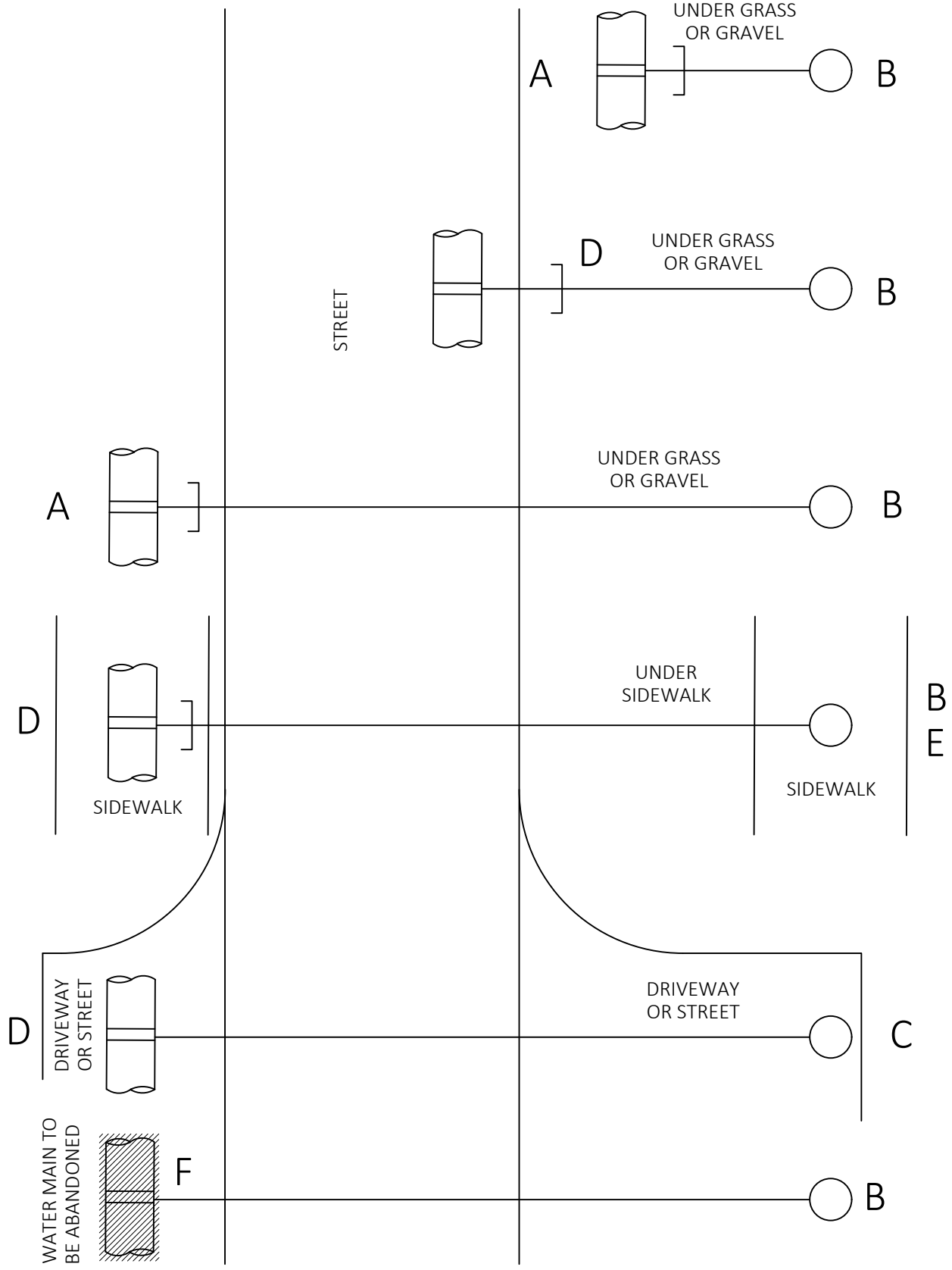
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/02/2021

Issued: 8/02/2021

Detail No. 3421



A: CAP AT CORP STOP WITH FORD OR MUELLER GRIP JOINT CAP. BACKFILL AND RESTORE.
B: REMOVE METER BOX AND SETTER. BACKFILL AND RESTORE.
C: REMOVE LID AND SETTER. BACKFILL WITH CONCRETE.
D: CAP SERVICE LINE AT EDGE OF PAVEMENT.
E: REPLACE SIDEWALK PANEL.
F: LEAVE SADDLE AND SERVICE LINE IN PLACE.

REV	DATE	DESCRIPTION	BY

Abandonment of Water Service Connection

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/02/2021

Issued: 8/02/2021

Detail No. 3423

A: CAP AT SADDLE OR AT 4' DEPTH. BACKFILL AND RESTORE
B: CAP AT EDGE OF STREET, PARKING LOT, OR SIDEWALK
C: SIDEWALK PANEL DEMO IF REQURIED FOR ASSOCIATED PROJECT

REV	DATE	DESCRIPTION	BY

Abandonment of Sewer Service Connection

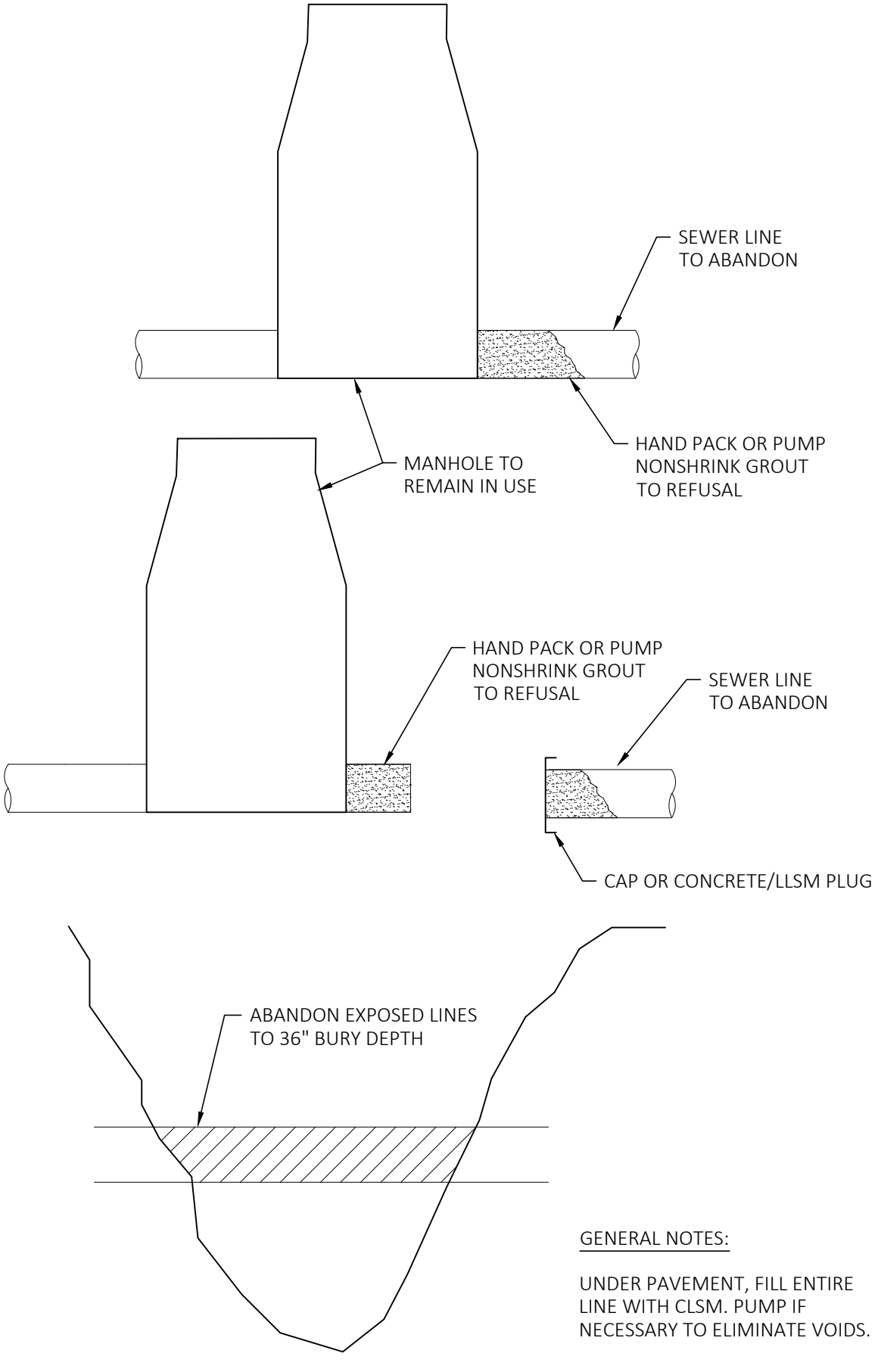
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/02/2021

Issued: 8/02/2021

Detail No. 3424



GENERAL NOTES:

UNDER PAVEMENT, FILL ENTIRE LINE WITH CLSM. PUMP IF NECESSARY TO ELIMINATE VOIDS.

REV	DATE	DESCRIPTION	BY

Abandonment of Sewer at Manhole

CITY OF STILLWATER STANDARDS

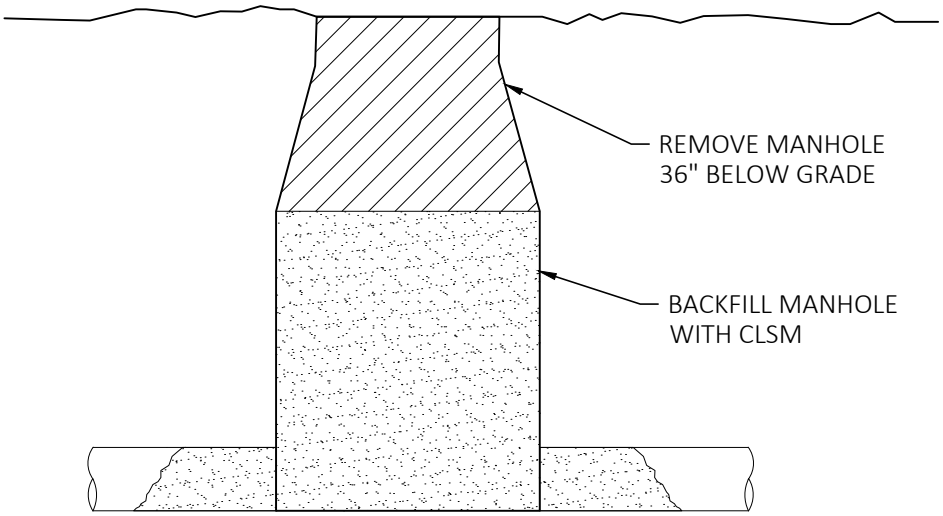
The City of Stillwater OKLAHOMA

Adopted: 8/02/2021

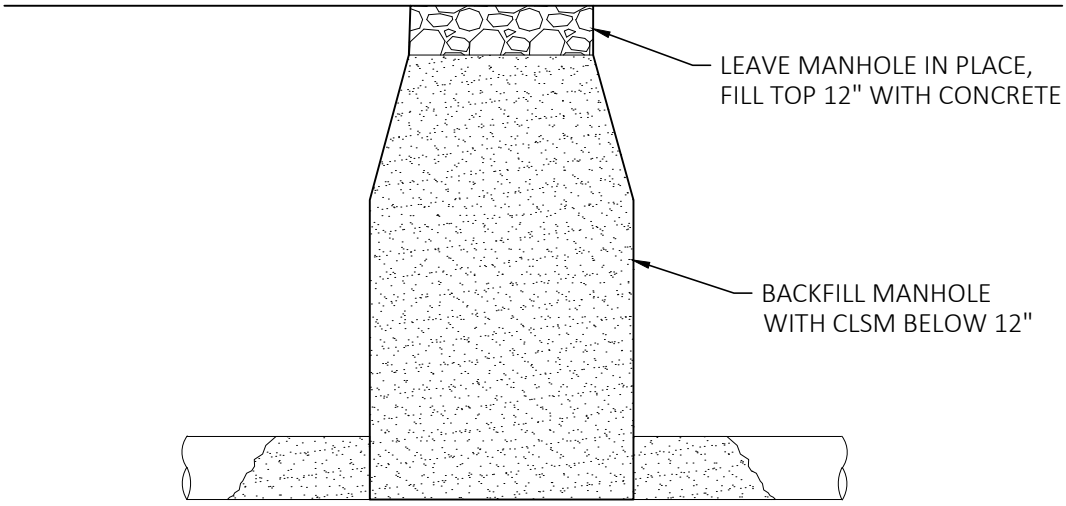
Issued: 8/02/2021

Detail No. 3425

ABANDON MANHOLE IN GRASS, SIDEWALK, OR GRAVEL



ABANDON MANHOLE IN PAVEMENT, DRIVEWAY, OR PARKING LOT



GENERAL NOTES:

ABANDON CLEANOUTS AND
LAMPHOLES IN SIMILAR FASHION

REV	DATE	DESCRIPTION	BY

Abandonment of Manhole

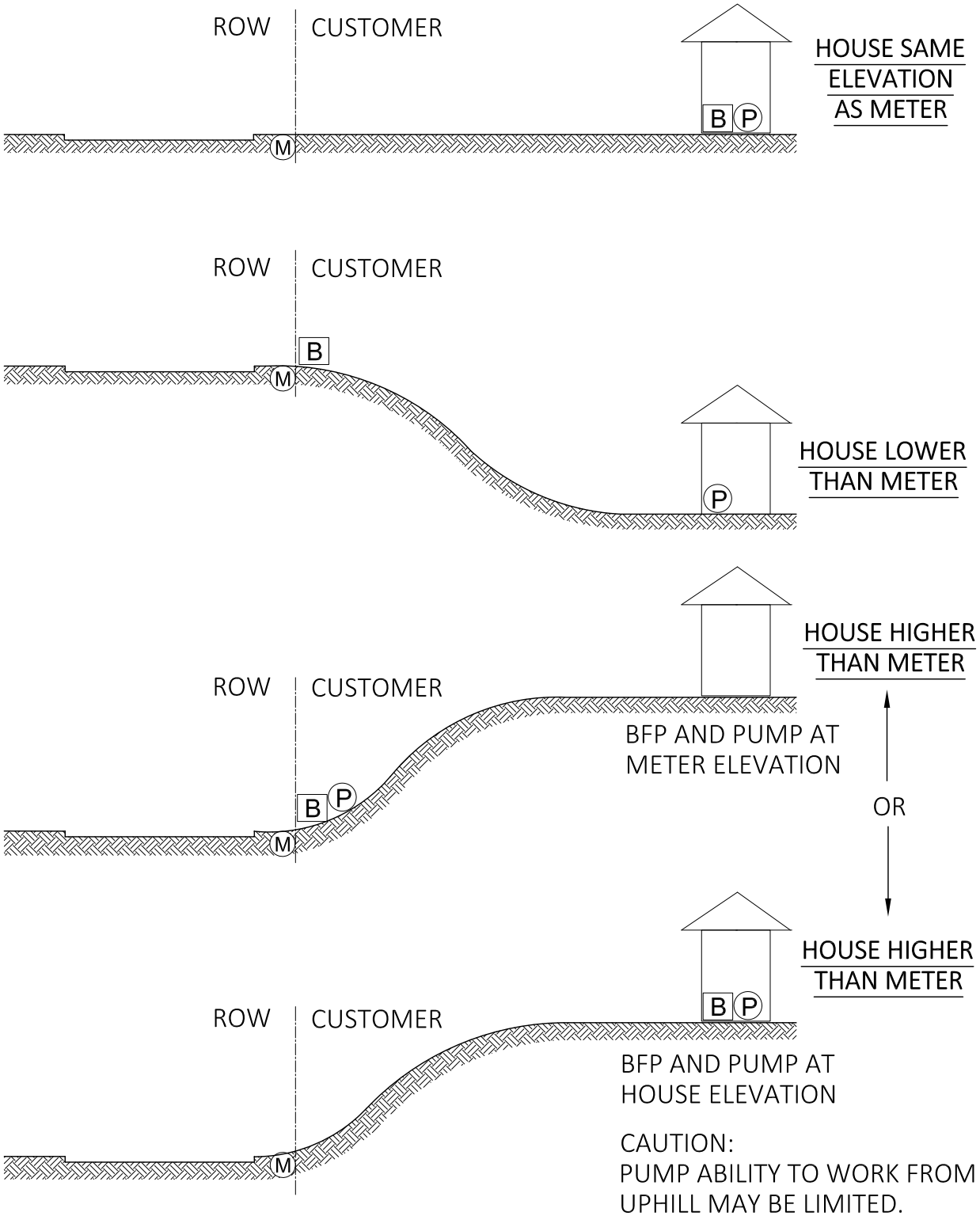
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/02/2021

Issued: 8/02/2021

Detail No. 3426



CAUTION:
PUMP ABILITY TO WORK FROM UPHILL MAY BE LIMITED.

(P) PRIVATE BOOSTER PUMP
[B] BACKFLOW PREVENTER
(M) WATER METER

NOTE:
ADEQUATE PROVISIONS SHALL BE MADE TO PROTECT WATER SUPPLY AND BACKFLOW PREVENTION FROM FREEZING. WELLS OR PITS ARE PROHIBITED.

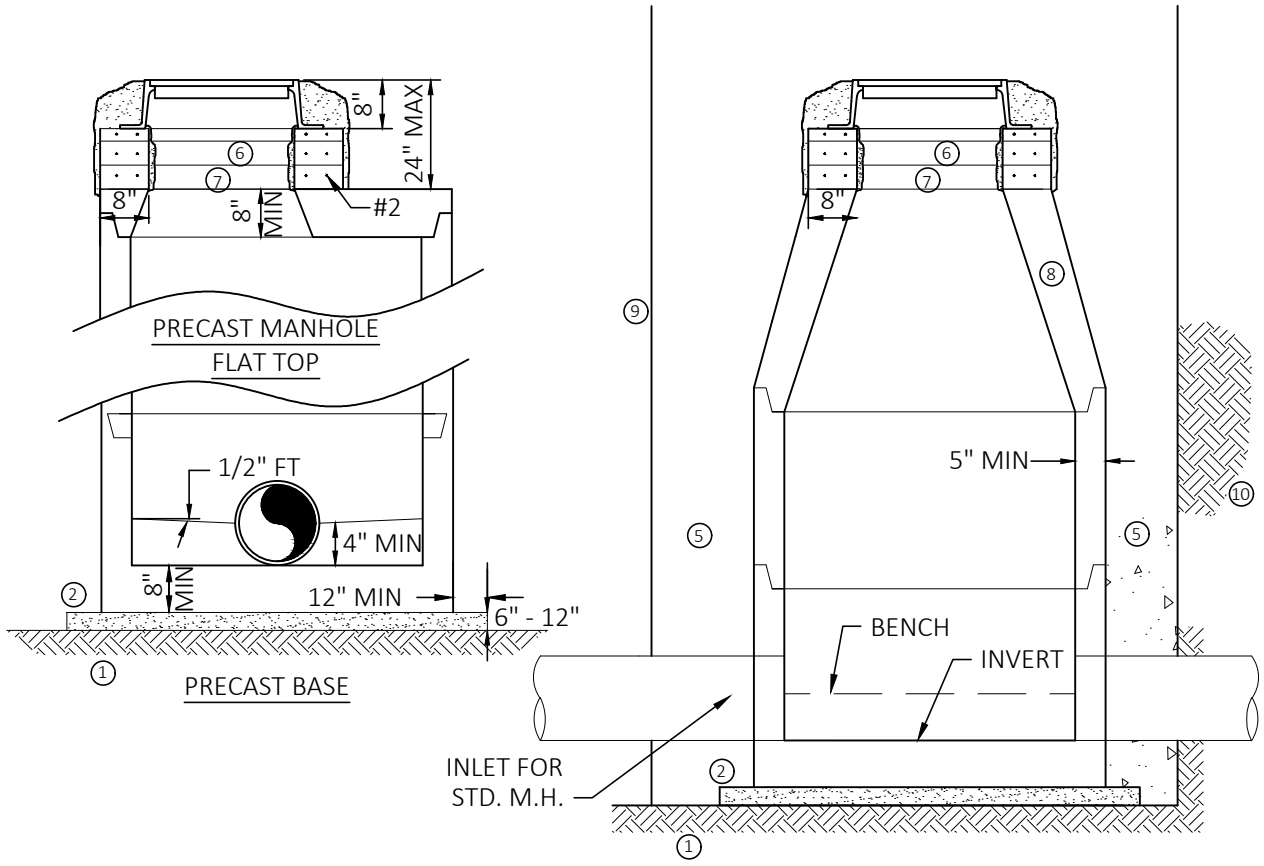
REV	DATE	DESCRIPTION	BY

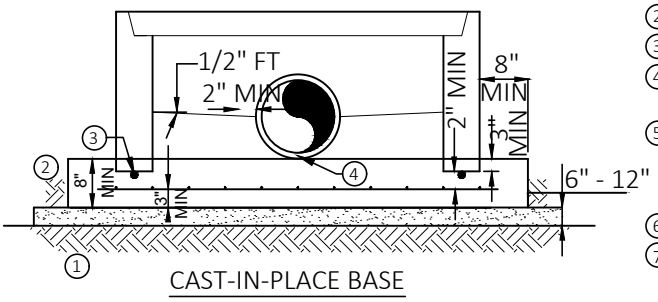
Private Booster Pump Station Locations

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 5/7/2018
Issued: 5/7/2018
Detail No. 3490





KEY NOTES:

1. COMPACTED SUBGRADE.
2. COMPACTED BASE MATERIAL.
3. WATERSTOP.
4. MATCH INVERT TO FLOWLINE OF PIPE CONNECTIONS.
5. BACKFILL WITH EMBEDMENT MATERIAL, MIN 12" ALL SIDES OF MANHOLE STRUCTURE. VIBRATE IN PLACE TO CONSOLIDATE. MAX 12" LIFTS.
6. ECCENTRIC CORBEL.
7. COAT INSIDE AND OUTSIDE OF ADJUSTMENT RINGS WITH MINIMUM 1/4" MORTAR.
8. MATCH INSIDE OF FRAME TO INSIDE OF PRECAST WALL OR CORBEL SECTION.
9. LIMITS OF EXCAVATION.
10. UNDISTURBED EARTH.

GENERAL NOTES:

- PROVIDE FULL HEIGHT ID WALL SECTIONS AND FLATTOP SECTION IN LIEU OF CORBEL SECTION WHEN MANHOLE IS LESS THAN 4'-6" FROM INVERT TO RIM.
- ALL COMPONENTS SHALL BE RATED FOR Hs2O WHEEL LOAD.
- USE 3000PSI MINIMUM STRENGTH CONCRETE FOR ALL CAST IN PLACE AND PRECAST COMPONENTS.

REV	DATE	DESCRIPTION	BY

Precast Manhole

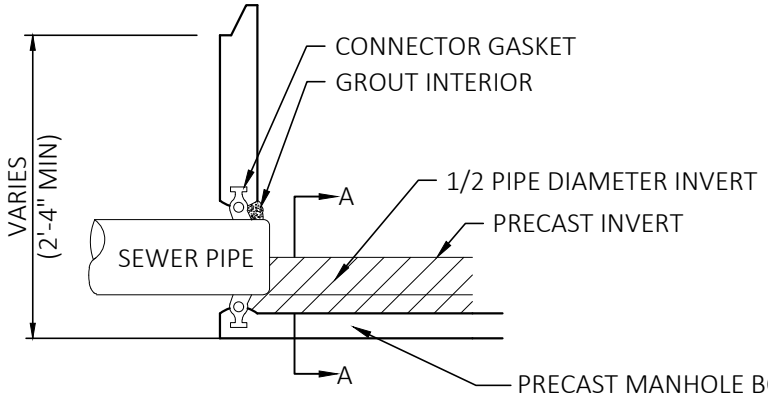
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

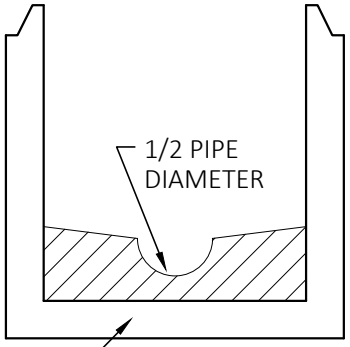
Adopted: 3/20/2017

Issued: 8/02/2021

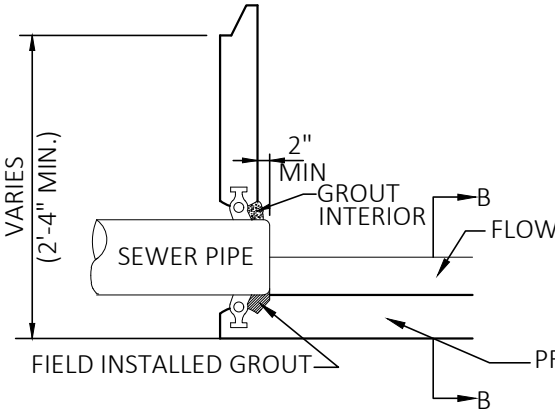
Detail No. 3501



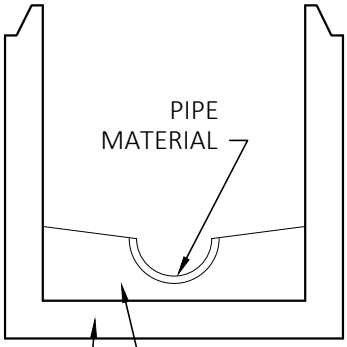
MANHOLE WITH PRECAST INVERT



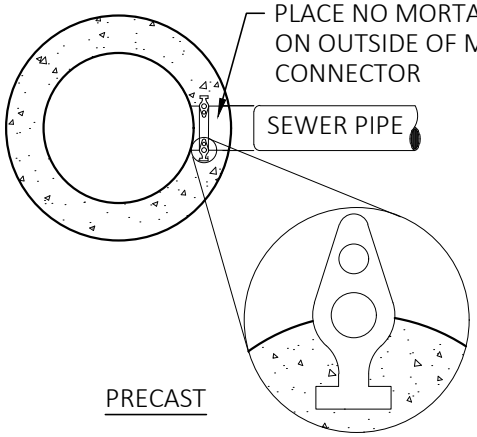
SECTION A-A



MANHOLE WITH FIELD-INSTALLED INVERT

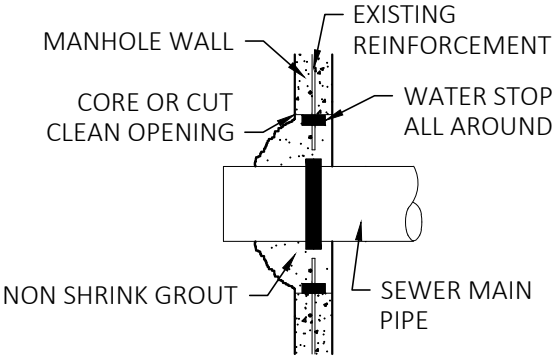


SECTION B-B



PRECAST

ENLARGED
VIEW



INSTALLED IN FIELD

REV	DATE	DESCRIPTION	BY

Manhole Pipe Connections

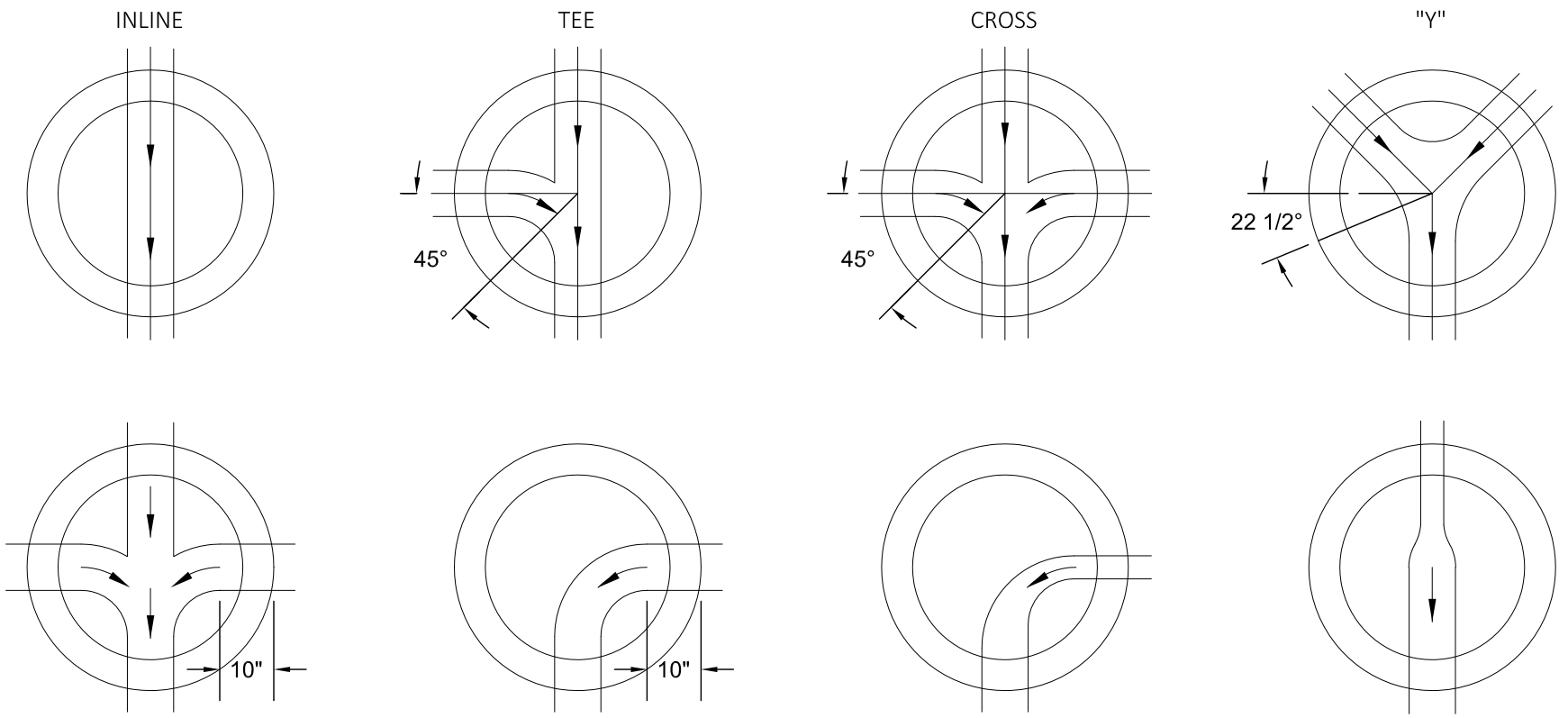
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 2/21/2013

Issued: 8/02/2021

Detail No. 3502



TYPICAL MANHOLE INVERT DETAIL

Detail No.	Issued:	Adopted:
3503	3/20/2017	4/29/2011

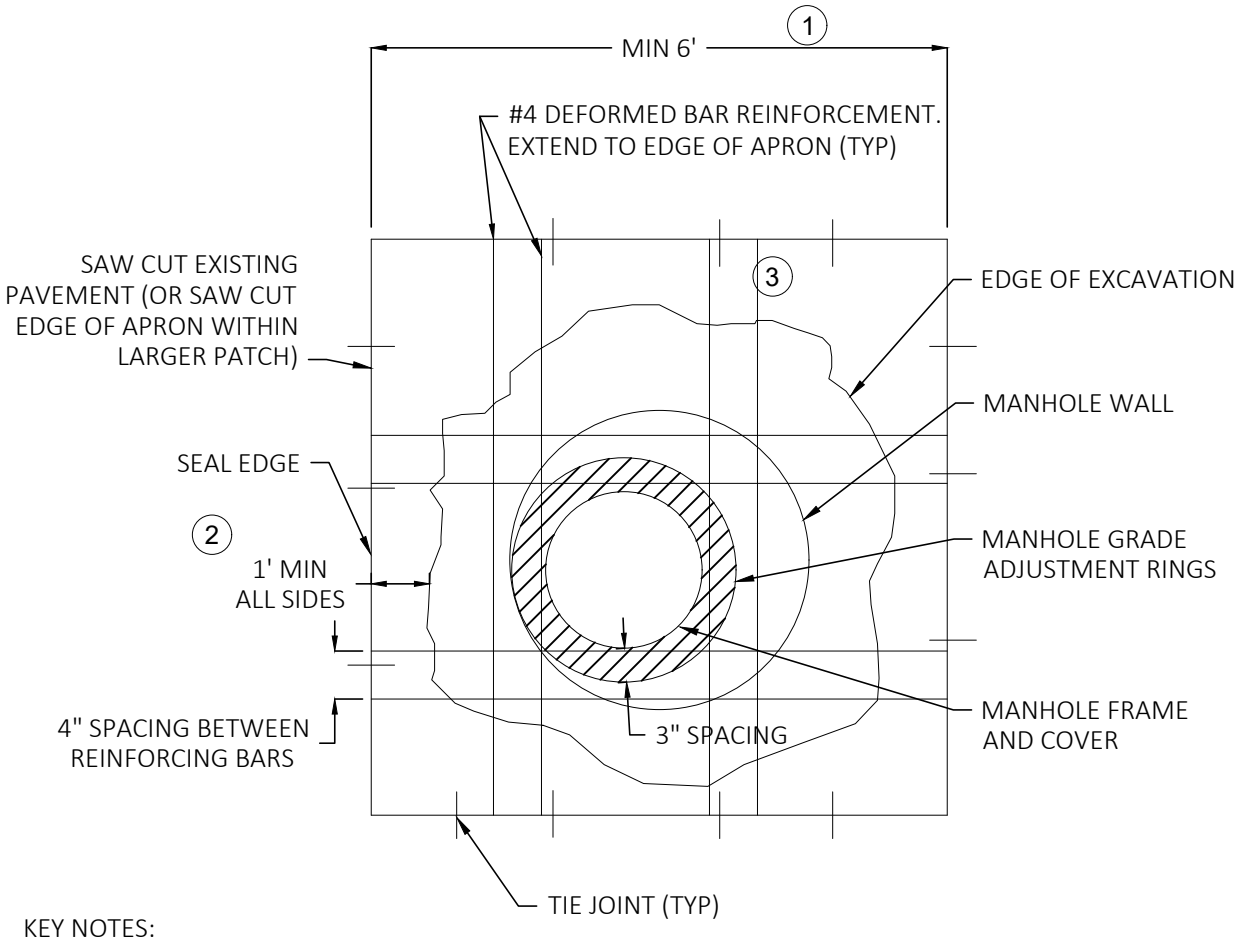
The City of Stillwater OKLAHOMA

Manhole Invert Details

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

w:\engineering\standards\details\01_adopted details\cad\3503 manhole invert details_20110429.dwg



KEY NOTES:

1. COORDINATE WITH CITY TO DETERMINE FINAL EXTENTS OF PATCH & APRON. PATCH MAY BE ADJUSTED TO MATCH ADJACENT PAVEMENT CONTROL JOINTS AND REPAIR CRACKING OR OTHER DAMAGE.
2. ROTATE CORBEL TO CENTER BETWEEN WHEEL PATHS.
3. WHEN EDGE OF APRON IS < 5 FEET FROM MANHOLE FRAME, EXTEND REINFORCEMENT AND TIE TO EXISTING PAVEMENT.

REV	DATE	DESCRIPTION	BY

Manhole Concrete Apron

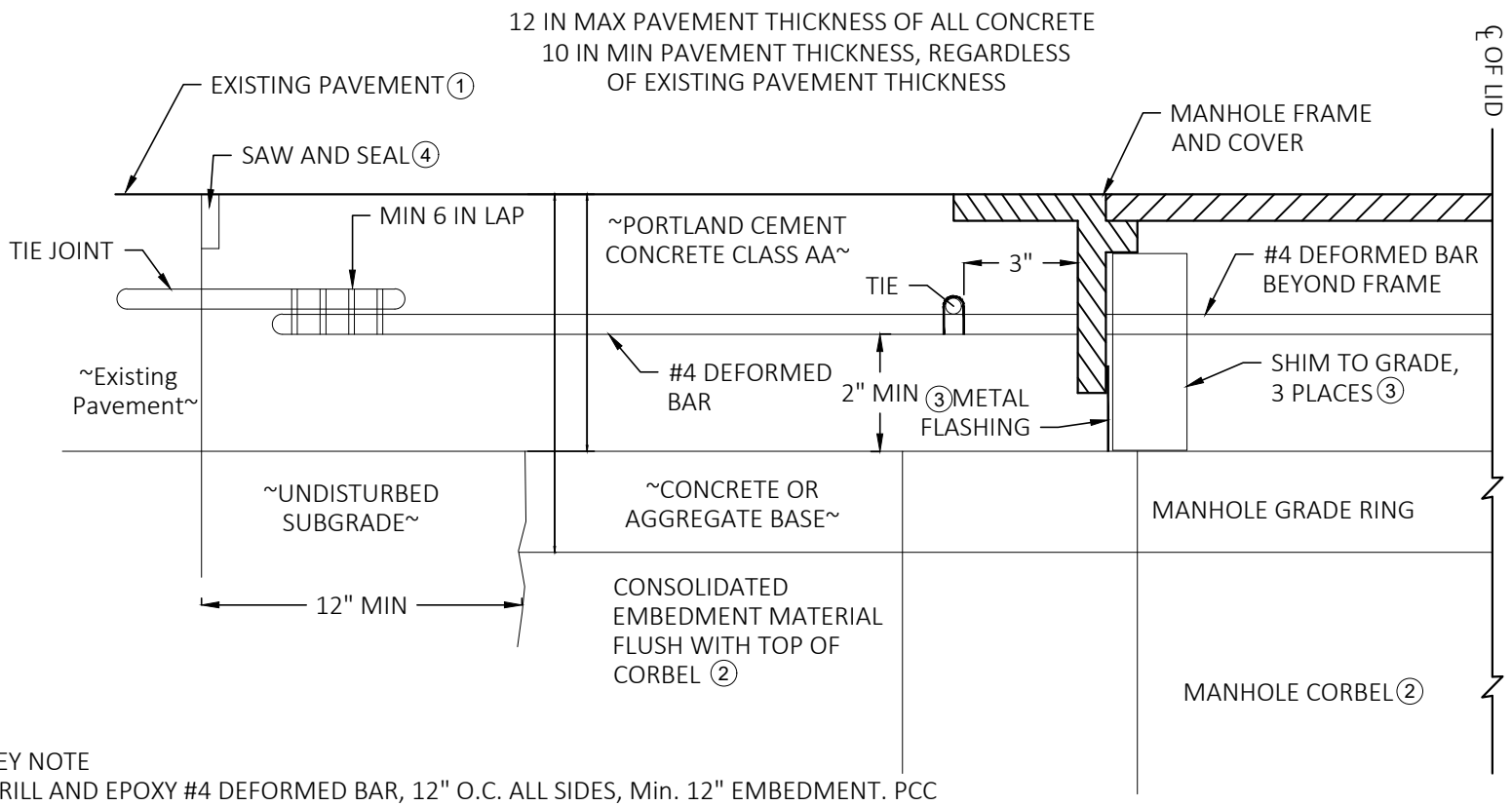
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 2/21/2013

Issued: 8/02/2021

Detail No. 3504



KEY NOTE

(1) DRILL AND EPOXY #4 DEFORMED BAR, 12" O.C. ALL SIDES, Min. 12" EMBEDMENT. PCC EXISTING PAVEMENT ONLY. CENTER IN PAVEMENT THICKNESS.

(2) TOP OF CORBEL AND TOP OF CONSOLIDATED EMBEDMENT MATERIAL TO MATCH BOTTOM OF EXCAVATION FOR GRADE RING.

(3) REMOVE AFTER CONCRETE APRON INSTALLATION.

(4) USE PREFORMED EXPANSION JOINT FILLER. HAND TOOL ROUND EDGE FOR NEW CONCRETE. USE ZIP STRIP OR EQUAL TO CAST VOID FOR SEALANT. PROVIDE HOT POURED JOINT SEALANT IN EXISTING ACC PAVEMENT. PROVIDE LOW MODULUS SILICONE JOINT SEALANT (SELF-LEVELING) IN EXISTING PCC PAVEMENT.

Detail No. 3505

Issued: 8/02/2021

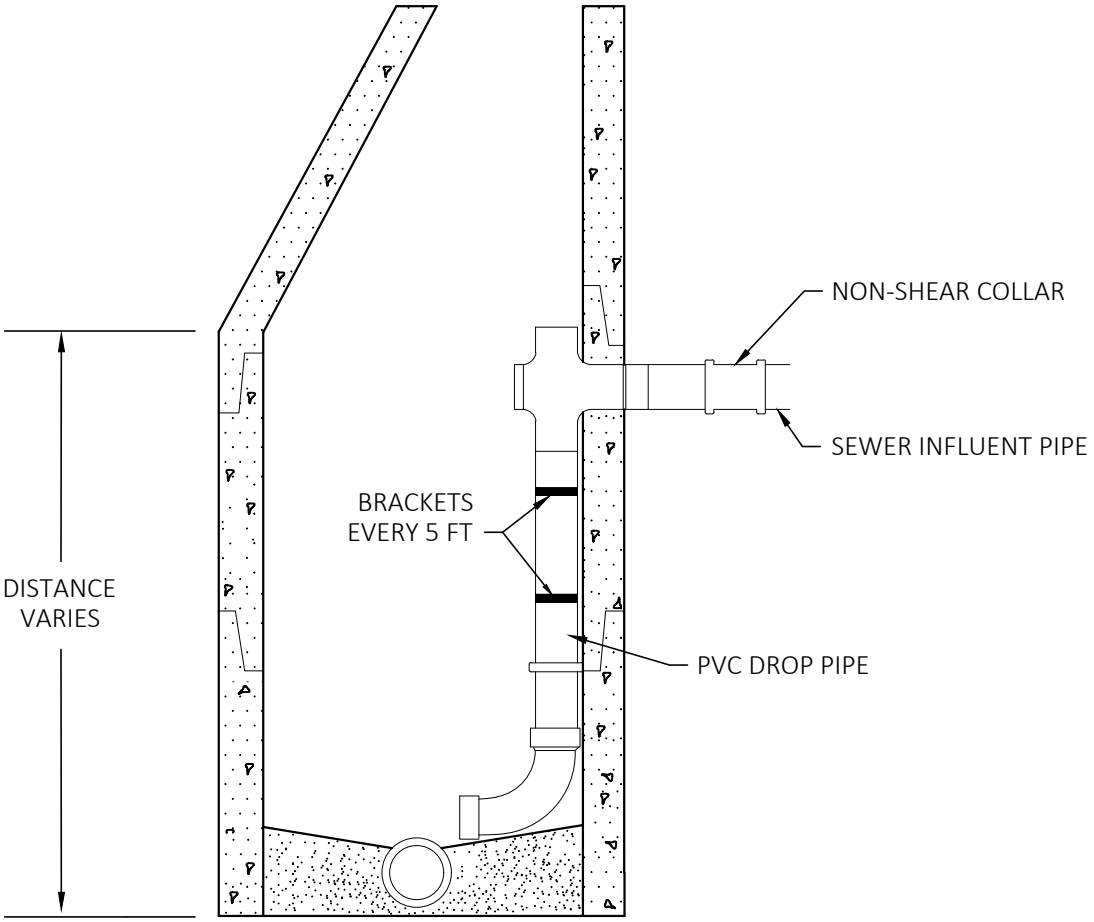
Adopted: 2/21/2013

The City of Stillwater OKLAHOMA

Manhole Concrete Apron Section

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY



NOTES:

1. ALL SEALS BETWEEN SEWER LINES AND MANHOLES SHALL BE WATERTIGHT, SIZE-ON-SIZE RESILIENT CONNECTIONS ALLOWING FOR DIFFERENTIAL SETTLEMENT AND MEETING ASTM C923.

2. ALL FITTINGS INSIDE MANHOLE SHALL BE SDR 26 SOLVENT WELD.

3. ALL PIPE INSIDE MANHOLE FOR DROP CONNECTION SHALL BE SDR 26 MINIMUM.

4. PIPE BRACKETS AND WALL ANCHORS SHALL BE 316 STAINLESS STEEL AS MANUFACTURED BY RELINER. MINIMUM ANCHOR EMBEDMENT 3". ALTERNATE CORROSION-PROOF MATERIALS, SUCH AS FIBERGLASS REINFORCED PLASTIC BRACKETS AND ANCHORS, OR ALTERNATE EMBEDMENT, SUCH AS EPOXY-BASED, MAY BE CONSIDERED AS APPROVED EQUAL.

5. MINIMUM 6 FT. MANHOLE TO BE USED WHERE INSIDE DROP IS REQUIRED.

6. ALL MANHOLE DROPS SHALL BE INSIDE DROPS.

REV	DATE	DESCRIPTION	BY

Manhole Inside Drop

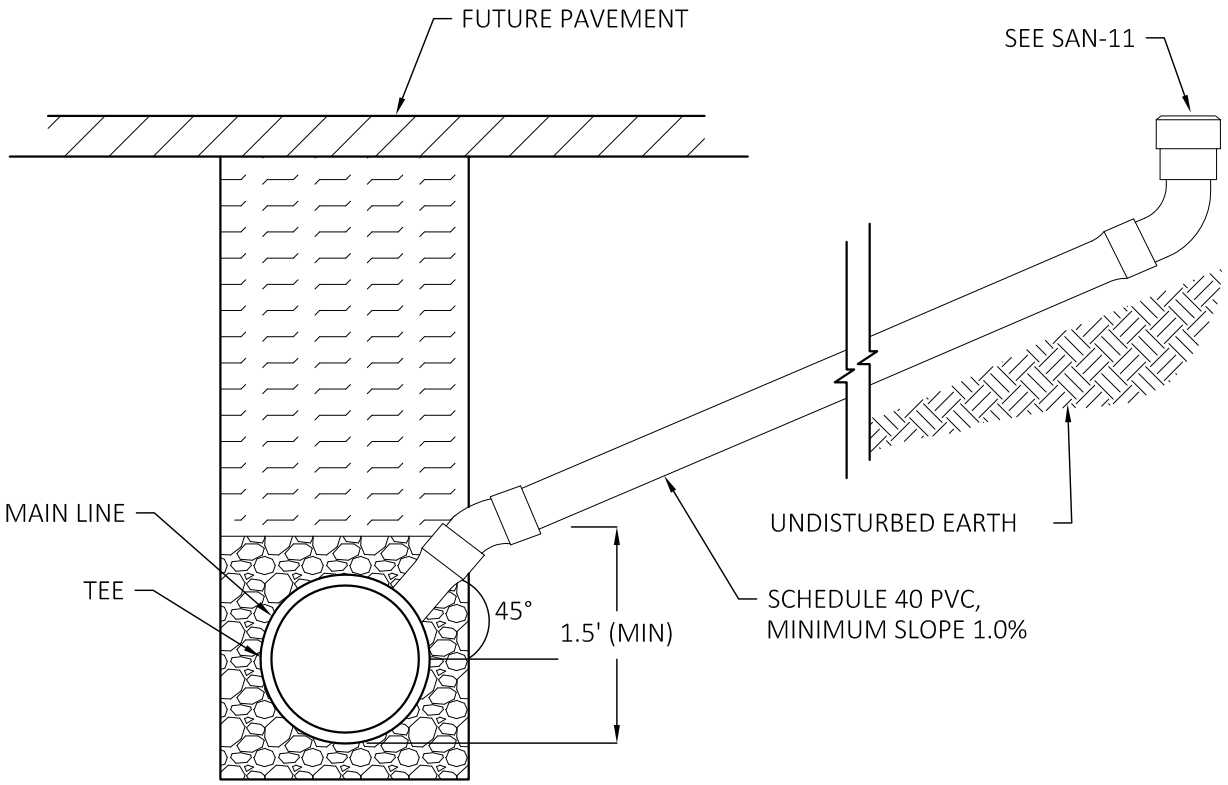
CITY OF STILLWATER STANDARDS

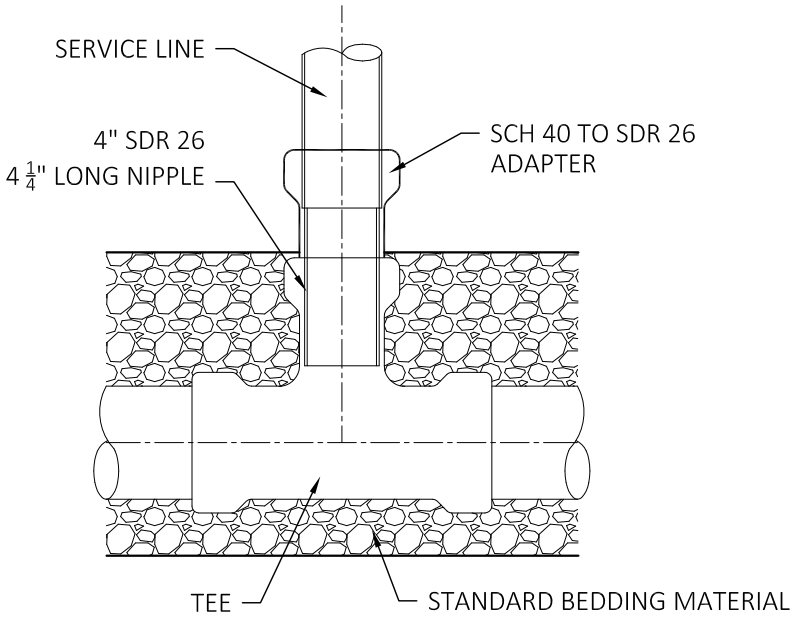
The City of Stillwater OKLAHOMA

Adopted: 4/29/2011

Issued: 8/02/2021

Detail No. 3506





REV	DATE	DESCRIPTION	BY

Service Connection

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 2/21/2013

Issued: 3/20/2017

Detail No. 3507

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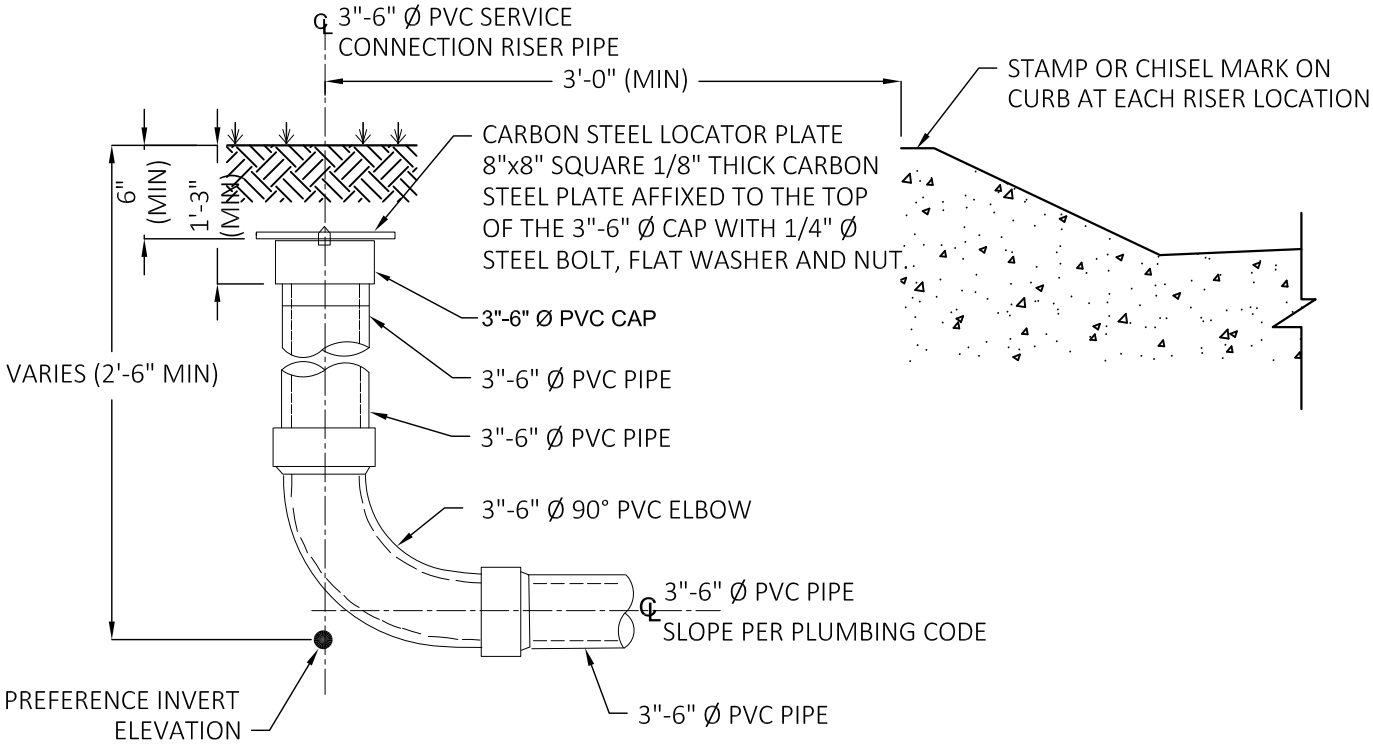


SECTION VIEW

3"-6" Ø PVC SERVICE CONNECTION RISER

Detail No.	Issued:	Adopted:
3508	3/20/2017	4/29/2011

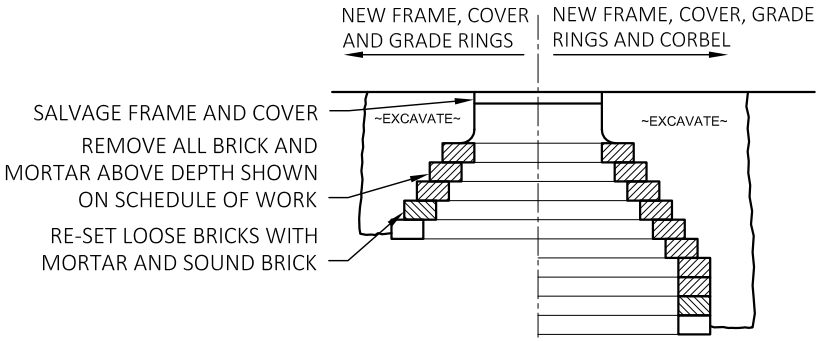
The City of Stillwater OKLAHOMA

Service Connection Riser

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

w:\engineering\standards\details\01_adopted details\cad\3508 service connection riser_20110429.dwg



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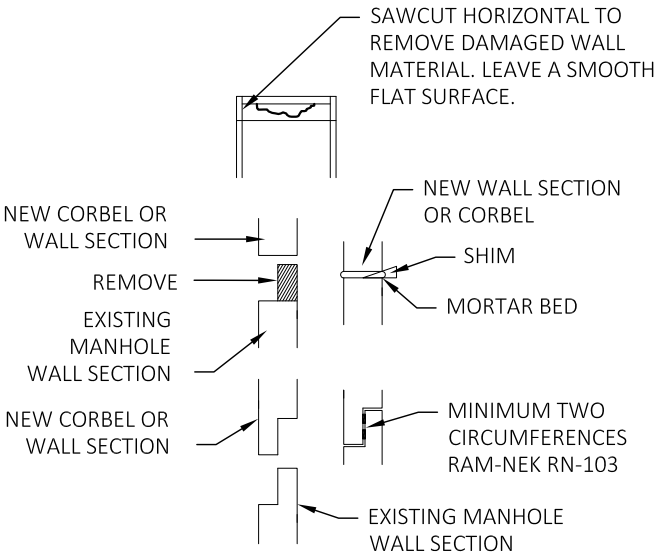
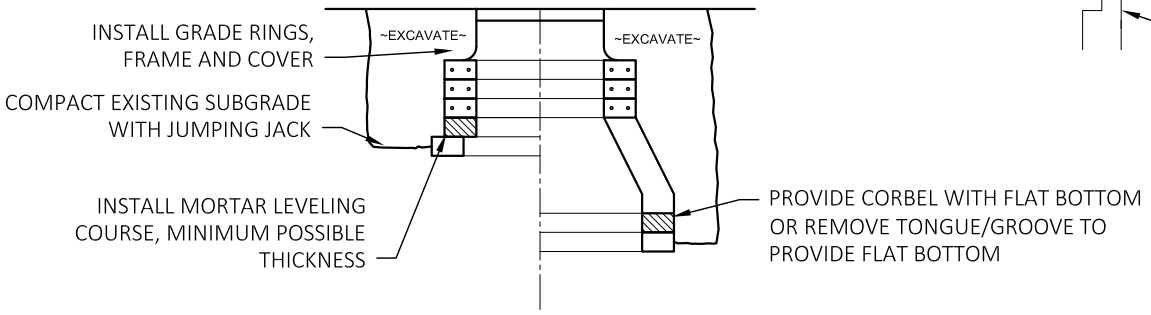




INSTALLATION

w:\engineering\standards\details\01_adopted details\cad\3509 brick manhole frame & cover_20120309.dwg

Detail No. 3509

Issued: 3/20/2017

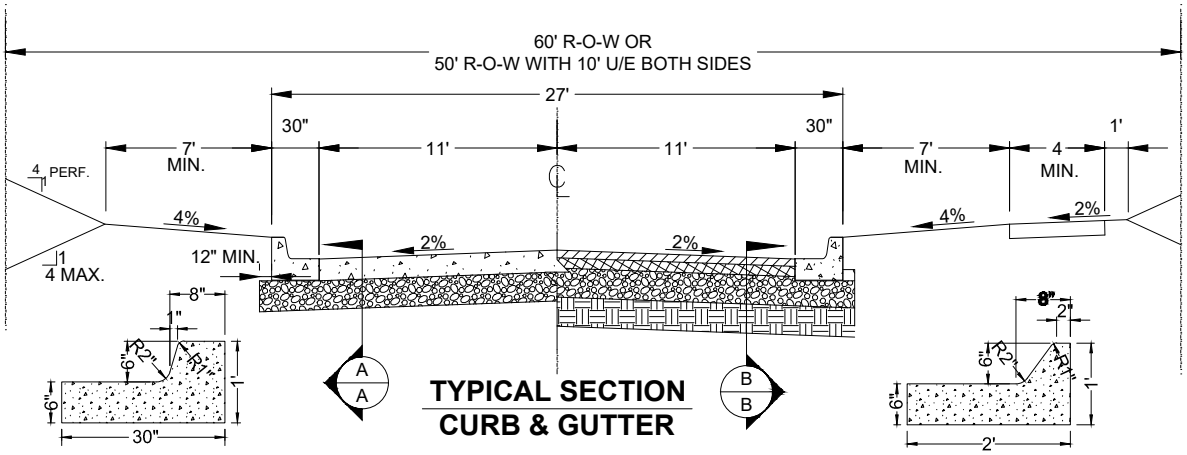
Adopted: 3/9/2012

The City of Stillwater OKLAHOMA

Brick MH Frame/Cover/Corbel Replacement

CITY OF STILLWATER STANDARDS

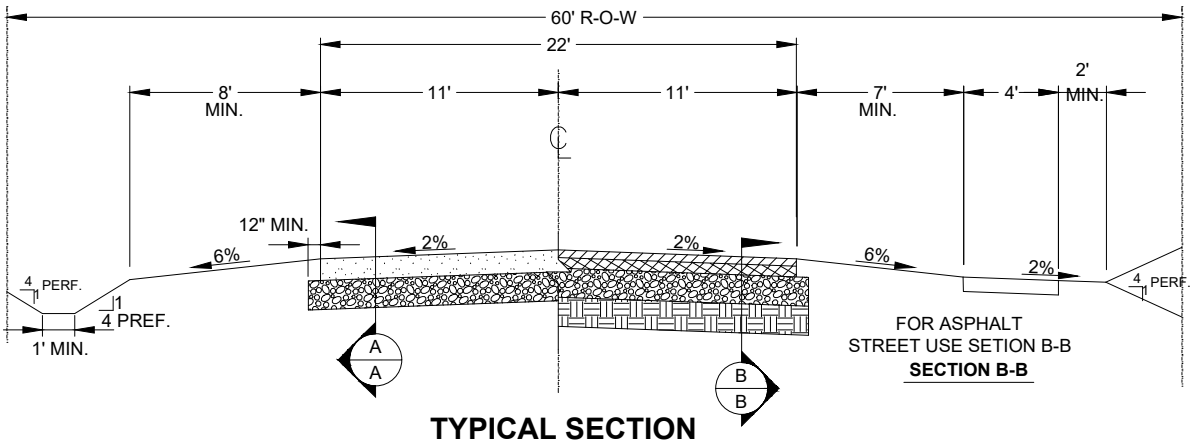
REV	DATE	DESCRIPTION	BY



TYPICAL SECTION
CURB & GUTTER

COMBINED CURB & GUTTER (6" BARRIER)
LOCAL, COLLECTOR, AND ARTERIAL STREETS

COMBINED CURB & GUTTER (6" MOUNTABLE)
LOCAL STREETS

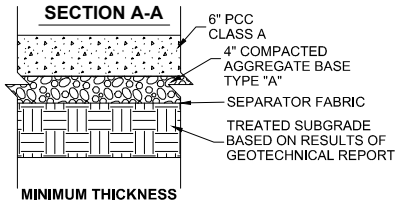


FOR ASPHALT STREET USE SETION B-B
SECTION B-B

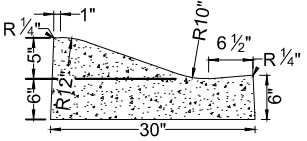
TYPICAL SECTION
OPEN GRADED

FOR CONCRETE STREET USE SECTION A-A

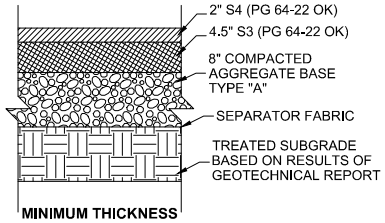
SECTION A-A



MINIMUM THICKNESS CONCRETE CONSTRUCTION
LOCAL STREETS



COMBINED CURB & GUTTER (5" MOUNTABLE)
LOCAL STREETS



MINIMUM THICKNESS ASPHALT CONSTRUCTION
LOCAL STREETS

NOTES:

1. SECTIONS SHOWN ARE MINIMUM REQUIRED.
2. SUBGRADE MAY REQUIRE ADDITIONAL THICKNESS, MODIFICATION, OR A SUBBASE DRAINAGE SYSTEM WHERE SEVERE SOIL CONDITIONS EXIST BASED ON THE RESULTS OF THE GEOTECHNICAL REPORT.
3. FOR EXISTING SUBBASE MATERIAL WITH PI <10 SUBGRADE SHALL BE CLASSIFIED SELECT, INERT MATERIAL OR STABILIZED AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.
4. ASPHALT SURFACES SHALL CONFORM TO ODOT STANDARD 401.04 FOR TOLERANCES.
5. IF A COMPACTED AGGREGATE SUBBASE IS USED, THE AGGREGATE SHALL BE PLACED ON SEPARATOR FABRIC.
6. FOR OPEN CHANNEL SECTION A 20' LONG x 3' WIDE, 6" DEEP TBSC SHOULDER IS REQUIRED AT ALL MAIL BOXES

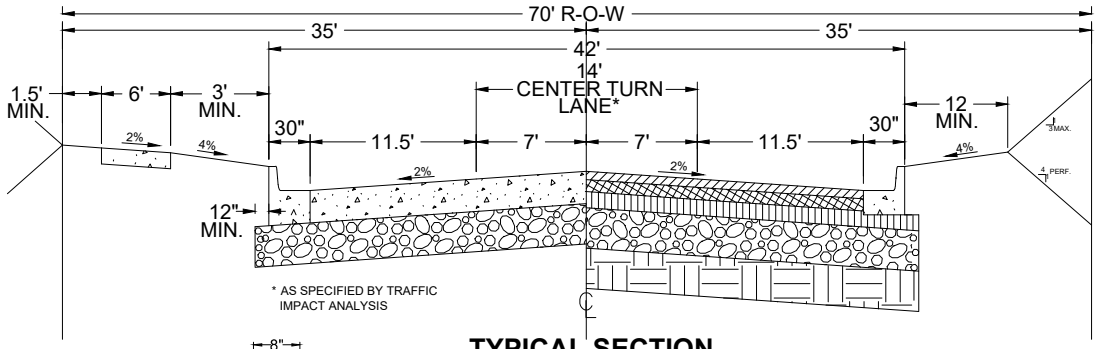
REV	DATE	DESCRIPTION	BY

Local Street

CITY OF STILLWATER STANDARDS

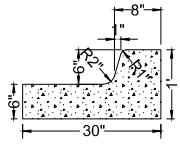
The City of Stillwater OKLAHOMA

Adopted: 7/18/2011
Issued: 8/02/2021
Detail No. 3701



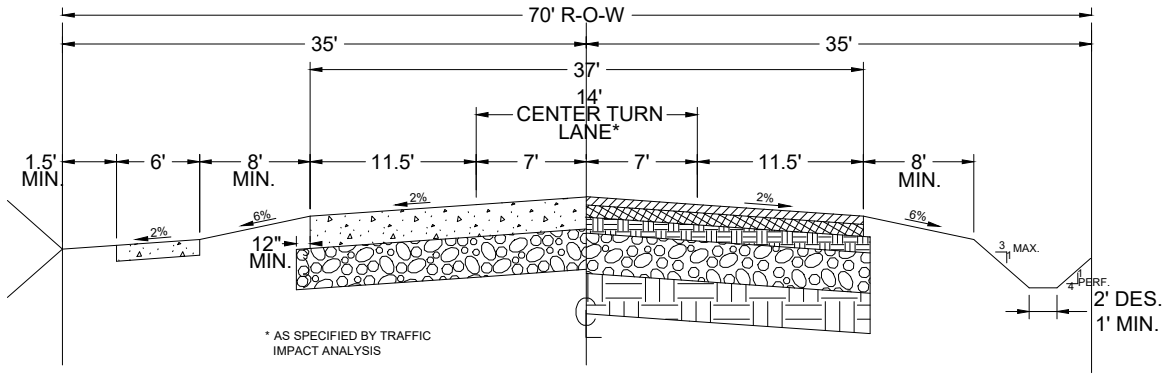
TYPICAL SECTION

CURB & GUTTER



COMBINED CURB & GUTTER (6" BARRIER)

LOCAL, COLLECTOR, AND ARTERIAL STREETS

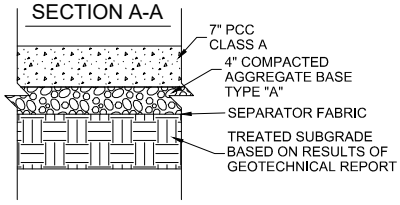


TYPICAL SECTION

OPEN GRADED

FOR CONCRETE STREET
USE SECTION A-A

SECTION A-A

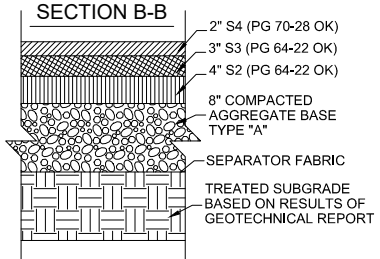


MINIMUM THICKNESS CONCRETE CONSTRUCTION

COLLECTOR STREETS

FOR ASPHALT STREET
USE SECTION B-B

SECTION B-B



MINIMUM THICKNESS ASPHALT CONSTRUCTION

COLLECTOR STREETS

NOTES:

1. SECTIONS SHOWN ARE MINIMUM REQUIRED.
2. SUBGRADE MAY REQUIRE ADDITIONAL THICKNESS, MODIFICATION, OR A SUBBASE DRAINAGE SYSTEM WHERE SEVERE SOIL CONDITIONS EXIST BASED ON THE RESULTS OF THE GEOTECHNICAL REPORT.
3. FOR EXISTING SUBBASE MATERIAL WITH PI <10 SUBGRADE SHALL BE CLASSIFIED SELECT, INERT MATERIAL OR STABILIZED AND COMPACTED TO 95% STANDARD PROCTOR DENSITY.
4. ASPHALT SURFACES SHALL CONFORM TO ODOT STANDARD 401.04 FOR TOLERANCES.
5. IF A COMPACTED AGGREGATE SUBBASE IS USED, THE AGGREGATE SHALL BE PLACED ON SEPARATOR FABRIC.
6. FOR OPEN CHANNEL SECTION A 20' LONG X 3' WIDE, 6" DEEP TBSC SHOULDER IS REQUIRED AT ALL MAIL BOXES.

REV	DATE	DESCRIPTION	BY

Collector Street

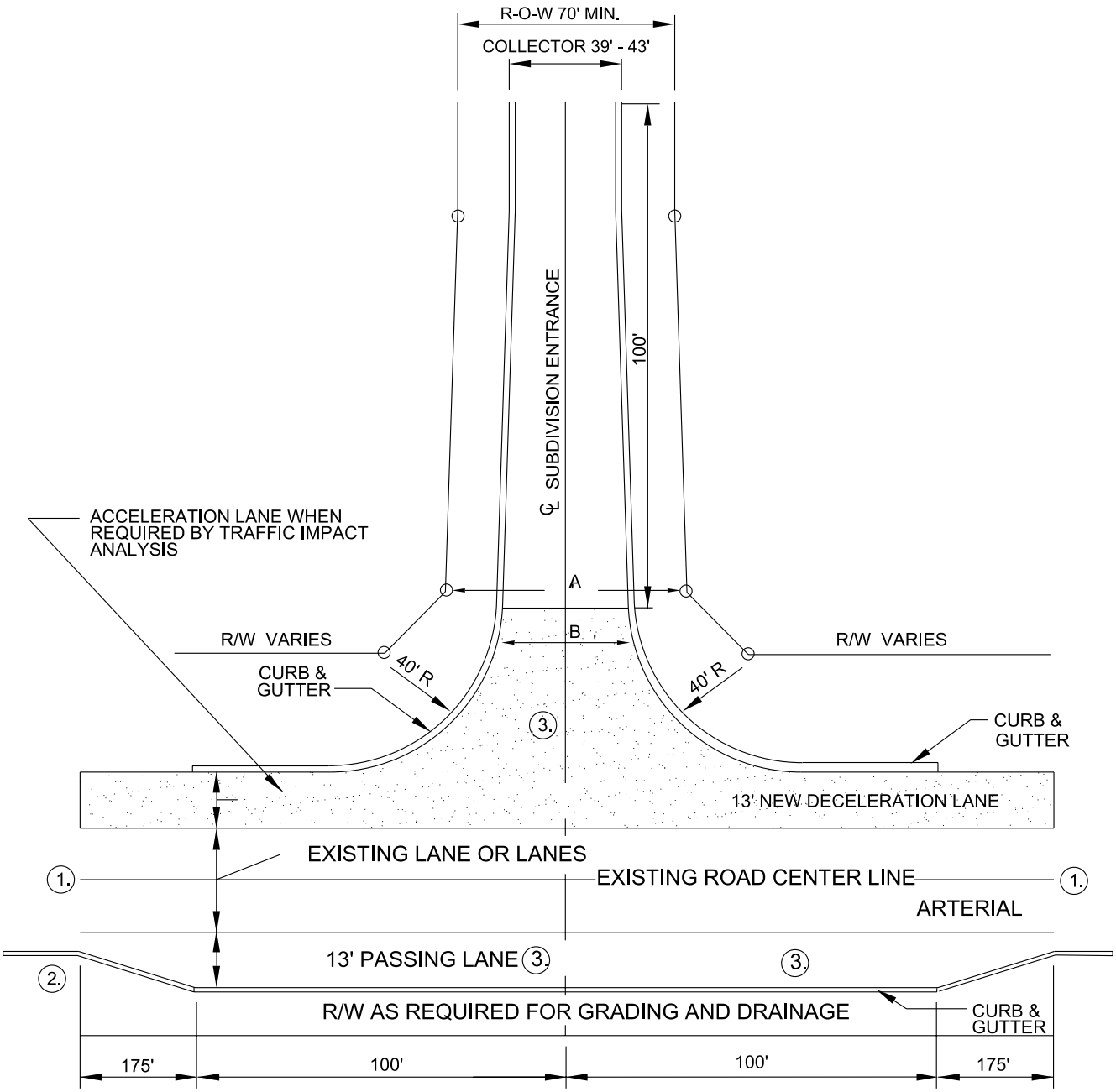
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 7/18/2011

Issued: 8/02/2021

Detail No. 3703



NOTES:

1. CONSTRUCTION PLANS SHALL INCLUDE CENTERLINE PROFILE OF THE EXISTING ROAD BEING INTERSECTED BY THE ENTRANCE. THE PROFILE SHALL EXTEND A MINIMUM OF 500' EACH DIRECTION FROM ENTRANCE CENTERLINE
2. TIE TO EXISTING CURB AND GUTTER ON URBAN STREETS
3. AUXILIARY LANES WHEN REQUIRED BY TRAFFIC ANALYSIS
4. LANE WIDENING SHALL MATCH EXISTING PAVEMENT SURFACE TYPE.
5. SEE STANDARD 3705 FOR ACCELERATION/ DECELERATION LANE DETAIL.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

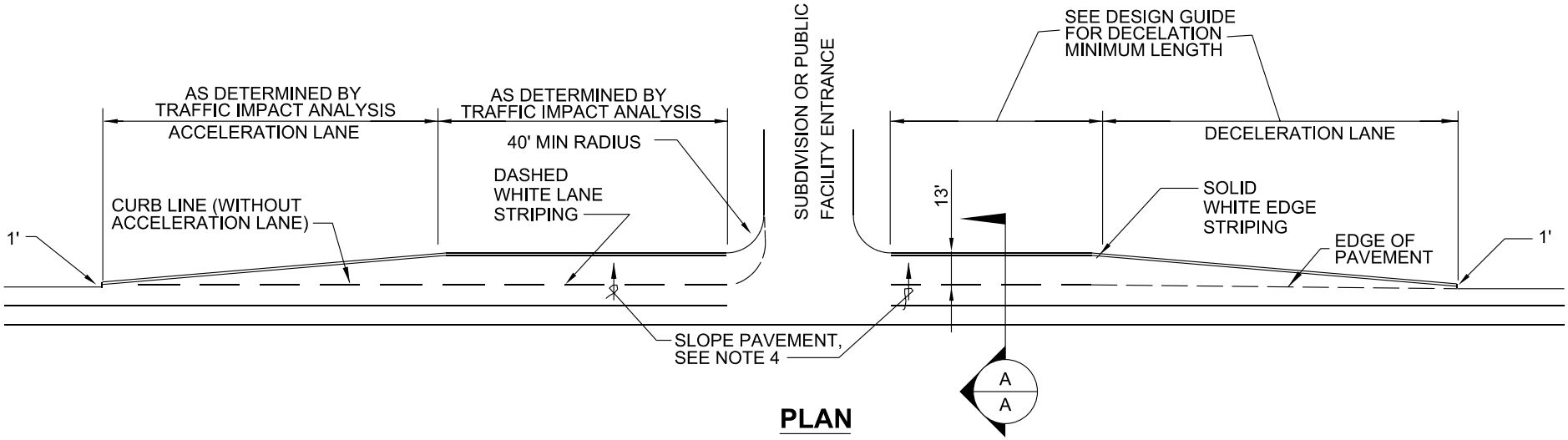
COLLECTOR - INTERSECTION WITH ARTERIAL

STANDARD DETAILS

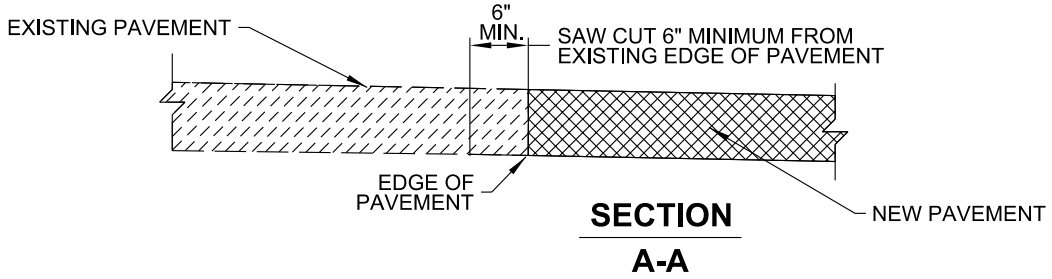
DATE: AUGUST 2010

STANDARD NO. 3704

DRAFT STANDARD



PLAN



SECTION
A-A

NOTES:

1. ACCELERATION LANES SHALL ONLY BE REQUIRED IN SPECIAL CIRCUMSTANCES WHERE TRAFFIC OR OTHER CONDITIONS INDICATE THE NEED.
2. FULL- DEPTH SAW CUT THE EDGE OF THE EXISTING PAVEMENT TO RECEIVE THE NEW ACCEL/ DECEL PAVEMENT, TACK COAT PRIOR TO PLACING NEW PAVEMENT.
3. ACCEL/ DECEL LANES SHALL MEET MINIMUM DESIGN AND MATCH ADJACENT PAVEMENT.
4. ACCEL DECEL LANES SHALL CONTINUE THE SLOPE OF ADJACENT ROADWAY (2% MIN.)

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

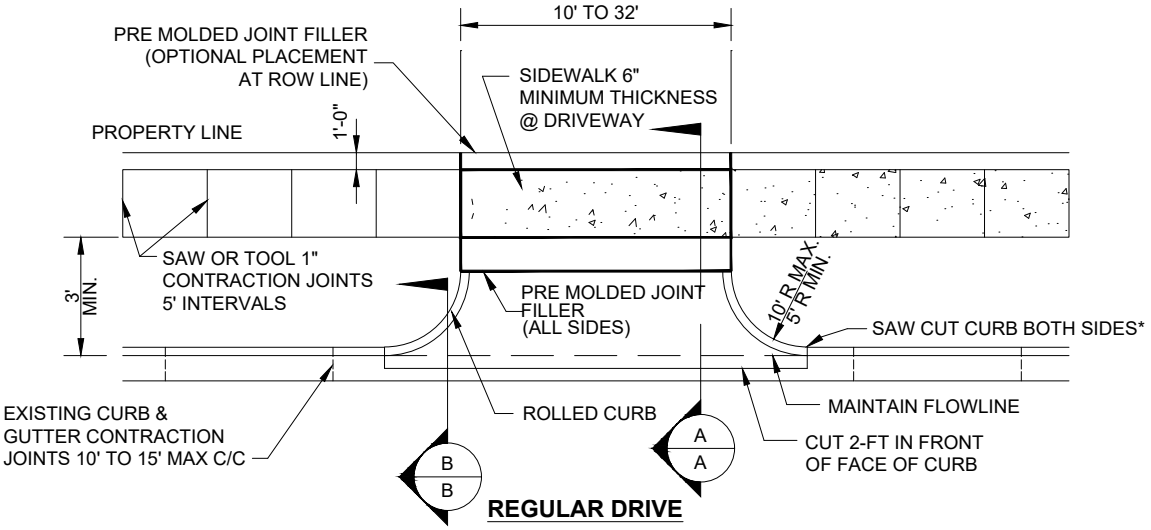
ACCELERATION \ DECELERATION LANES

STANDARD DETAILS

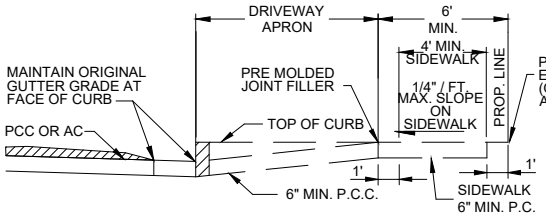
DATE: AUGUST 2010

STANDARD NO. 3705

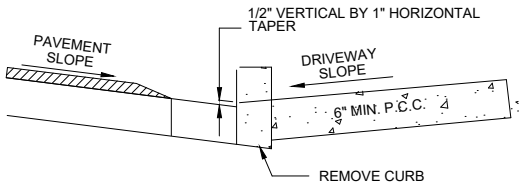
DRAFT STANDARD



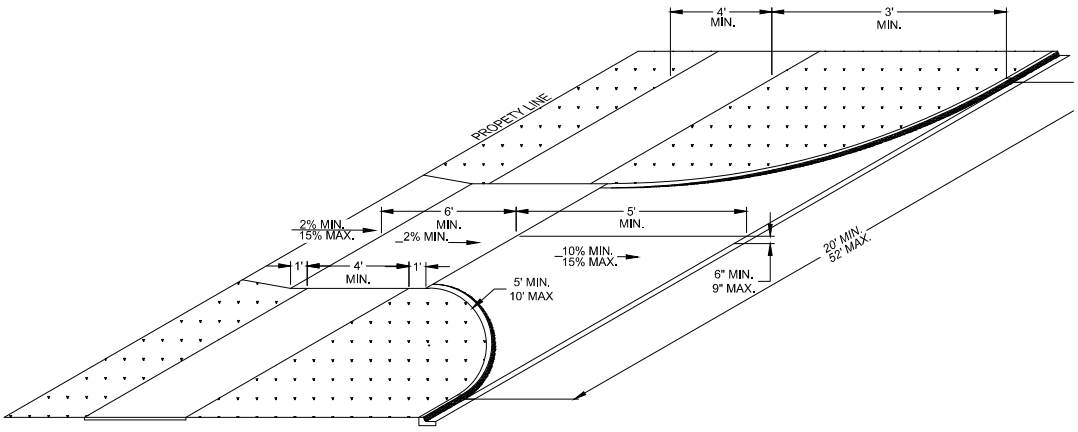
REGULAR DRIVE



SECTION A-A



SECTION B-B



NOTE:

1. MINIMUM OF 6" CLASS A 3000 PSI (28 DAY STRENGTH) ON DRIVEWAY WITHIN THE RIGHT-OF-WAY.
2. IF CURB CUT IS WITH IN 18" OF EXISTING CURB CONTRACTION JOINT, REMOVE EXISTING CURB TO THE CONTRACTION JOINT AND REPLACE WITH NEW CURB RETURN PLACEMENT

REV	DATE	DESCRIPTION	BY

Urban Residential Driveway and Curb Cut

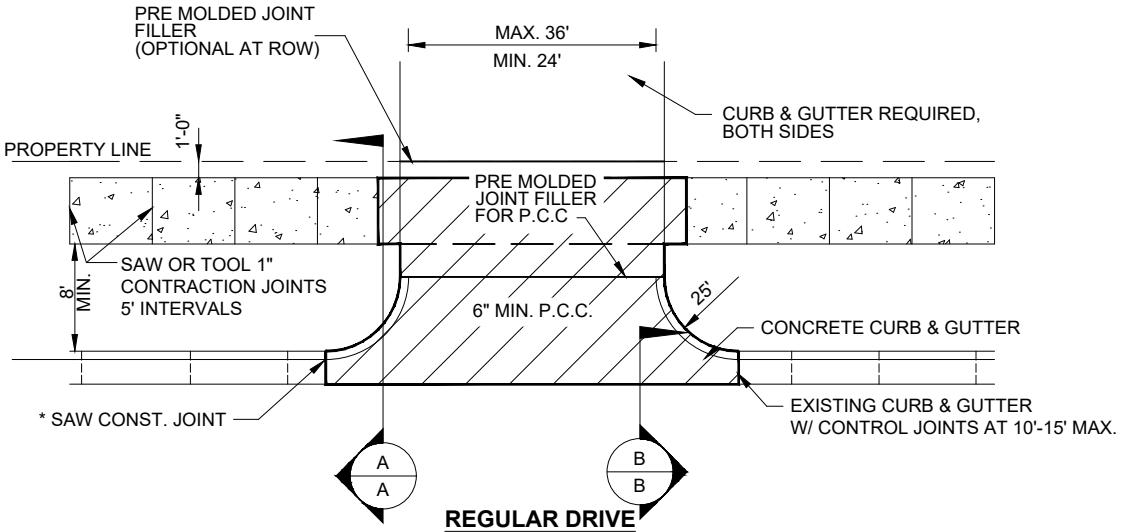
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

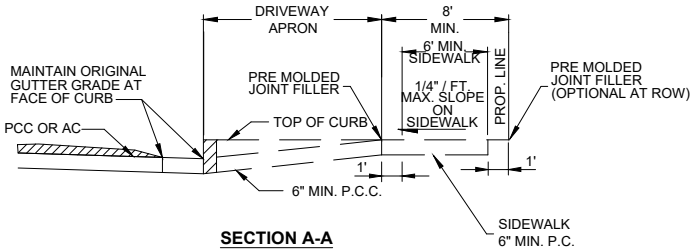
Adopted: 2/26/2013

Issued: 8/02/2021

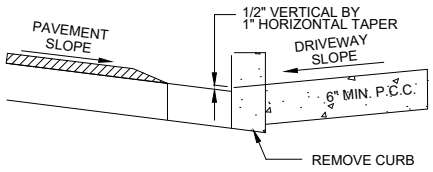
Detail No. 3706



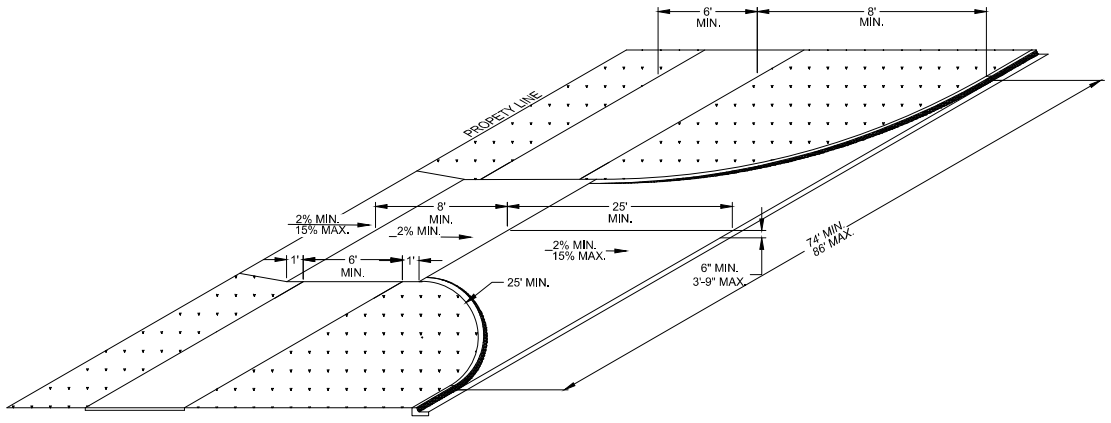
REGULAR DRIVE



SECTION A-A



SECTION B-B



NOTE:

1. MINIMUM OF 6" CLASS A 3000 PSI (28 DAY STRENGTH) ON DRIVEWAY WITHIN THE RIGHT-OF-WAY.
2. IF CURB CUT IS WITH IN 18" OF EXISTING CURB CONTRACTION JOINT, REMOVE EXISTING CURB TO THE CONTRACTION JOINT AND REPLACE WITH NEW CURB RETURN PLACEMENT
3. DRIVEWAY SHALL BE DESIGNED FOR HEAVIEST RECURRING LOAD POSSIBLE
4. TRUNCATED DOMES ARE REQUIRED ON EITHER SIDE OF DRIVEWAY FOR HIGH VOLUME ENTRANCES.

REV	DATE	DESCRIPTION	BY

Commercial Driveway

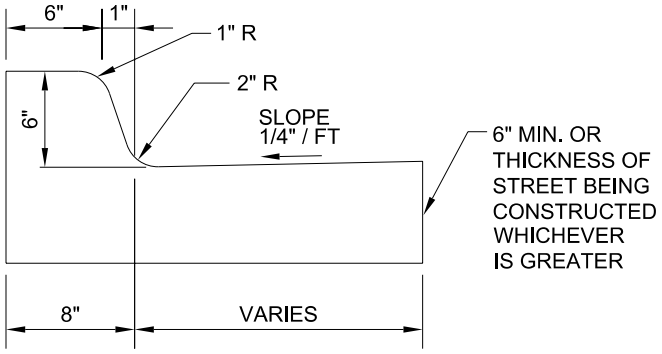
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

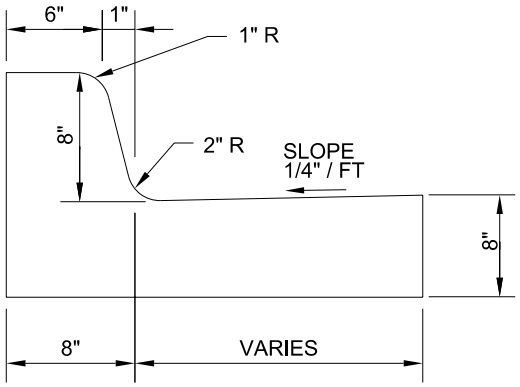
Adopted: 2/26/2013

Issued: 8/02/2021

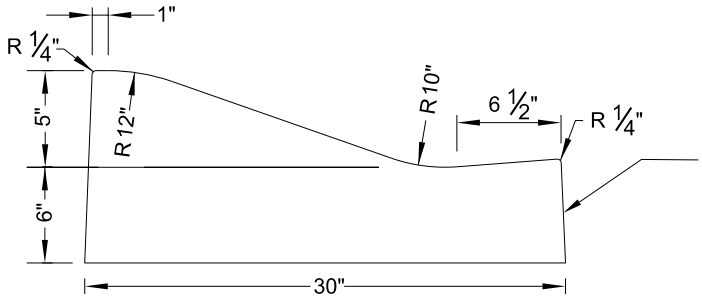
Detail No. 3707



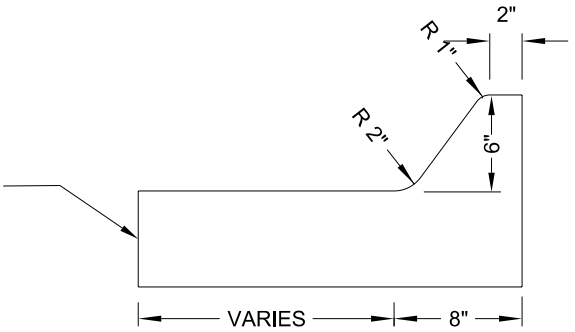
6" BARRIER CURB & GUTTER



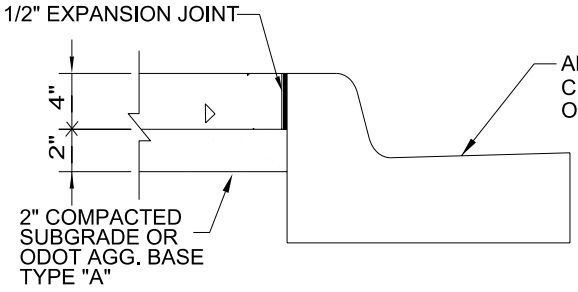
8" BARRIER CURB & GUTTER



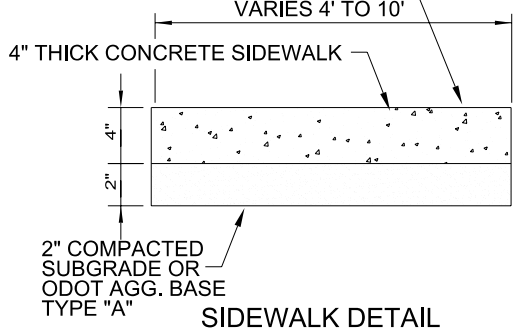
5" MOUNTABLE CURB & GUTTER



6" MOUNTABLE CURB & GUTTER



SIDEWALK ADJACENT TO CURB



SIDEWALK DETAIL

NOTES:

1. #4 X 30" DOWELS AT 30" C/C REQUIRED WHEN PAVEMENT SECTION IS NOT PLACED INTEGRALLY WITH CURB AND GUTTER.
2. FOR ASPHALTIC CONCRETE PAVEMENTS, SAW CURB AND GUTTER JOINTS 10'-15' MAX C/C WITH EVERY 8TH JOINT A 3/4" EXPANSION JOINT. FOR CONCRETE PAVEMENTS, CURB JOINT SHALL MATCH PAVEMENT JOINTS.
3. CONCRETE SHALL BE ODOT CLASS A
4. EXPANSION JOINTS ARE REQUIRED AT INTERSECTION WITH STORMWATER INLETS BOXES.

REVISION	BY	DATE

City of **stillwater**

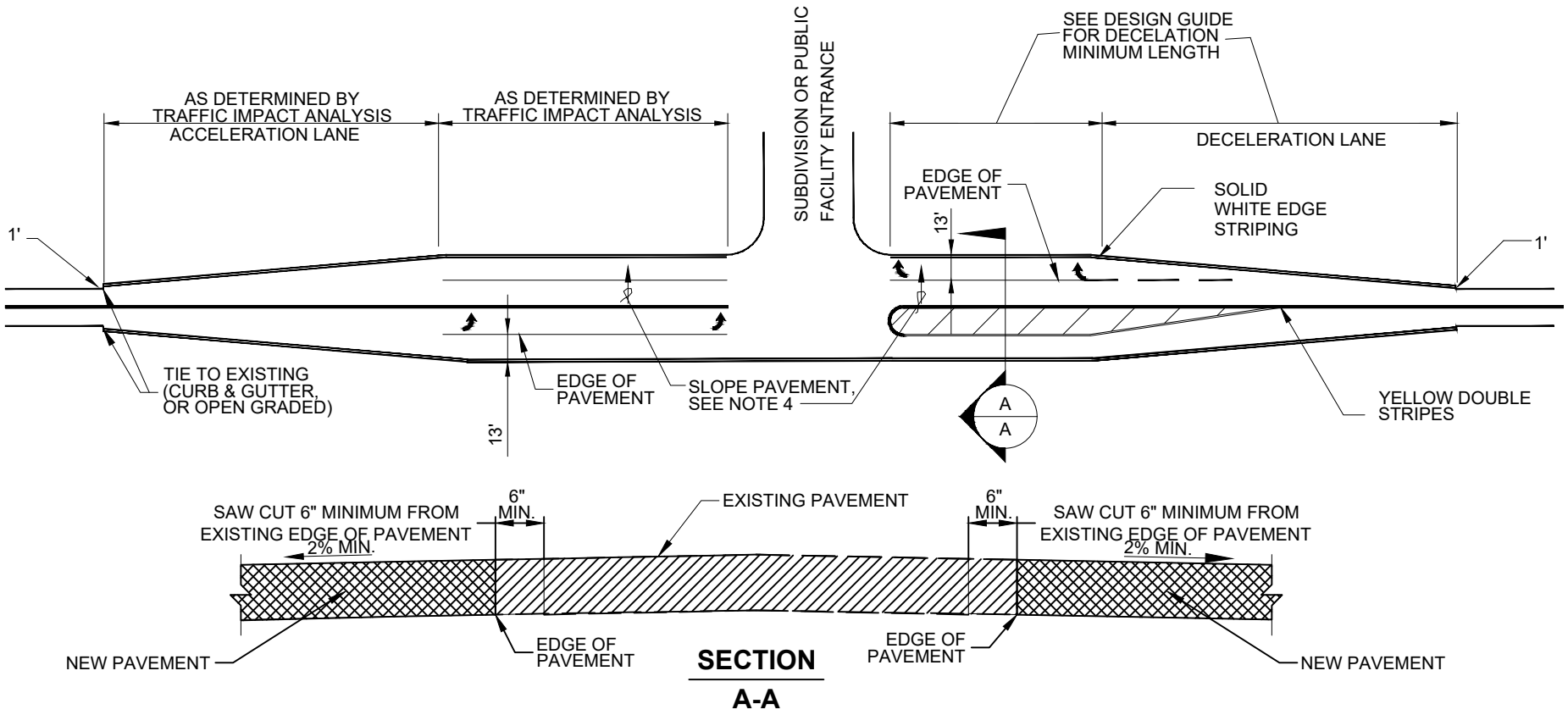
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CURB, GUTTER, AND SIDEWALK

STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3708



SECTION

A-A

NOTES:

1. ACCELERATION LANES SHALL ONLY BE REQUIRED IN SPECIAL CIRCUMSTANCES WHERE TRAFFIC OR OTHER CONDITIONS INDICATE THE NEED.
2. FULL- DEPTH SAW CUT THE EDGE OF THE EXISTING PAVEMENT TO RECEIVE THE NEW ACCEL/ DECEL PAVEMENT, TACK COAT PRIOR TO PLACING NEW PAVEMENT.
3. ACCEL/ DECEL LANES SHALL MEET MINIMUM DESIGN AND MATCH ADJACENT PAVEMENT. PAVEMENT SECTION SHALL MEET MINIMUM DESIGN STANDARDS.
4. ACCEL/ DECEL LANES SHALL CONTINUE THE SLOPE OF ADJACENT ROADWAY (2% MIN.)

Detail No. 3709

Issued: 8/02/2021

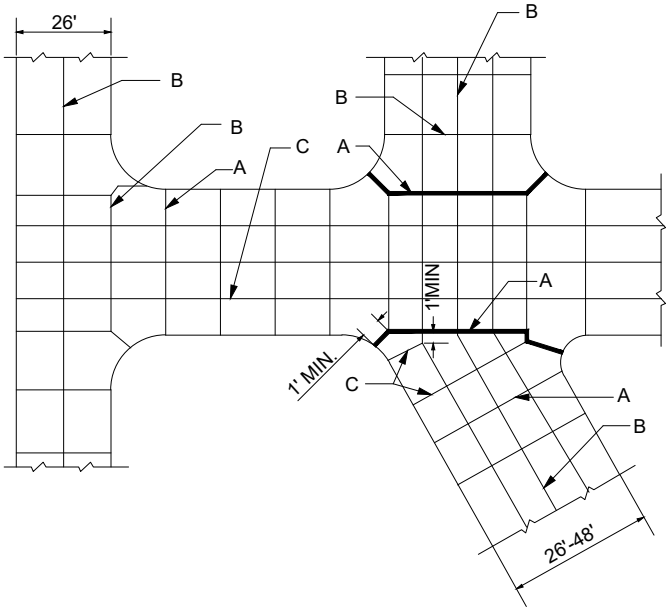
Adopted: 8/31/2010

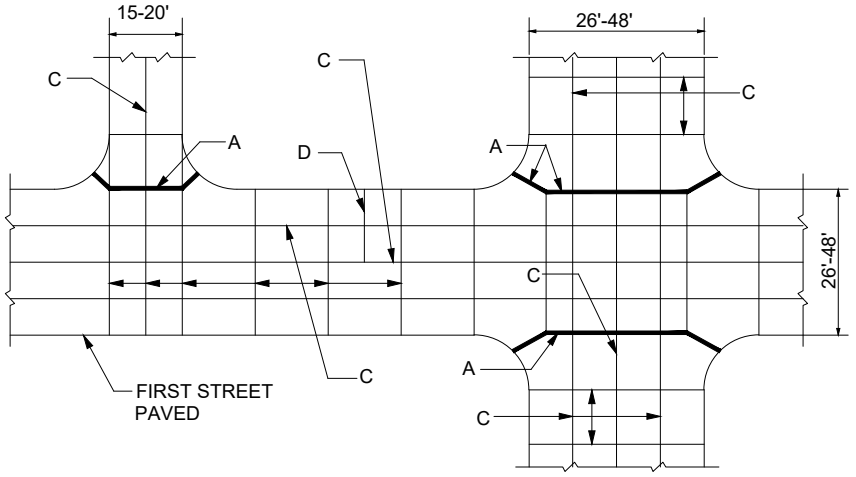
The City of Stillwater OKLAHOMA

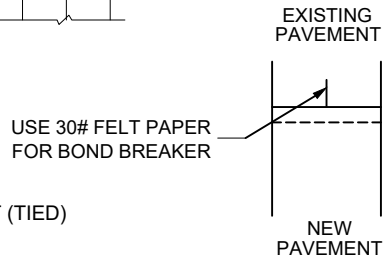
Acceleration/Deceleration with Passing Lane

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY





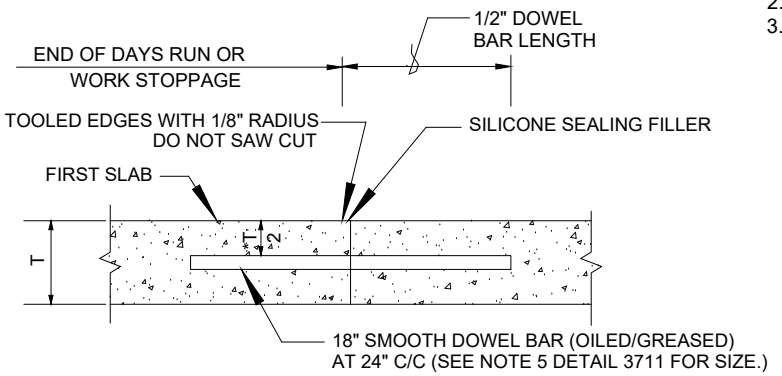


LEGEND

A - TRANSVERSE ISOLATION JOINT
B - TRANSVERSE CONTRACTION JOINT (DOWELED)
C - SAWED TRANSVERSE JOINT OR LONGITUDINAL JOINT (TIED)
D - TRANSVERSE CONSTRUCTION JOINT

NOTES:

1. JOINT ANGLE TO BE GREATER THAN OR EQUAL TO 90°.
2. MAXIMUM LENGTH:WIDTH RATIO EQUALS 1:1.25.
3. MAXIMUM PANEL LENGTH: 2 x THICKNESS (INCHES) IN FEET
   E.G. 6IN PAVING: 2 x 6IN = 12FT MAX



TRANSVERSE CONSTRUCTION JOINT

NOTE:

1. TO BE USED AT THE END OF DAYS CONCRETING OR ANY STOPPAGE OF 30 MINUTES OR MORE.
2. AFTER CONTINUATION PLACEMENT, DO NOT SAW CUT AND SEAL THE JOINT BETWEEN THE OLD AND NEW PLACEMENTS

Detail No. 3710
Issued: 8/02/2021
Adopted: 8/31/2010

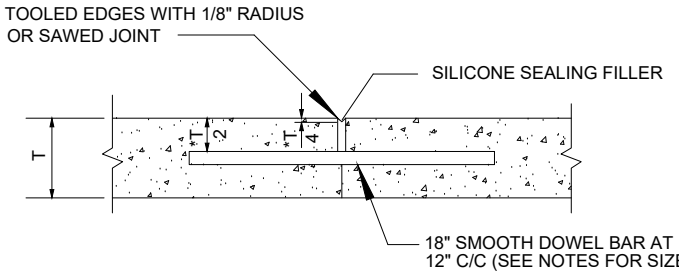
The City of Stillwater OKLAHOMA

Concrete Pavement Joint Plan

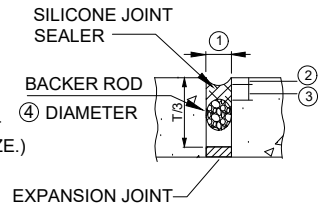
(Intersections & Lanes)

CITY OF STILLWATER STANDARDS

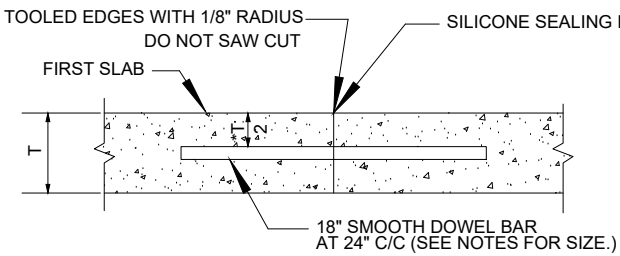
REV	DATE	DESCRIPTION	BY



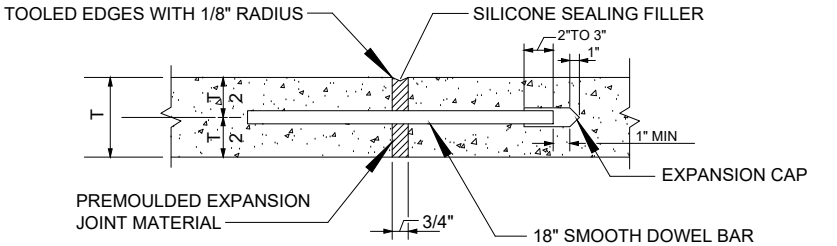
TRANSVERSE CONTRACTION JOINT



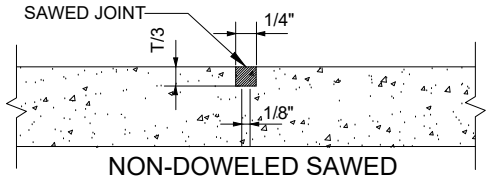
SEALED EXPANSION JOINT



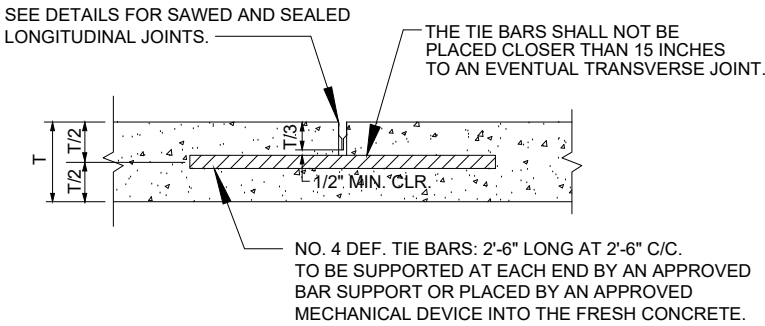
TRANSVERSE CONSTRUCTION JOINT



ISOLATION JOINT



NON-DOWELED SAWED
TRANSVERSE CONTRACTION JOINT



LONGITUDINAL JOINT

EXPANSION JOINT TREATMENT TABLE			
JOINT WIDTH ①	SEALANT RECESS DEPTH ②	SILICONE SEALANT THICKNESS ③	BACKER ROD DIAMETER ④
INCHES	INCHES	INCHES	INCHES
1/2	1/4	1/4	5/8
3/4	1/4	3/8	7/8
1	3/8	1/2	1-1/4
1-1/2	1/2	1/2	2
2	1/2	3/4	2-1/2

* OR MANUFACTURERS SPECIFICATION

NOTES:

1. ONE HALF OF SMOOTH DOWEL BAR ACROSS TRANSVERSE JOINTS SHALL BE COATED WITH GREASE TO PREVENT BOND WITH CONCRETE. SMOOTH DOWEL BARS ACROSS EXPANSION JOINTS SHALL BE PROVIDED WITH EXPANSION CAPS, AND COATED WITH GREASE AS NOTED ABOVE.
2. GROOVES IN JOINTS MAY BE FORMED BY:
   - TEMPORARY EMBEDMENT OF SUITABLE MANDREL
   - INSTALLATON OF THIN STRIP OF PREMOULDED JOINT FILLER MATERIAL
   - SAWING THE PAVEMENT AFTER THE CONCRETE HAS HARDENED
3. T = PAVEMENT THICKNESS
4. DOWELS SHALL CONFROM TO ASSHTO M31, GRADE 40 OR 60.
5. DOWEL BAR SIZE:
   - 1" DIA. DOWEL BARS FOR PAVEMENTS 6" TO 8"
   - 1 ¼" DIA. DOWEL BARS FOR PAVEMENTS 8 ½" TO 10"
   - 1 ½" DIA. DOWEL BARS FOR PAVEMENTS 10 ½" OR THICKER

Detail No. 3711

Issued: 8/02/2021

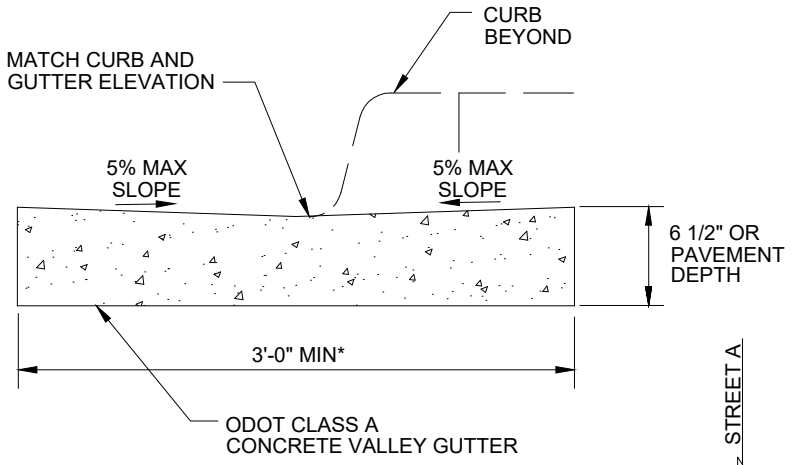
Adopted: 7/18/2011

The City of Stillwater OKLAHOMA

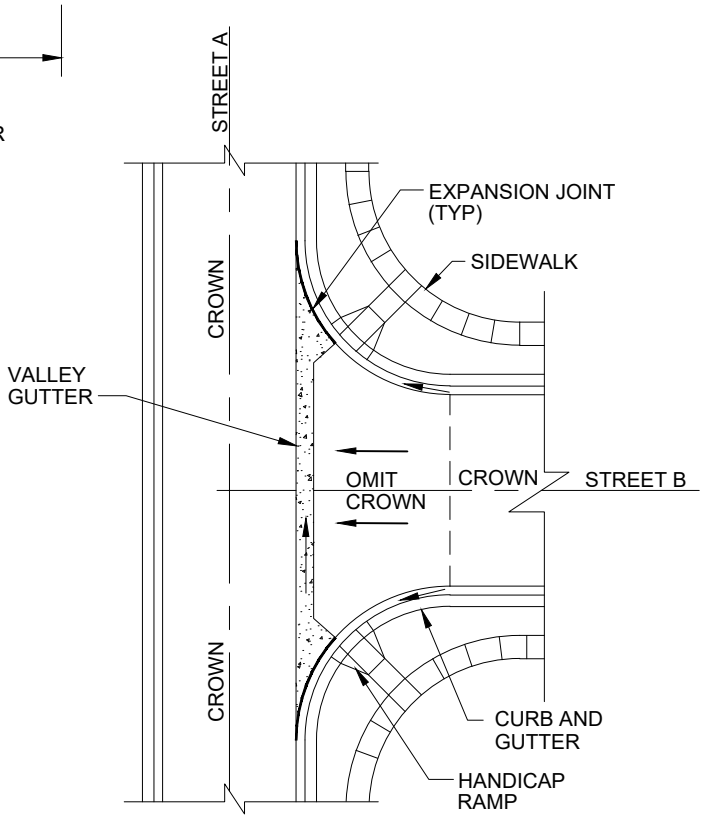
Concrete Pavement - Joint Details

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY



SECTION



PLAN

VALLEY GUTTER

NOTES:

1. VALLEY GUTTER MAY BE USED IN LIEU OF STORM DRAIN PROVIDED ROADWAYS GUTTER SPREAD DESIGN REQUIREMENTS ARE MET.
2. CONCRETE SHALL BE ODOT CLASS A
3. EXPANSION JOINT ARE REQUIRED AT INTERSECTION WITH CURB AND GUTTER.
4. VALLEY GUTTERS ARE REQUIRED FOR ANY CHANNELIZED FLOW ACROSS ASPHALT PAVING.
5. THE WIDTH OF THE VALLEY GUTTER IS TO BE DETERMINED BY THE DRAINAGE STUDY. THE MINIMUM WIDTH IS 3 FT.

REV	DATE	DESCRIPTION	BY

Valley Gutter

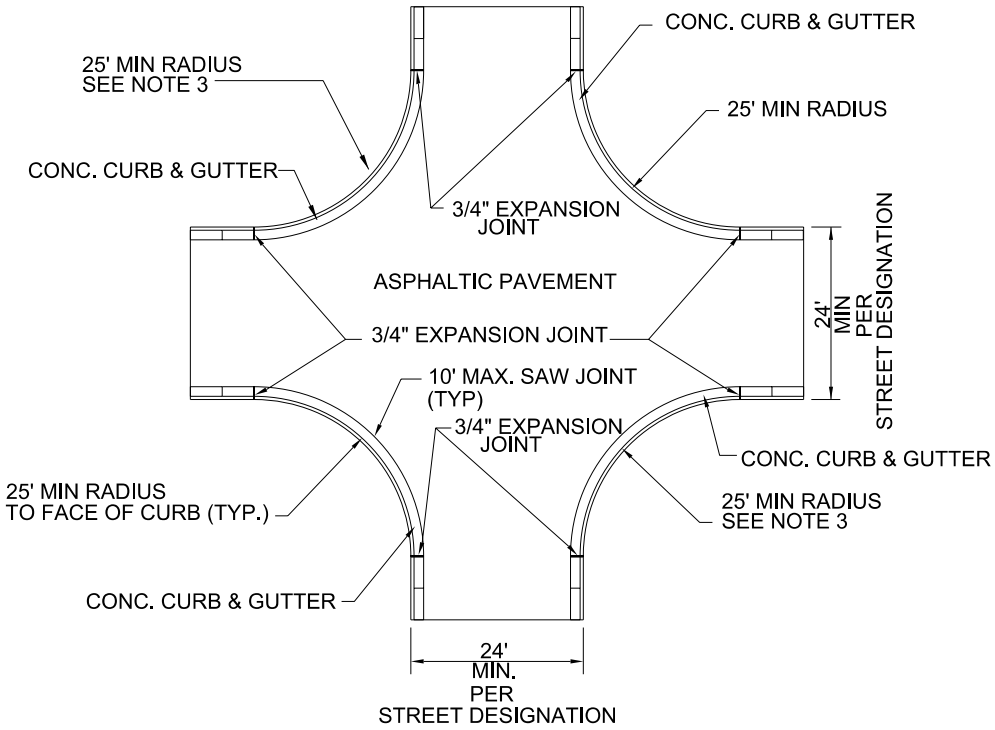
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

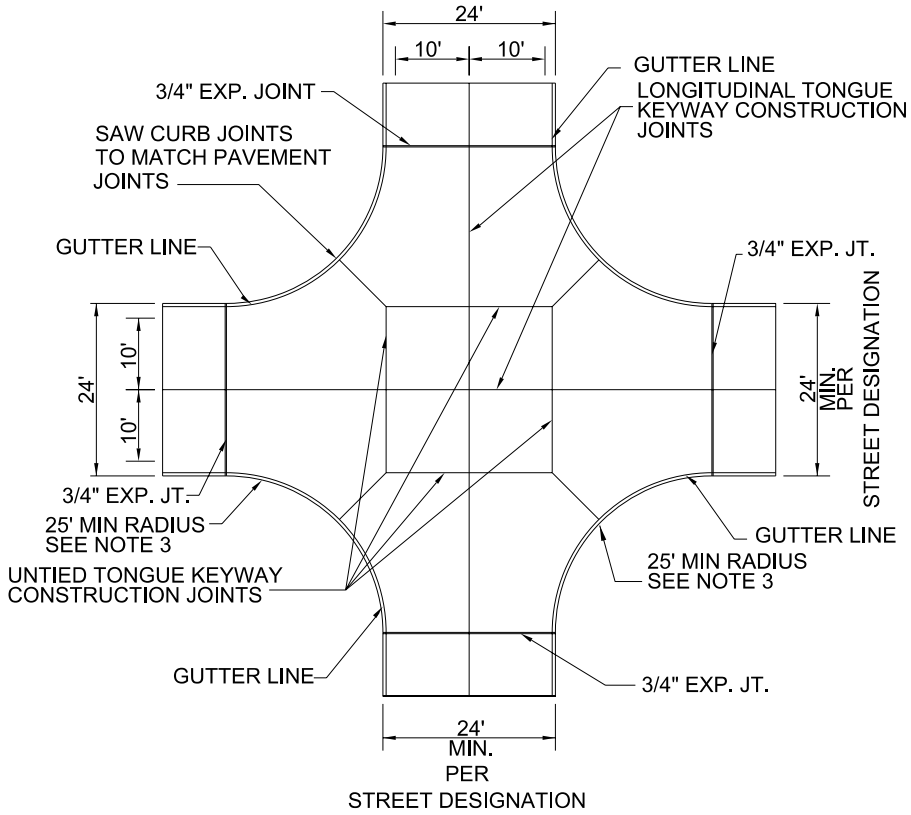
Adopted: 2/26/2013

Issued: 8/02/2021

Detail No. 3712



ASPHALTIC CONCRETE



PORTLAND CEMENT CONCRETE

NOTE:

1. SIDEWALKS TO BE LOCATED PER STREET TYPICAL SECTION DETAILS.
2. INTERSECTIONS WITH MAJOR STREETS OR HIGHWAYS SHALL HAVE A MINIMUM 40' CORNER RADIUS.
3. INTERSECTION DRAINAGE SHALL BE INSTALLED TO COLLECT RUNOFF IN ADVANCE OF INTERSECTION.
4. ALL INLETS SHALL BE UPSTREAM OF WHEELCHAIR RAMPS
5. WHEEL CHAIR RAMP TO BE INSTALLED PER STANDARD DETAILS
6. DOWELS AND TIE BARS SHALL CONFORM TO AASHTO M31 GRADE 60. *DOWEL BARS BENT PRIOR TO INSTALLATION MAY CONFORM TO AASHTO M31 GRADE 40.

REVISION	BY	DATE

City of **stillwater**

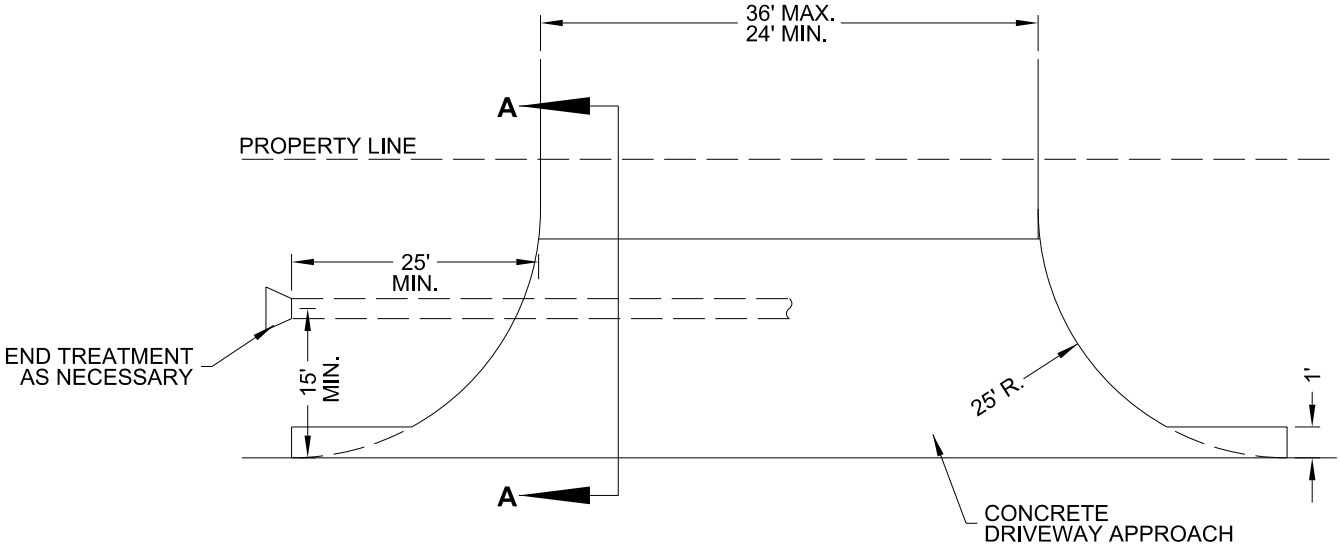
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

STREET INTERSECTION LAYOUT

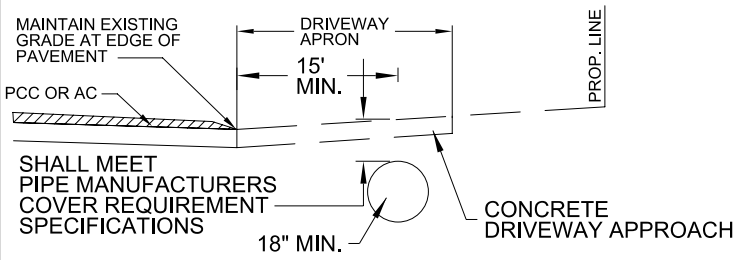
STANDARD DETAILS

DATE: JULY 18, 2011 | STANDARD NO. 3713

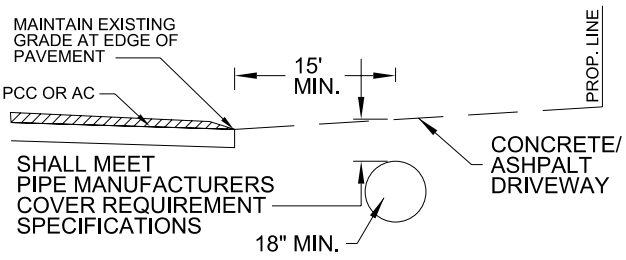
DRAFT STANDARD



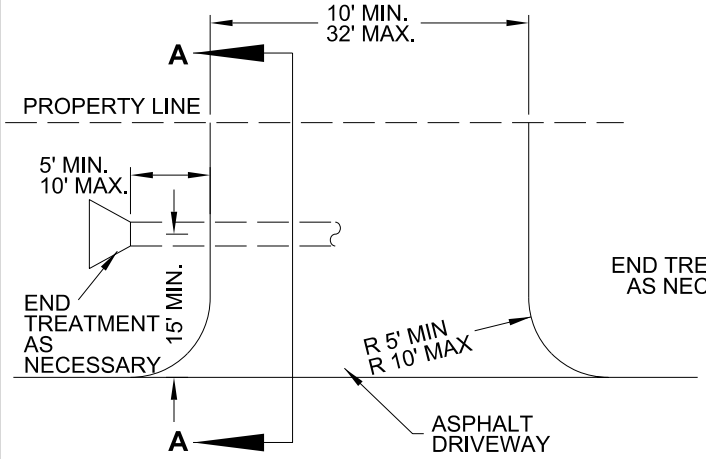
COMMERCIAL RURAL DRIVE



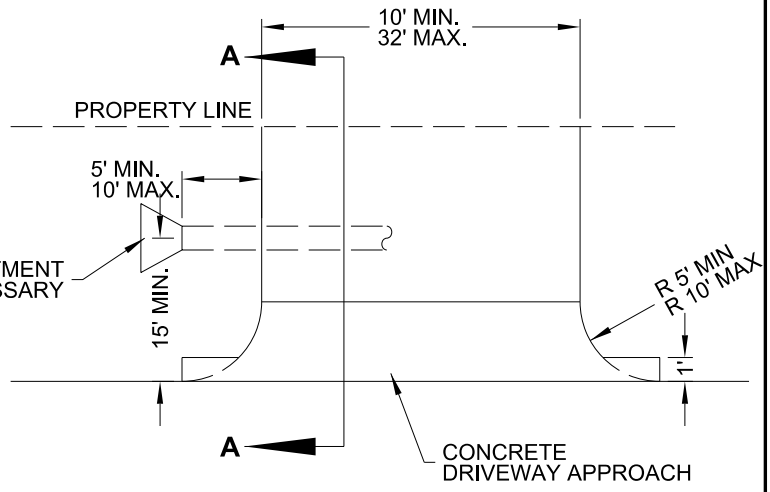
SECTION A-A
COMMERCIAL RURAL DRIVE



SECTION A-A
RESIDENTIAL RURAL DRIVE



RESIDENTIAL RURAL DRIVE
ASPHALT



RESIDENTIAL RURAL DRIVE
CONCRETE

NOTE:

1. MINIMUM OF 6" CLASS A CONCRETE ON COMMERICAL DRIVEWAYS WITHIN THE RIGHT-OF-WAY.
2. ALL PIPE SIDE DRAIN AND CULVERTS SHALL INCLUDE APPROPRIATELY DESIGNED END SECTIONS. REFER TO ODOT PREFABRICATED CULVERT END SECTIONS, PCES-4. OR ODOT STANDARD DETAILS FOR CULVERT END TREATMENTS
3. ALL PIPE GRATES SHALL BE INSTALLED ON ALL PIPES WITHIN THE CLEAR ZONE ON ALL ARTERIAL ROADWAY AND COLLECTOR STREETS AS DESIGNATED BY THE CITY OF STILLWATER.

REVISION	BY	DATE

City of **stillwater**

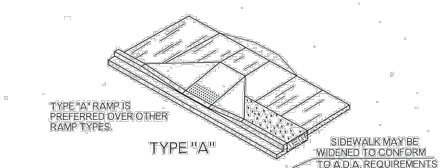
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

RURAL COMMERCIAL & RESIDENTIAL DRIVEWAY

STANDARD DETAILS

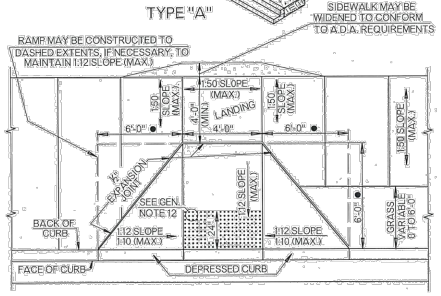
DATE: JULY 18, 2011

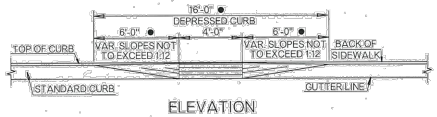
STANDARD NO. 3714



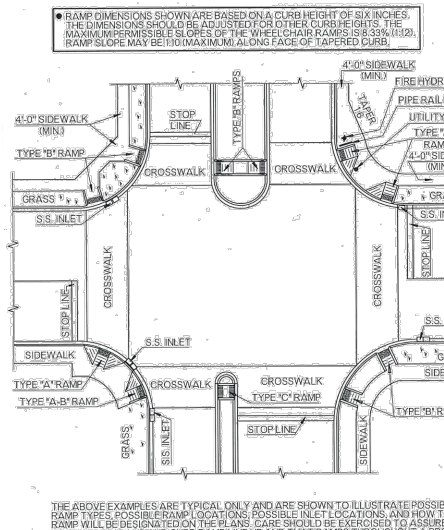
TYPE "A" RAMP IS PREFERRED OVER OTHER RAMP TYPES.

TYPE "A"

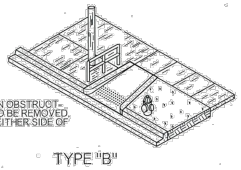




ELEVATION

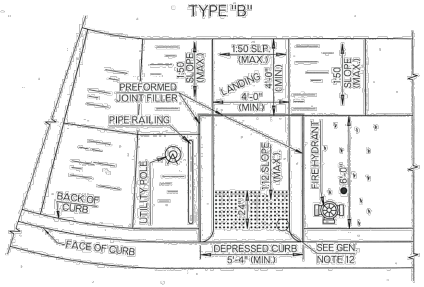


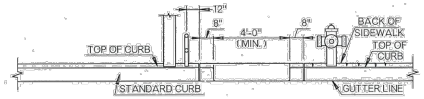
THE ABOVE EXAMPLES ARE TYPICAL ONLY AND ARE SHOWN TO ILLUSTRATE POSSIBLE RAMP TYPES, POSSIBLE RAMP LOCATIONS, POSSIBLE INLET LOCATIONS, AND HOW THE RAMP WILL BE DESIGNATED ON THE PLANS. CARE SHOULD BE EXERCISED TO ASSURE THAT MEDIAN RAMP AND CURB RAMP LINE UP AND THAT RAMPS THROUGHOUT A PROJECT ARE LOCATED WITH SOME DEGREE OF UNIFORMITY.



USE TYPE "B" RAMP WHEN OBSTRUCTIONS, WHICH ARE NOT TO BE REMOVED, ARE ENCOUNTERED ON EITHER SIDE OF WHEELCHAIR RAMPS.

TYPE "B"





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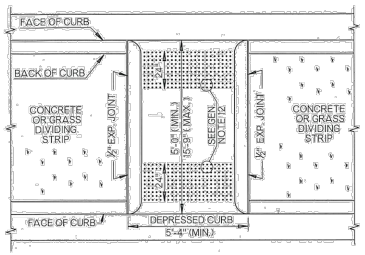

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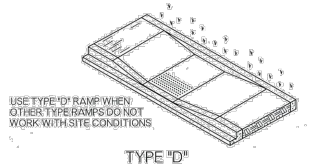
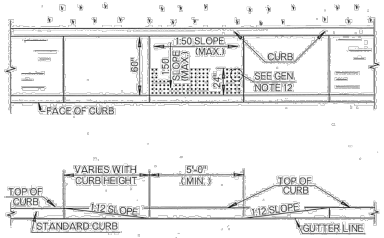


USE TYPE "D" RAMP WHEN OTHER TYPE RAMPS DO NOT WORK WITH SITE CONDITIONS

TYPE "D"



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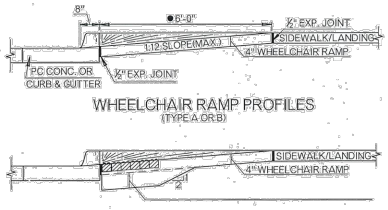
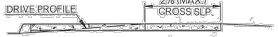
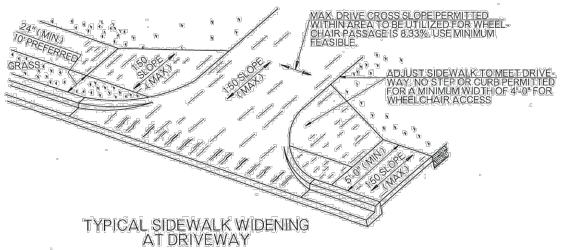


WHEELCHAIR RAMP PROFILES
(TYPE A OR B)

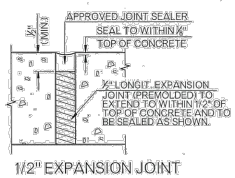
SIDEWALK THICKENING FOR TYPE A TACTILE WARNING DEVICES



AT DRIVEWAY LOCATIONS, THE NORMAL 4'-0" SIDEWALK MUST BE WIDENED SO THAT A 4' PORTION OF SIDEWALK IS ALIGNED WITH SIDEWALK CROSSING SHELF IN THE DRIVEWAY PROFILE. A WIDER SIDEWALK (5'-0" TYP.) SHALL ALSO BE USED AT INTERVALS LESS THAN 200 FEET, TO ASSURE WHEELCHAIR PASSAGE.



TYPICAL SIDEWALK WIDENING AT DRIVEWAY



1/2" EXPANSION JOINT

JOINT FILLER SHALL MEET THE REQUIREMENTS OF SECTION 703.08 OF THE SPECIFICATIONS.

JOINT FILLER SHALL BE USED BETWEEN SIDEWALK AND CURBS, WHEELCHAIR RAMPS, DRIVEWAYS, STREETS, RETAINING WALLS, ETC.

GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIAL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE 2009 ODOT STANDARD SPECIFICATIONS.
2. THERE WILL BE NO DEDUCTION OF PAYMENT FOR CONCRETE CURB & GUTTER AND/OR INTEGRAL CURB FOR THE LENGTH OF THE DEPRESSED CURB.
3. DRAINAGE STRUCTURES SHALL NOT BE PLACED IN LINE WITH THE RAMPS.
4. THE NORMAL GUTTER LINE PROFILE SHALL BE MAINTAINED THROUGH THE AREA OF THE RAMP WITH A 1:50 SLOPE (MAX.), SEE GENERAL NOTE NO. 9.
5. WHEELCHAIR RAMPS SHOULD BE LOCATED SO THAT THE RAMP WILL BE ON THE TRAFFIC APPROACH SIDE OF ANY OBSTACLE.
6. WHEELCHAIR RAMPS SHOULD BE BUILT AS SHOWN ON THE PLANS OR AS DIRECTED BY THE ENGINEER. THE TYPE OF RAMP WILL BE DESIGNATED ON THE PLANS. IF A RAMP IS TO BE CONSTRUCTED AS A COMBINATION OF TWO TYPES, (ONE SIDE TYPE "A" AND ONE SIDE TYPE "B") THE RAMP SHALL BE DESIGNATED AS TYPE "A-B."
7. PIPE RAILING CONSTRUCTION DETAILS, WHEN REQUIRED AT TYPE "B" WHEELCHAIR RAMPS, WILL BE SHOWN ON THE PLANS.
8. EXCAVATION, BACKFILL, EXPANSION JOINT MATERIAL, SEALERS, AND OTHER RELATED MISCELLANEOUS ITEMS WILL NOT BE PAID FOR SEPARATELY BUT THE COST THEREOF SHALL BE INCLUDED IN THE COST OF THE SIDEWALK.
9. ALL FEATURES OF CONSTRUCTION INCLUDING, BUT NOT LIMITED TO, SIDEWALKS, CURB RAMPS AND CROSSWALK MARKINGS SHALL COMPLY WITH THE PUBLIC RIGHT-OF-WAY ACCESSIBILITY GUIDELINES (PROWAG). WHERE SPATIAL LIMITATIONS OR EXISTING FEATURES WITHIN THE LIMITS OF THE PROJECT PREVENT FULL COMPLIANCE WITH THE PROWAG, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER UPON DISCOVERY OF SUCH FEATURE(S). THE CONTRACTOR SHALL NOT PROCEED WITH ANY ASPECT OF THE WORK WHICH IS NOT IN FULL COMPLIANCE WITH THE PROWAG WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER. ANY WORK WHICH IS NOT PERFORMED WITHIN THE GUIDELINES OF THE PROWAG, FOR WHICH THE CONTRACTOR DOES NOT HAVE WRITTEN APPROVAL, SHALL BE CORRECTED AT THE CONTRACTOR'S EXPENSE.
10. ALL WHEELCHAIR RAMP CURBS SHALL BE INCLUDED IN COST OF SIDEWALK.
11. FOR DETAILS OF TACTILE WARNING DEVICES, SEE THE CURRENT VERSION OF ROADWAY STANDARD TWD-1.

BASIS OF PAYMENT		
ITEM NO.	ITEM	UNIT
610 (A)	■ CONCRETE SIDEWALK	SY
622 (A)	PIPE RAILING	LF

■ SIDEWALK THICKNESS SHALL BE SPECIFIED IN INCHES.

Detail No. 3715

Issued: 8/02/2021

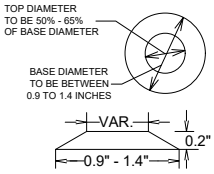
Adopted: 8/02/2021

The City of Stillwater OKLAHOMA

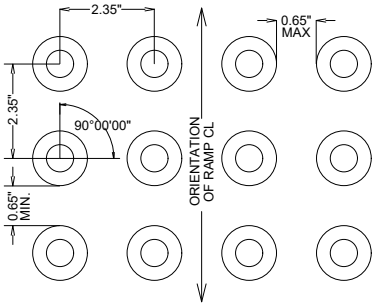
Accessible Ramp Details

CITY OF STILLWATER STANDARDS

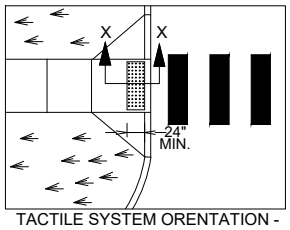
REV	DATE	DESCRIPTION	BY



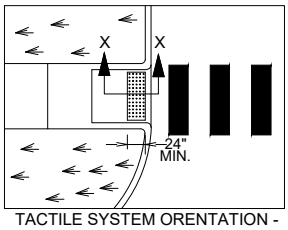
TACTILE WARNINGS
TRUNCATED DOMES



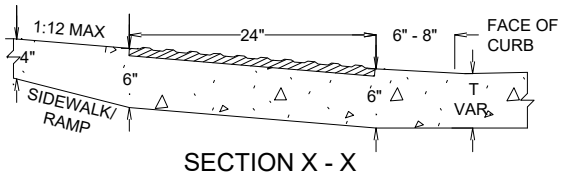
90º GRID DOME PATTERN
(SEE GENERAL NOTE NUMBER 9 & 10)



TACTILE SYSTEM ORENTATION -
TYPICAL FLARED RAMPS



TACTILE SYSTEM ORENTATION -
TYPICAL CURBED RAMPS



SECTION X - X
TYPE A
DOMED TILE SYSTEM
(WET SET INLAY)

NOTES:

1. ALL CONSTRUCTION AND MATERIAL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE OKLAHOMA 2009 ENGLISH STANDARD SPECIFICATIONS AND APPLICABLE SPECIAL PROVISIONS.
2. ALL FEATURES OF TACTILE WARNING DEVICE DESIGN AND FINAL INSTALLATION SHALL COMPLY WITH THE AMERICANS WITH DISABILITIES ACT (ADA). WHERE SPATIAL LIMITATIONS OR EXISTING FEATURES WITHIN THE LIMITS OF THE PROJECT PREVENT FULL COMPLIANCE WITH THE ADA, THE CONTRACTOR SHALL IMMEDIATELY NOTIFY THE ENGINEER UPON DISCOVERY OF SUCH FEATURE(S). THE CONTRACTOR SHALL NOT PROCEED WITH ANY ASPECT OF THE WORK WHICH IS NOT IN FULL COMPLIANCE WITH THE ADA WITHOUT PRIOR WRITTEN APPROVAL FROM THE ENGINEER. ANY WORK WHICH IS NOT PERFORMED WITHIN THE GUIDELINES OF THE ADA, FOR WHICH THE CONTRACTOR DOES NOT HAVE WRITTEN APPROVAL SHALL BE CORRECTED AT THE CONTRACTORS EXPENSE.
3. TACTILE WARNING SURFACE SHALL EXTEND FROM EDGE TO EDGE OF WALKWAY ENTERING THE CROSSWALK AT STREET LEVEL.
4. THICKNESS "T" OF PAVEMENT ABUTTING SIDEWALK/RAMP VARIES.
5. SIDEWALK, RAMP AND FLARE THICKNESS SHALL BE 4" MINIMUM THICKNESS AFTER INSTALLATION OF TACTILE WARNING TREATMENT.
6. TRUNCATED DOME SURFACE SHALL CONTRAST VISUALLY WITH THE ADJOINING WALKING SURFACES EITHER LIGHT-ON-DARK OR DARK-ON -LIGHT. THE MATERIAL USED TO PROVIDE CONTRAST SHALL BE AN INTEGRAL PART OF THE TRUNCATED SURFACE.
7. ROWS OF TACTILE DOME TREATMENT SHOULD BE ORIENTED PARALLEL WITH THE CENTERLINE OF SIDEWALK/RAMP OR TOWARD THE CENTERLINE OF MARKED CROSSWALK.
8. EXPANSION JOINTS DEEMED NECESSARY, BUT NOT SHOWN ON THE PLANS, MAY BE ADDED AND PLACED DURING CONSTRUCTION, AS DIRECTED BY THE ENGINEER.
9. TACTILE SYSTEMS, DOME PATTERNS OF FEATURES DIFFERING FROM THOSE SHOWN ON THIS DETAIL, BUT MEETING CURRENT ADA SPECIFICATIONS, SHALL BE SUBMITTED TO AND REVIEWED BY THE ENGINEER BEFORE INSTALLATION.
10. THE SAME TACTILE DOME PATTERN AND COLOR SHALL BE USED THOUGH OUT ANY NEW OR RETROFIT PROJECT. DOME PATTERN & LOCATION OF EXISTING RAMPS TO BE RETROFIT WITH TACTILE DEVICES SHALL BE DESIGNATED ON THE PLANS, OR AS DIRECTED BY THE ENGINEER.
11. RETROFIT INSTALLATIONS WILL NOT REQUIRE REPLACING EXISTING DEPRESSED CURBING. A NOMINAL 6 INCH SETBACK FROM FACE OF CURB SHALL BE ENFORCED FOR NEAR EDGE OF TACTILE DOMES.
12. WET OR DRY STATIC COEFFICIENT OF FRICTION SHALL BE 0.7 FOR TACTILE SURFACE AND MEET ASTM C 1028.
13. TACTILE WARNING SURFACES MAY NOT BE STAMPED IN WET CONCRETE
14. TACTILE WARNING SURFACES SHALL BE PLACED WITHIN SIX (6") INCHES OF THE EDGE OF RAMP
15. TACTILE WARNING SURFACES SHALL BE PRECAST PANELS UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER
16. CAST IRON AND GLUE DOWN INSTALLATIONS ARE NOT ALLOWED. TACTILE WARNING SURFACES MUST BE WET SET INLAYS.
17. ONE CORNER OF THE TACTILE WARNING MUST BE WITH IN 8" OF THE GRADE BREAK MARKING THE FACE OF CURB. NO OTHER POINT ON THE LEADING EDGE OF THE TACTILE WARNING MAY BE MORE THAN 5' FROM THE GRADE BREAK.

REV	DATE	DESCRIPTION	BY

Tactile Warning Device Details

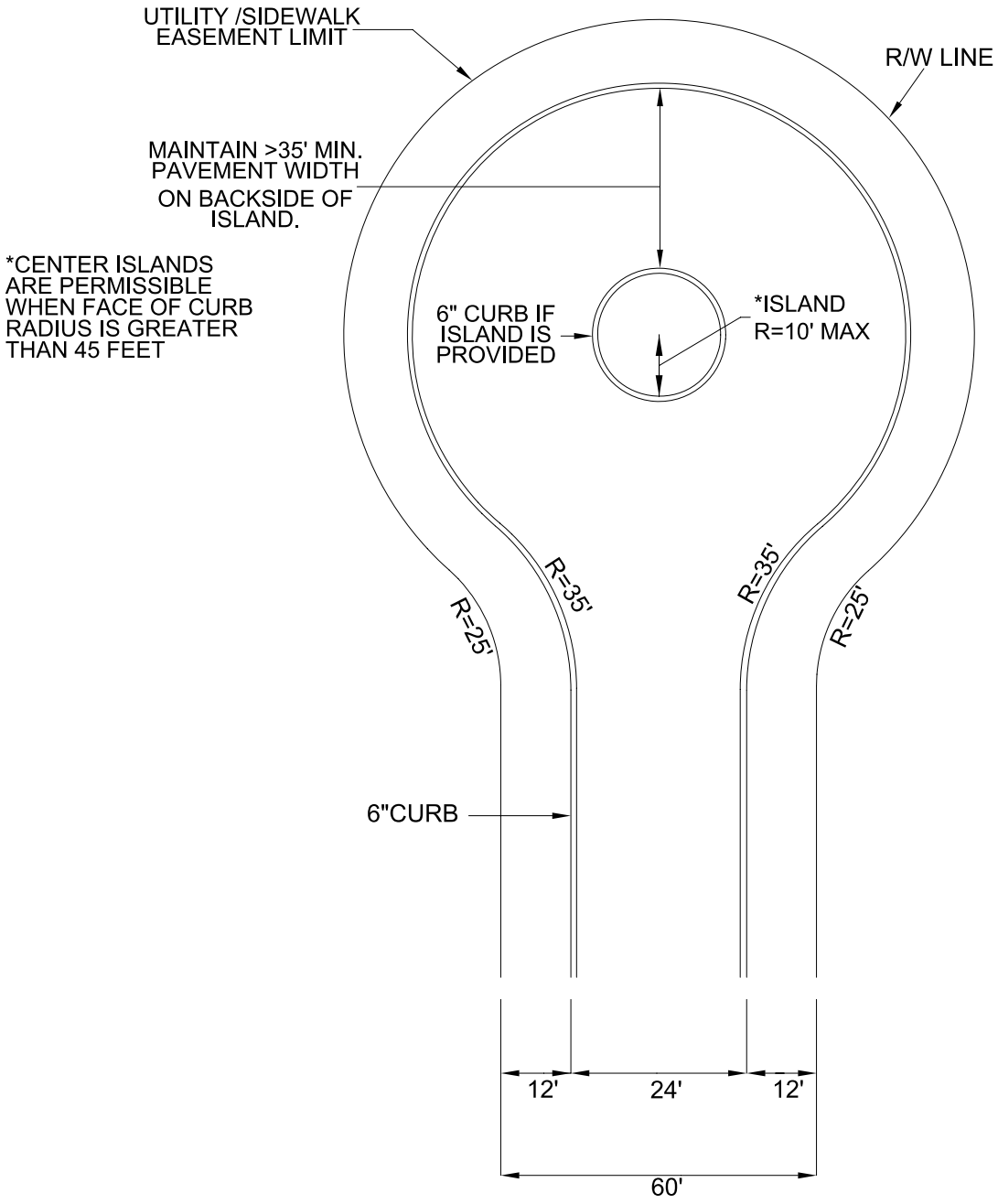
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 8/31/2010

Issued: 8/02/2021

Detail No. 3716



NOTES:

1. WARNING SIGNS SHALL BE POSTED AT ENTRANCE TO CUL-DE-SAC STREETS 300' OR GREATER IN LENGTH, INDICATING NO OUTLET.
2. DETAIL SHALL BE IDENTIFIED BY STREET NAME.
3. ELEVATION PROVIDED SHALL BE PROPOSED FLOW LINE OF GUTTER.
4. ONE DETAIL SHALL BE PROVIDED FOR EACH CUL-DE-SAC.
5. SCALE SHALL BE 1"=40' OR LARGER.
6. MINIMUM CUL-DE-SAC RADIUS:
   40' RESIDENTIAL
   48' COMMERCIAL
7. RIGHT-OF-WAY FOR CUL-DE-SAC SHALL BE A MINIMUM OF PAVED RADIUS PLUS 10'
8. IN LIEU OF STANDARD CUL-DE-SAC ALTERNATE STREET TERMINI DESIGNS WILL BE CONSIDERED FOR REVIEW AND APPROVAL BY THE CITY OF STILLWATER

REVISION	BY	DATE
R1	MAS	6/28/12

City of **stillwater**

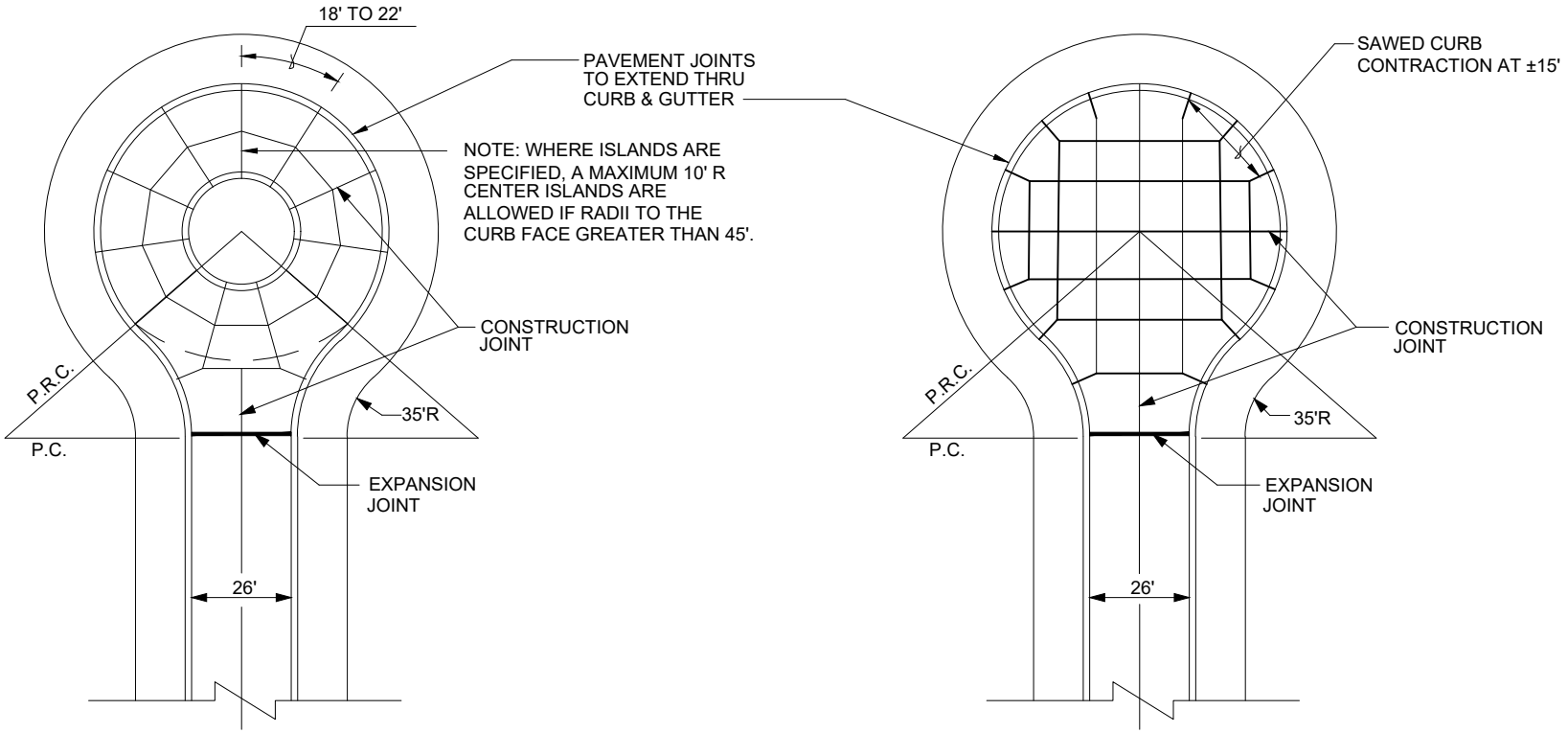
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CUL-DE-SAC (ASPHALT PAVING)

STANDARD DETAILS

DATE: JULY 28, 2012

STANDARD NO. 3717



STANDARD CUL-DE-SAC

ISLAND CENTER

STANDARD CUL-DE-SAC

OPEN CENTER

1. MINIMUM CUL-DE-SAC RADIUS:
   40' RESIDENTIAL
   48' COMMERCIAL
2. RIGHT-OF-WAY FOR CUL-DE-SAC SHALL BE A MINIMUM OF PAVED AREA PLUS 10'
3. IN LIEU OF STANDARD CUL-DE-SAC ALTERNATE STREET TERMINI DESIGNS WILL BE CONSIDERED FOR REVIEW AND APPROVAL BY THE CITY OF STILLWATER

Detail No. 3718

Issued: 8/02/2021

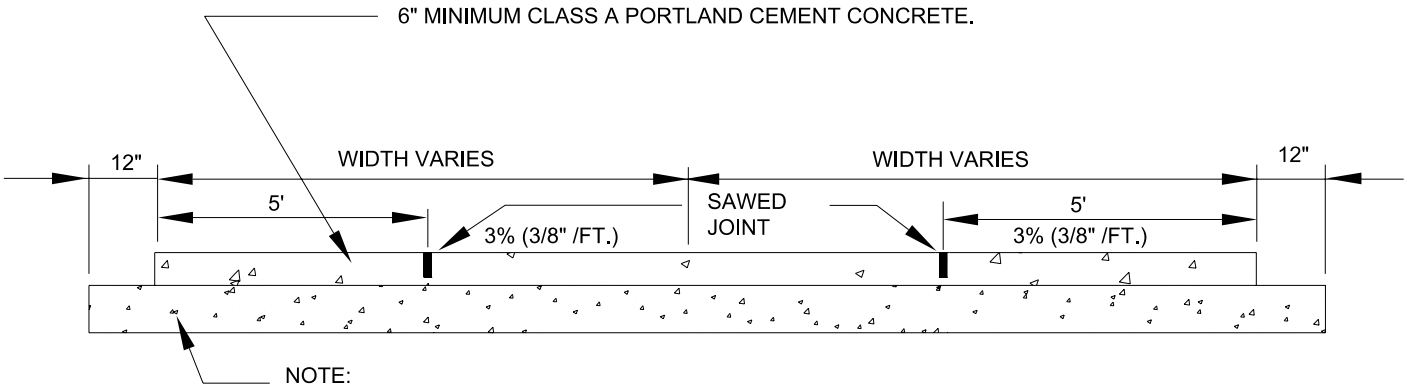
Adopted: 6/28/2012

The City of Stillwater OKLAHOMA

Concrete Pavement Joint Plan

(Cul-De-Sac)

CITY OF STILLWATER STANDARDS



NOTE:
MINIMUM MODIFIED SUBDRADE COMPACTED
TO 95% STANDARD DENSITY, PLASTICITY
INDEX ≤ 10

NOTE:

1. PAVING CONSTRUCTION TO BE MONOLITHIC. NO CONSTRUCTION JOINTS.
2. TRANSVERSE CONTRACTION JOINTS TO BE SAW CUT AT 10 C/C.
3. SEAL ALL JOINTS WITH RUBBERIZED ASPHALT.

REVISION	BY	DATE

City of stillwater

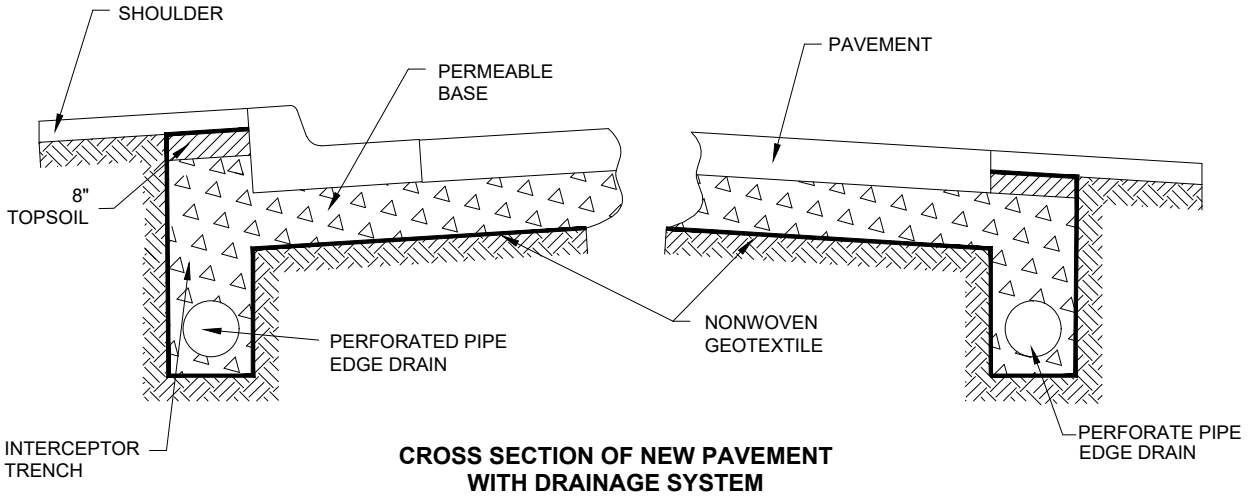
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

ALLEY PAVING

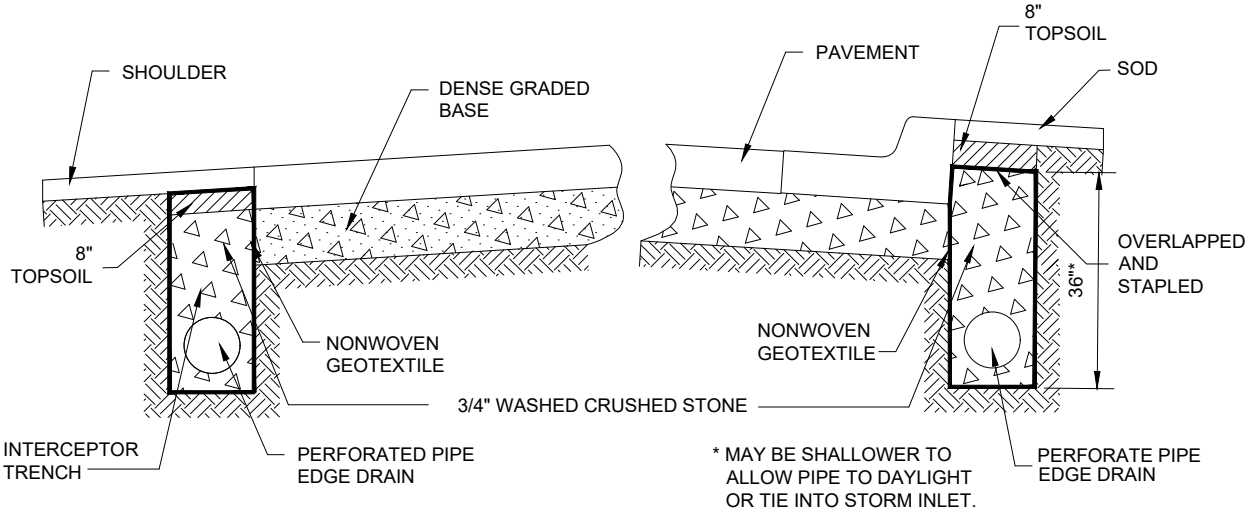
STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3719



CROSS SECTION OF NEW PAVEMENT WITH DRAINAGE SYSTEM



CROSS SECTION OF DRAINAGE IMPROVEMENT TO EXISTING PAVEMENT

NOTES:
1. MINIMUM PERFORATED PIPE SIZE IS 6" DIAMETER.
2. PERFORATED PIPES SHALL BE TIED TO THE STORM SEWER SYSTEM.
3. ON STREETS WITH CURB AND GUTTER, THE DRAIN SHALL BE OUTSIDE BUT ADJACENT TO THE CURB.
4. PIPE MATERIAL SHALL BE POLYETHYLENE PIPE THAT MEETS ASTM F405 SPECIFICATIONS.
5. DESIGN OF INTERCEPTOR TRENCH SHALL BE BY AN ENGINEER AND SHALL CONSIDER HOW DISCHARGE LOCATIONS IMPACT SURROUNDING AREAS.
6. UNLESS OTHERWISE IN NOTE 5, TRENCH WIDTH = 14" MAX.

REV	DATE	DESCRIPTION	BY

Paving Base Drainage

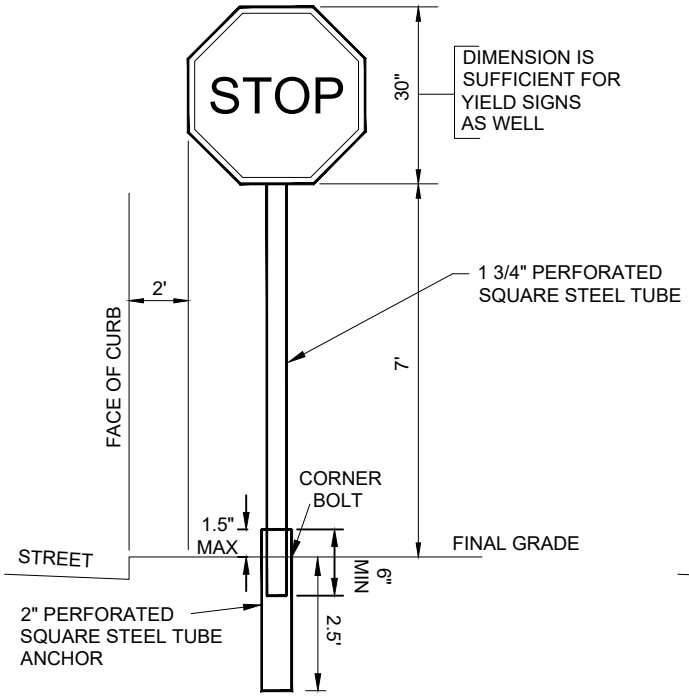
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

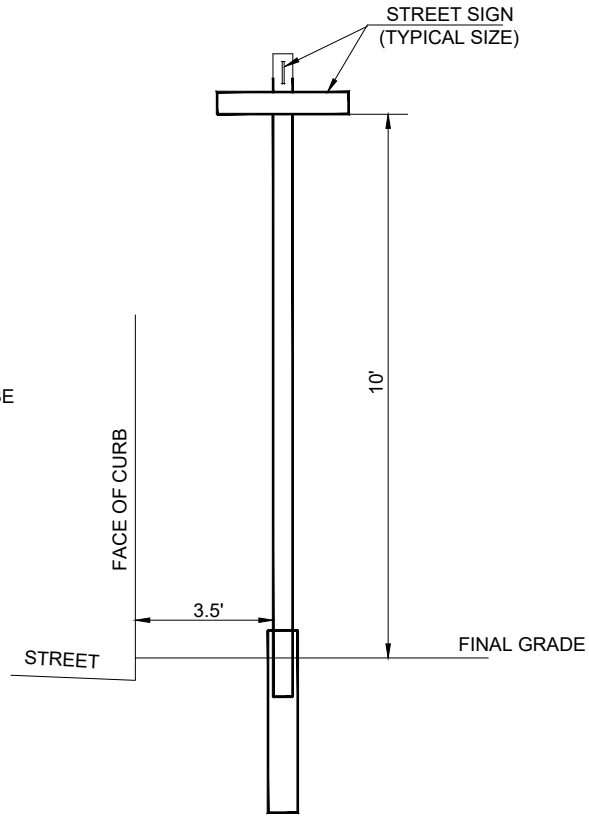
Adopted: 7/18/2011

Issued: 8/02/2021

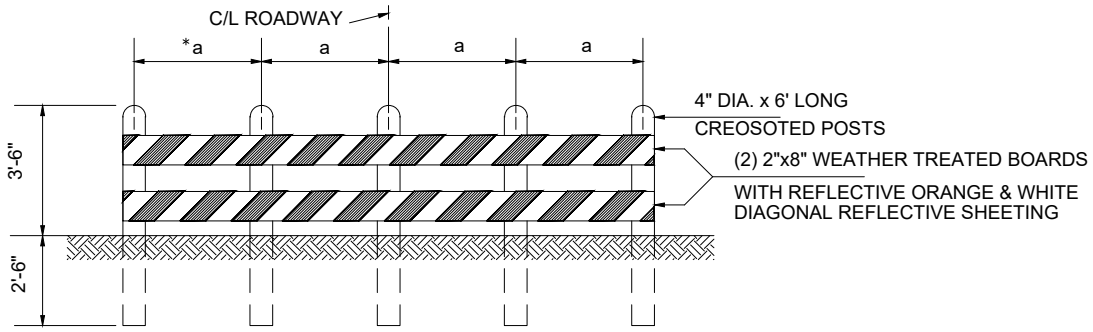
Detail No. 3721



STOP SIGN DETAIL



STREET SIGN DETAIL



BARRICADE DETAIL

* a=7'0" FOR 26' WIDE PAVING
a=9'0" FOR 36' WIDE PAVING

All street signs will conform to MUTCD Conventional Roads Standards

REV	DATE	DESCRIPTION	BY

Stop Sign & Barricade

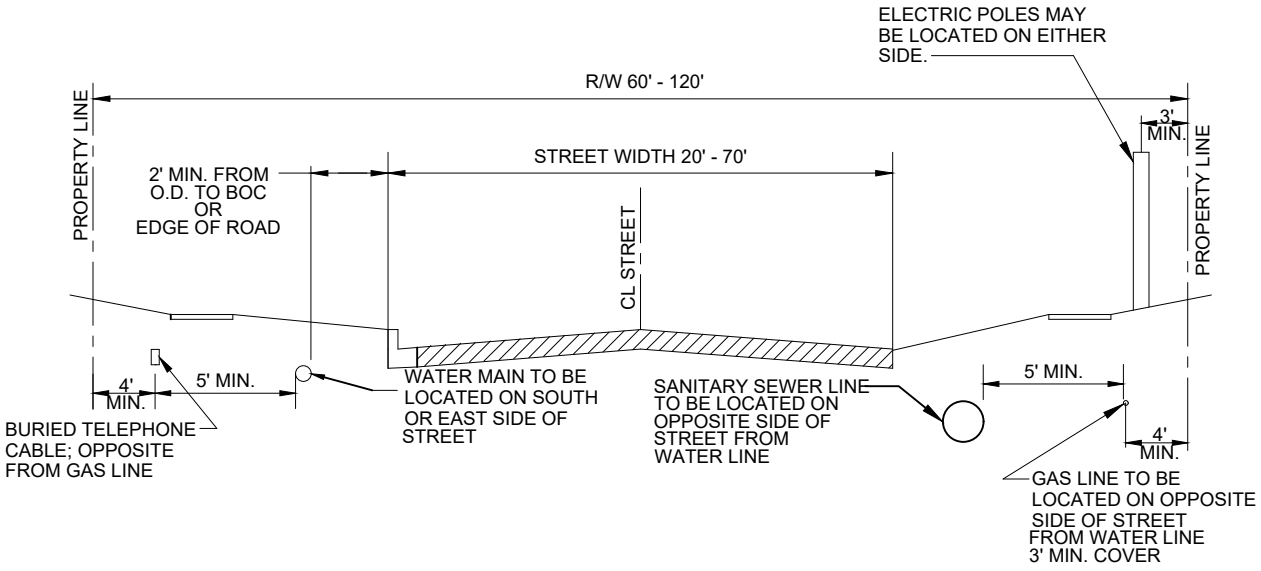
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 9/30/2010

Issued: 8/02/2021

Detail No. 3722



ALL RIGHT-OF-WAY WIDTHS

NOTES:

1. THESE ARE TYPICAL LOCATIONS PLANNED FOR CONSISTENCY OF UTILITY LOCATION AND COORDINATION.
2. ALIGNMENTS OUTSIDE OF THE CORRIDOR WILL BE EVALUATED ON A CASE BY CASE BASIS.
3. UTILITIES SHOULD BE LOCATED SO THAT PAVEMENT OR SIDEWALK WILL NOT BE REMOVED FOR REPAIRS
4. ALL UTILITIES TO MEET ODEQ REQUIREMENTS FOR UNDERGROUND PLACEMENT

REV	DATE	DESCRIPTION	BY

Utility Locations at Streets

CITY OF STILLWATER STANDARDS

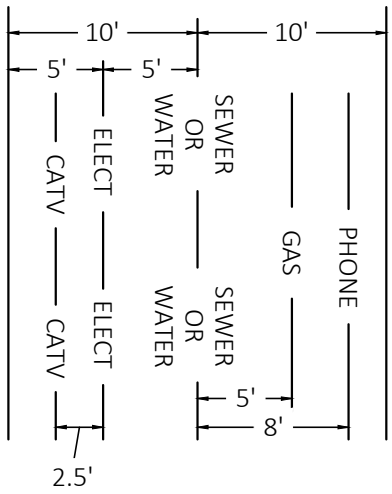
The City of Stillwater OKLAHOMA

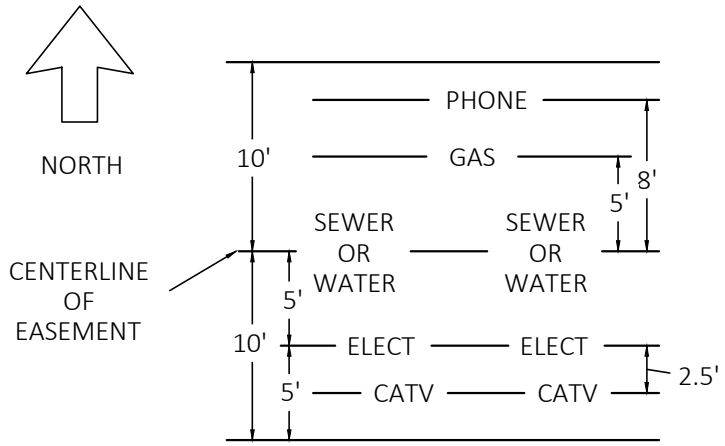
Adopted: 7/18/2011

Issued: 8/02/2021

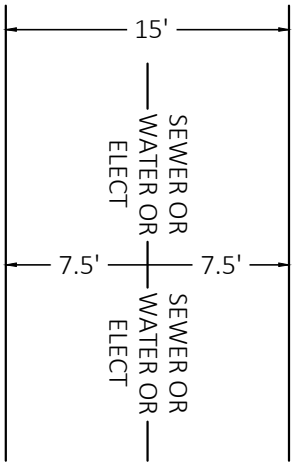
Detail No. 3725

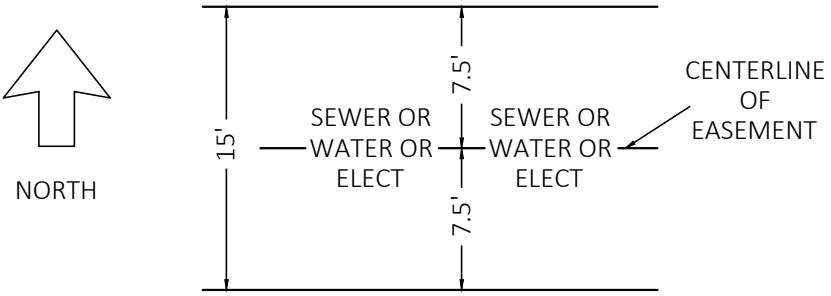
20' MULTIPLE UTILITY EASEMENT





15' SINGLE UTILITY EASEMENT





NOTES:

1. ALL WATER AND SEWER LINES REQUIRE A 10 FT HORIZONTAL SEPARATION FROM EACH OTHER AND A 5 FT HORIZONTAL SEPARATION FROM ALL OTHER UTILITY LINES.
2. ALL WATER AND SEWER LINES REQUIRE A 2 FT VERTICAL SEPARATION FROM ALL OTHER UTILITY LINES.
3. REQUIRED CLEARANCE FROM WATER OR SEWER LINES IS FROM EDGE OF PIPE TO EDGE OF UTILITY.

20' MULTIPLE UTILITY EASEMENT DISTANCES	
UTILITY	DISTANCE FROM CENTERLINE OF EASEMENT
SEWER/WATER	0 FEET SOUTH OR 0 FEET WEST
GAS	5 FEET NORTH OR 5 FEET EAST
ELECTRIC	5 FEET SOUTH OR 5 FEET WEST
TELEPHONE	8 FEET NORTH OR 8 FEET WEST
CABLE TV	7.5 FEET SOUTH OR 7.5 FEET WEST

REV	DATE	DESCRIPTION	BY

Easement Utility Clearances

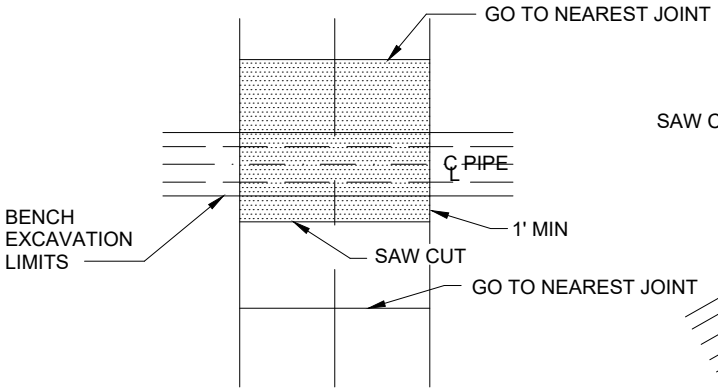
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

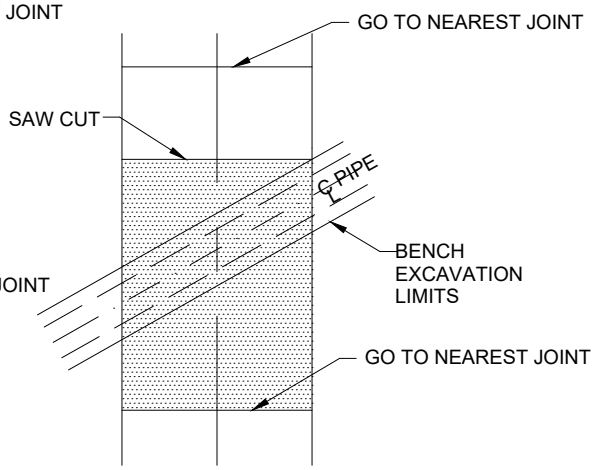
Adopted: 8/02/2021

Issued: 8/02/2021

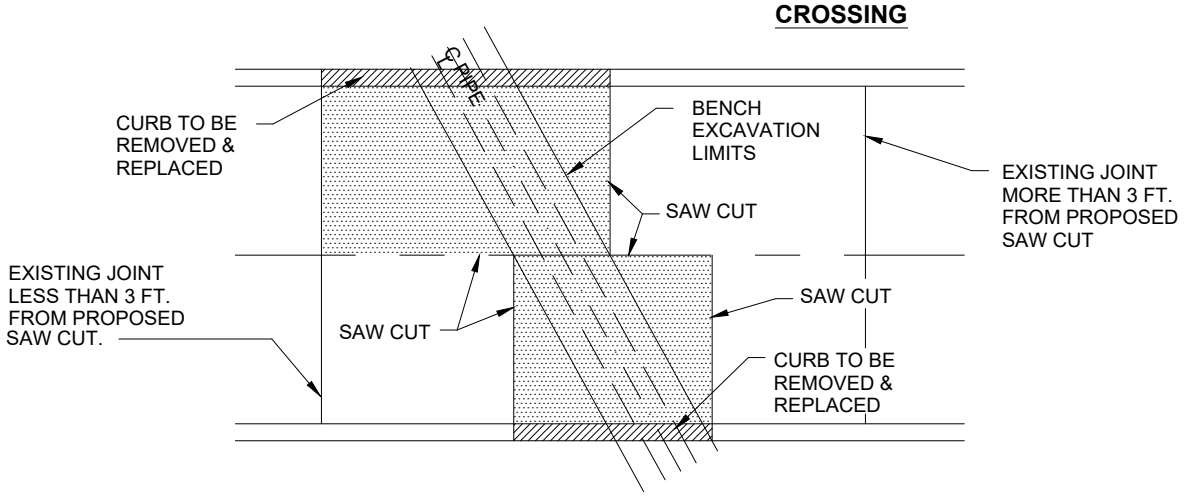
Detail No. 3726



TYPICAL STREET, DRIVEWAY, OR SIDEWALK WITH RIGHT ANGLE CROSSING



TYPICAL DRIVEWAY OR SIDEWALK W/ DIAGONAL CROSSING



TYPICAL STREET WITH DIAGONAL CROSSING

NOTES:

1. REMOVE AND REPLACE PAVEMENT WITHIN SHADED ARES BOUNDED BY SAW CUTS AND/OR CONSTRUCTION JOINTS.
2. FOR DIAGONAL CROSSING, REPLACE PAVEMENT USING SQUARED CUTS, AS SHOWN.
3. REMOVE AND REPLACE PAVEMENT TO CONSTRUCTION JOINT IF LESS THAN 3 FT. FROM PROPOSED SAW CUT.
4. FOR LONGITUDINAL INSTALLATIONS: REMOVE AND REPLACE PAVEMENT AND CURB TO EDGE OF STREET, IF THE SAW CUT IS LESS THAN 3 FT. FROM THE OUTSIDE EDGE OF THE PAVEMENT OR CURB. AVOID SAW CUTS IN THE EXISTING WHEEL LINE.
5. ALL CONSTRUCTION JOINTS SHALL BE REESTABLISHED IN ACCORDANCED WITH THE CITY OF STILLWATER STANDARDS FOR PORTLAND CEMENT CONCRETE PAVEMENT. WHEN A PAVEMENT SECTION IS REMOVED ALONG AN EXISTING LONGITUDINAL CONSTRUCTION JOINT, THE NEW PAVEMENT SHALL BE DOWELLED TO THE PAVEMENT ADJACENT TO THE JOINT.

REV	DATE	DESCRIPTION	BY

Pavement Cuts for Utilities

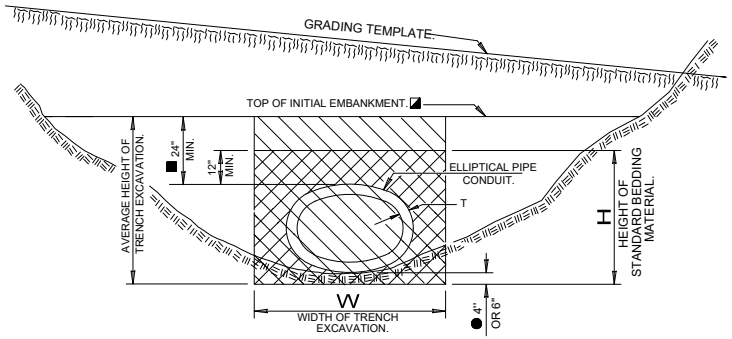
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

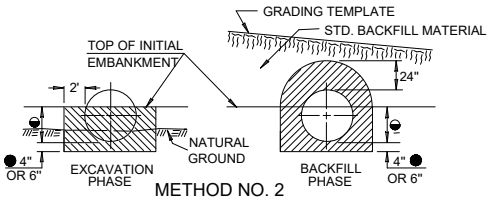
Adopted: 5/31/2011

Issued: 8/02/2021

Detail No. 3727

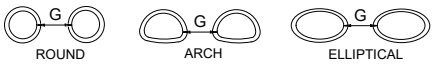


METHOD NO. 1
TRENCH EXCAVATION IN EMBANKMENT SECTIONS



METHOD NO. 2
(OPTIONAL INSTALLATION FOR R. C. PIPE)
TRENCH EXCAVATION IN EMBANKMENT SECTIONS
◒ EMBANKMENT HEIGHT PRIOR TO EXCAVATION
PIPE SIZES FROM 18" TO 42" =30"
PIPE SIZES FROM 48" TO 84" =2/3 DIAM.
PIPE SIZES LARGER THAN 84" 60"

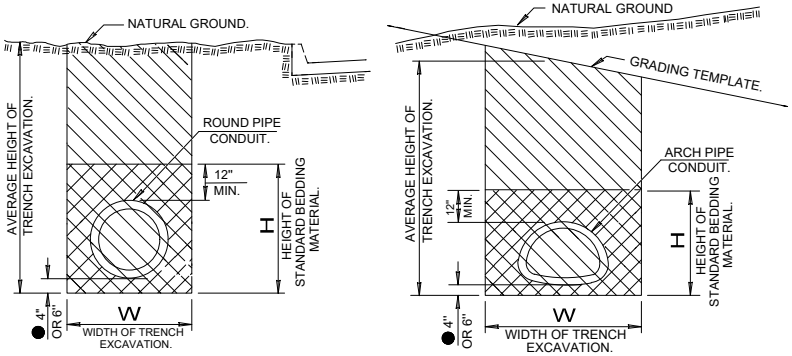
	CONDUIT SHAPE			DIST. G
	ROUND	ARCH	ELLIPTICAL	
FOR DIAM. OR SPAN	UP TO 24"	UP TO 36"	UP TO 36"	12"
	25" TO 72"			D/2"
		37" TO 108"	37" TO 108"	D/3"
	OVER 73"	OVER 108"	OVER 108"	36"



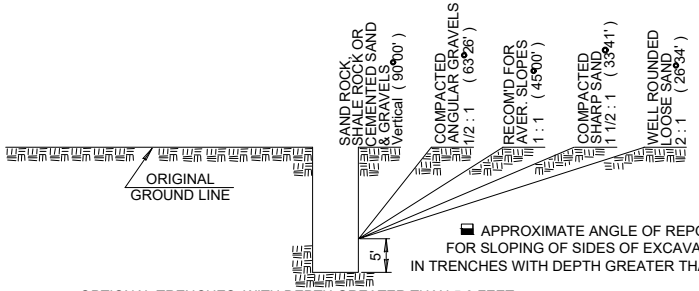
DOUBLE PIPE INSTALLATION

LIMITS OF STANDARD BEDDING MATERIAL.
QUANTITIES FOR BEDDING MATERIAL DO NOT INCLUDE THE SPACE WITHIN AND BOUNDED BY THE OUTER SURFACE OF THE PIPE CONDUIT.

LIMITS OF TRENCH EXCAVATION.



TRENCH EXCAVATION IN CUT SECTIONS



◒ APPROXIMATE ANGLE OF REPOSE FOR SLOPING OF SIDES OF EXCAVATIONS IN TRENCHES WITH DEPTH GREATER THAN 5 FEET.

◒ OPTIONAL TRENCHES WITH DEPTH GREATER THAN 5.0 FEET

GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIAL REQUIREMENT SHALL BE IN ACCORDANCE WITH THE 2019 ODOT STANDARD SPECIFICATIONS.
2. TRENCH EXCAVATION AND BEDDING MATERIAL WILL NOT BE REQUIRED FOR PIPE INSTALLATION OF SIDE DRAINS UNLESS OTHERWISE NOTED ON THE PLANS.
3. FOR PIPE UNDERDRIANS SEE 3721-PAVING BASE DRAINAGE STANDARD DETAIL
4. SPECIAL TRENCHING CONDITIONS ARE THOSE DEFINED BY O.S.H.A. REGULATIONS,TITLE 29 CFR CHAPTER XVII, PART 1926.650, 1926.652, SO DEFINED WILL APPLY UNTIL THEY ARE IN CONFLICT WITH CURRENT SPECIFICATIONS, FOR TRENCH DEPTHS OVER FIVE FEET.
5. NORMAL BACK FILLING OPERATIONS SHALL FOLLOW BEDDING AND PIPE INSTALLATION AS CLOSELY AS PRACTICAL. IN NO CASE SHALL A PIPE INSTALLATION SUBJECT TO SUDDEN FLOW DEVELOPMENT BE LEFT WITHOUT SUFFICIENT BACK FILL TO RESTRAIN THE CONDUIT AND PREVENT JOINT SEPARATION AND/OR PIPING SCOUR. PHYSICALLY RESTRAINING THE CONDUIT MAY BE USED TO AUGMENT OR REPLACE THIS IMMEDIATE BACK FILL REQUIREMENT.
6. ANY EXCESS EXCAVATION NOT USED FOR BACK FILL WILL BECOME THE PROPERTY OF THE CONTRACTOR AND DISPOSED OF BY HIM, IN A MANNER APPROVED OF BY THE ENGINEER.
7. ◒ WHEN REQUIRED, THE SIDES OF THE TRENCHES SHALL BE SHEETED AND SHORED OR OTHERWISE SUPPORTED WHEN THE TRENCH IS MORE THEN 5.0 FEET IN DEPTH. IN LIEU OF SHEETING, THE SIDES OF THE TRENCH ABOVE THE 5.0 FOOT LEVEL MAY BE SLOPED TO PRECLUDE COLLAPSE, SEE OPTIONAL TRENCHES DETAIL THIS SHEET.
8. PROPER COMPACTION OF BACK FILL REQUIRES A VERTICAL WALLED TRENCH TO 24 INCHES ABOVE TOP OF PIPE, REGARDLESS OF EXCAVATION ABOVE THAT ELEVATION FOR PIPES EQUAL TO:
   ROUND PIPE: 36 INCHES AND GREATER
   ARCH PIPE: 48 INCHES AND GREATER
   HORIZONTAL ELLIPTICAL PIPE: 42 INCHES AND GREATER
9. ● EQUIVALENT PIPE SIZES 66 INCHES AND LARGER REQUIRE 6 INCHES OF BEDDING MATERIAL BELOW PIPE CONDUIT.
10. PIPE DIMENSIONS SHALL CONFORM TO AASHTO M 207, AS DESIGNATED RISE BY SPAN.
11. ◒ MULTIPLE PIPE INSTALLATIONS WILL REQUIRE A MINIMUM OF 12 INCHES BETWEEN PIPES FOR PROPER COMPACTION.

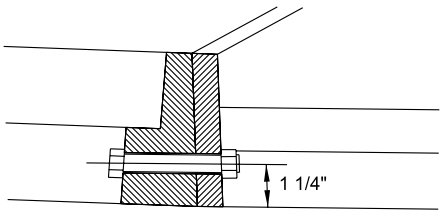
Detail No. 3803
Issued: 8/02/2021
Adopted: 10/1/2021

The City of Stillwater OKLAHOMA

Trench Excavation and Embankment

CITY OF STILLWATER STANDARDS

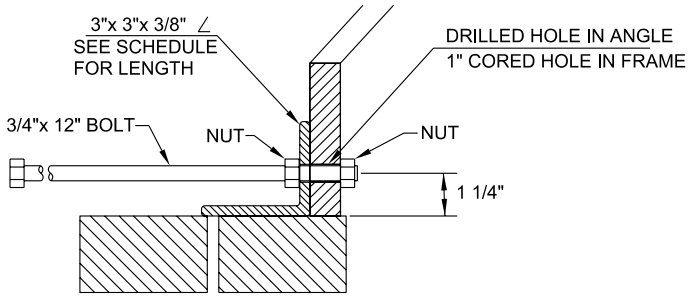
REV	DATE	DESCRIPTION	BY



DETAIL OF CONNECTION

FRAME AND CAST IRON CURB

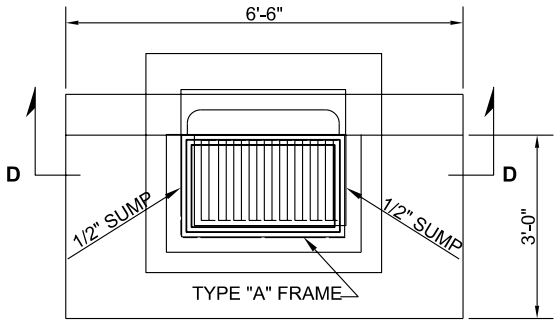
NOTE: FRAME TO BE BOLTED TO THE CURB WITH
3 EACH 3/4" x 4 1/2" MACHINE BOLTS



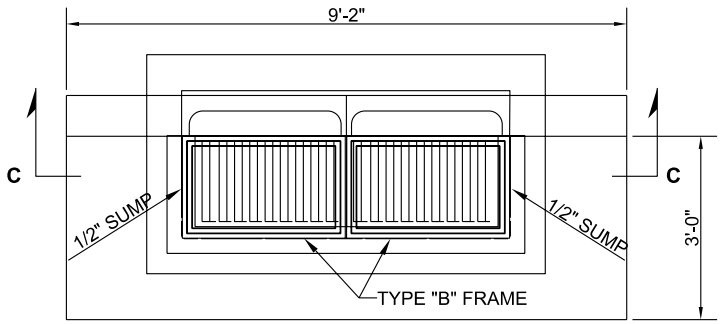
DETAIL OF CONNECTION

ANGLE IRON & CAST IRON CURB

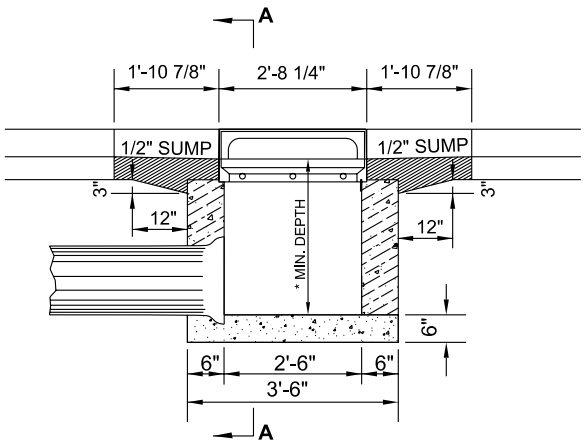
NOTE: ANGLE IRON TO BE BOLTED TO CURB
WITH 3 - 3/4"x 12" MACHINE BOLTS
IN EACH CURB SECTION



PLAN

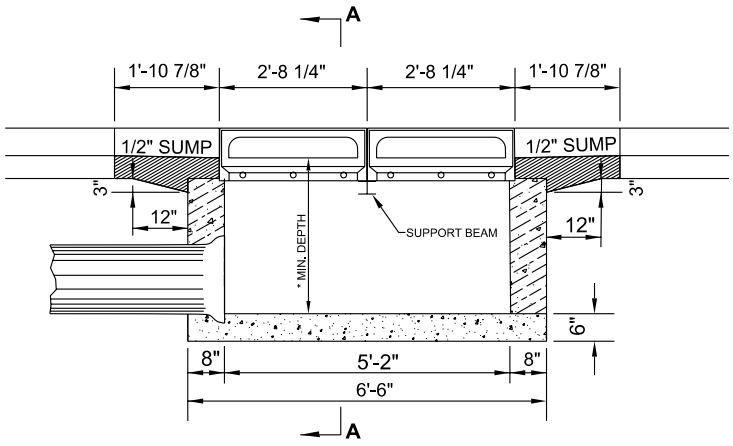


PLAN



SECTION D-D

SINGLE GRATE CURB INLET



SECTION C-C

DOUBLE GRATE CURB INLET

*** MINIMUM DEPTH FOR INLETS**
(FOR DETAILING)

2'-4" FOR 15" RCP
2'-8" FOR 18" RCP
3'-2" FOR 24" RCP
3'-8" FOR 30" RCP
4'-2" FOR 36" RCP

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

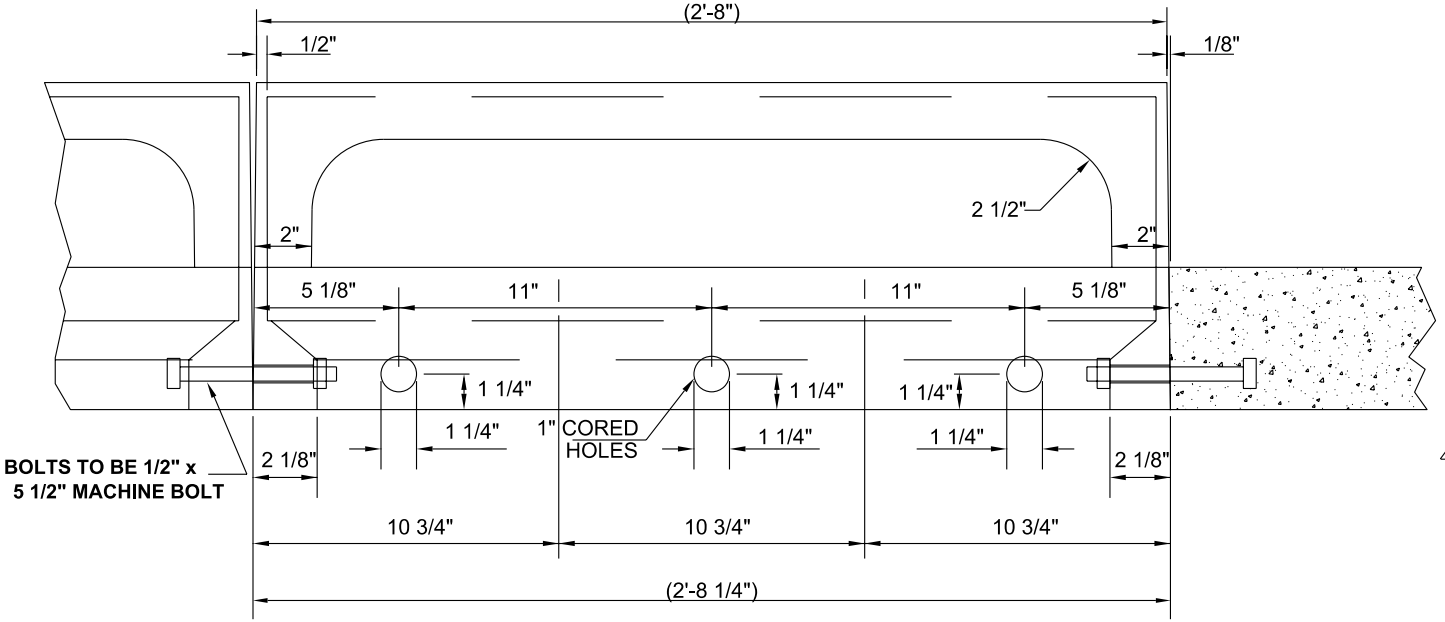
CURB INLET SHEET 1

STANDARD DETAILS

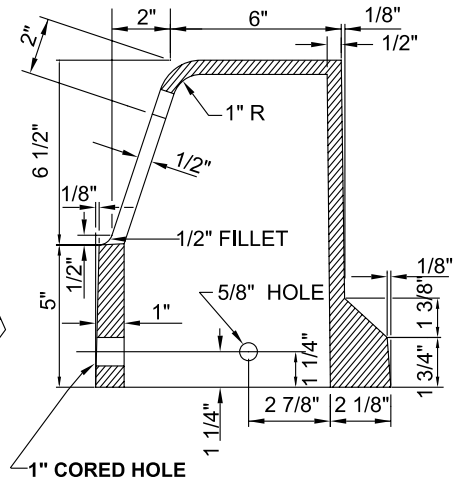
DATE: OCTOBER 2010

STANDARD NO. 3807

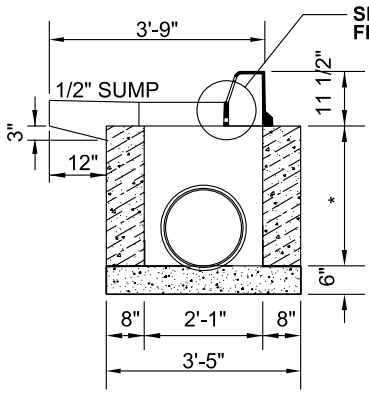
DRAFT STANDARD DETAIL



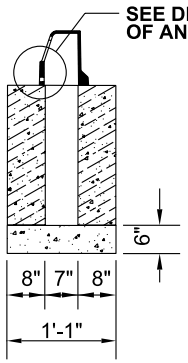
CAST IRON STORM SEWER CURB HOOD
NEENAH R-3076-6BOK
OR AN APPROVED EQUAL



6" BARRIER CURB HOOD
NEENAH R-3076-6BOK
OR AN APPROVED EQUAL



SECTION A-A

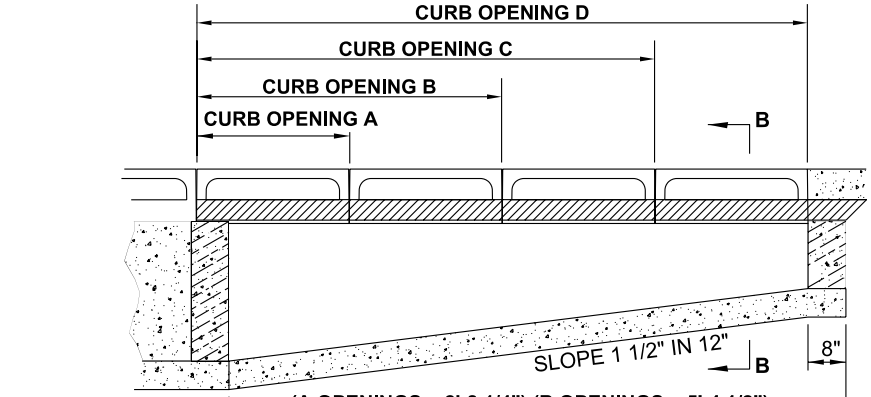


SECTION B-B

*** INLET DIMENSION**

*** MINIMUM DEPTH FOR PRECAST WALLS**

1'-11" FOR 15" RCP
2'-3" FOR 18" RCP
2'-9" FOR 24" RCP
3'-3" FOR 30" RCP
3'-9" FOR 36" RCP



ADDITIONAL CURB OPENINGS

REVISION	BY	DATE

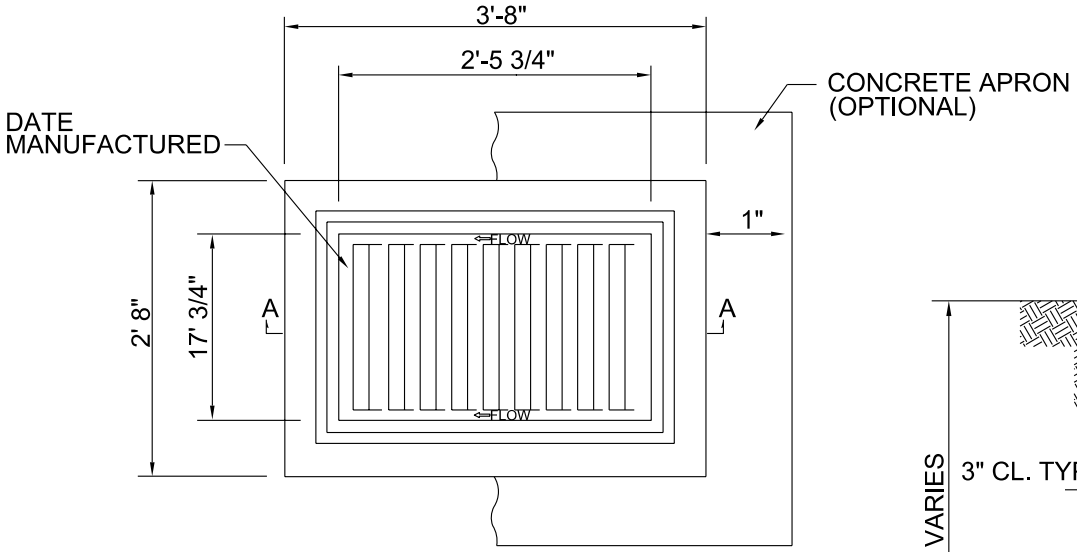
City of **stillwater**
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CURB INLET SHEET II

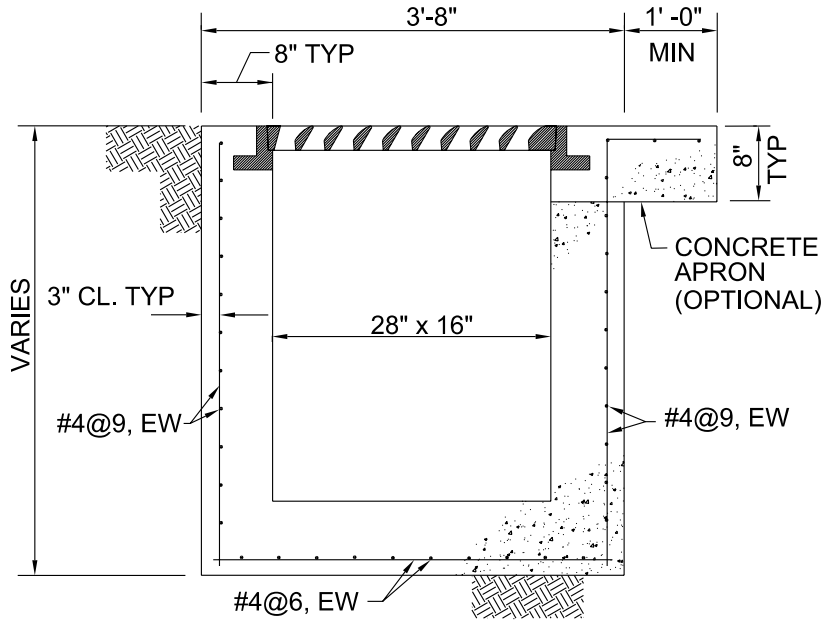
STANDARD DETAILS

DATE: OCTOBER 2010 | STANDARD NO. 3808

DRAFT STANDARD DETAIL



PLAN



SECTION A-A

NOTES:

1. ALL CONSTRUCTION METHODS & MATERIAL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE CURRENT SPECIFICATIONS.
2. SHARP EDGES RESULTING FROM FABRICATION SHALL BE DULLED BY ANY ACCEPTABLE METHOD FOR SAFETY IN HANDLING.
3. GRATES SHALL BE INSTALLED IN FRAME WITH FLOW ARROW POINTING DOWNSTREAM OR TOWARD THE LOW POINT IN A SUMP.
4. VANE GRATE SHALL BE ODOT TYPE VG-F, STANDARD DRAWING CIG-1-2.
5. FRAME SHALL BE ODOT TYPE A FOR INLET DESIGN 1, STANDARD DRAWING SSIF-2-4.
6. CASTINGS SHALL BE SMOOTH AND WELL CLEANED BY SHOT BLASTING OR OTHER APPROVED CLEANING.
7. ALL CASTINGS SHALL BE MANUFACTURED TRUE TO PATTERN: COMPONENT PARTS SHALL FIT TOGETHER IN A SATISFACTORY MANNER.
8. ALL LETTERING SHALL BE RECESSED 1/16".

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

AREA INLET

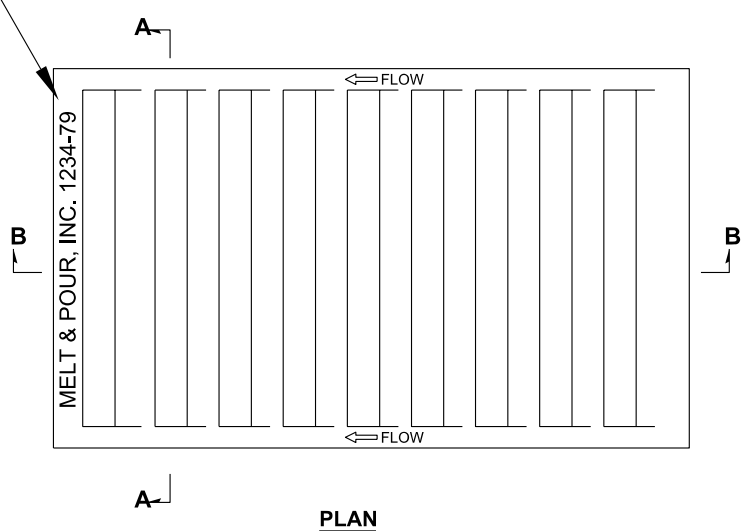
STANDARD DETAILS

DATE: October 2010

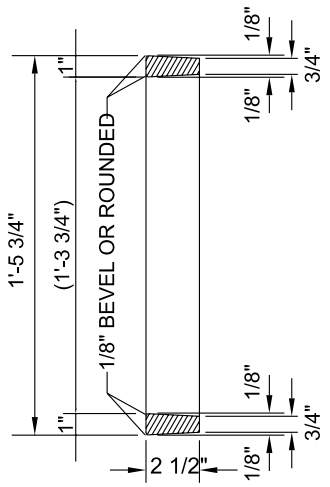
STANDARD NO. 3809

DRAFT STANDARD DETAIL

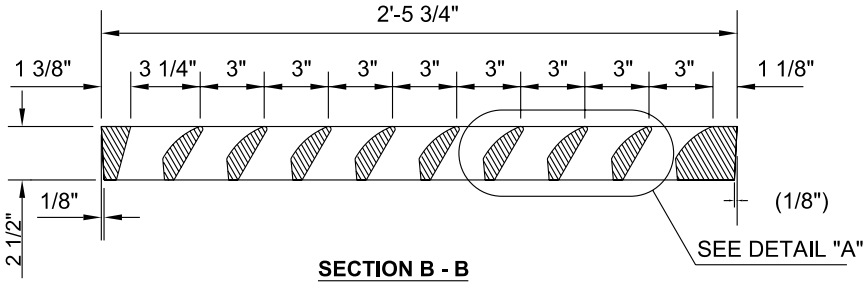
LETTERING TO IDENTIFY FOUNDRY OR DISTRIBUTOR. LETTERING TO BE NO HIGHER THAN 3/4". HEAT NUMBER OR OTHER IDENTIFICATION OF PRODUCT MAY BE INCLUDED.



PLAN



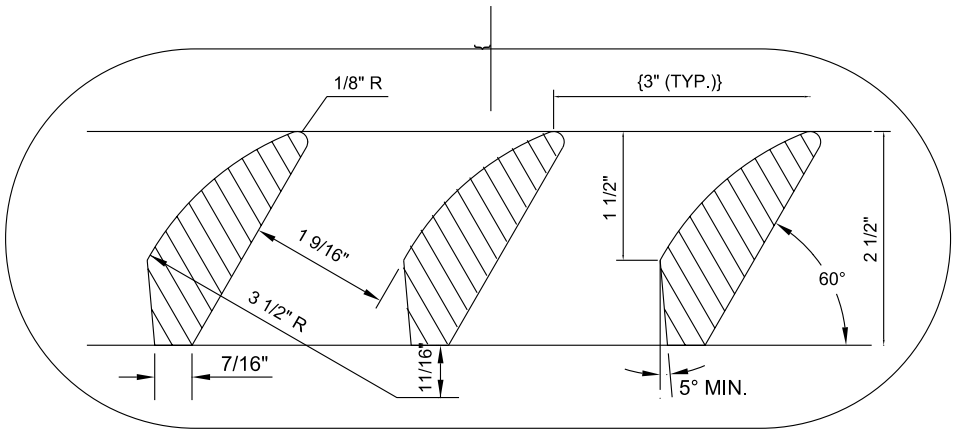
SECTION A - A



SECTION B - B

CAST GRATE

NEENAH R-3076 OR AN APPROVED EQUAL



DETAIL "A"

REVISION	BY	DATE

City of stillwater

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

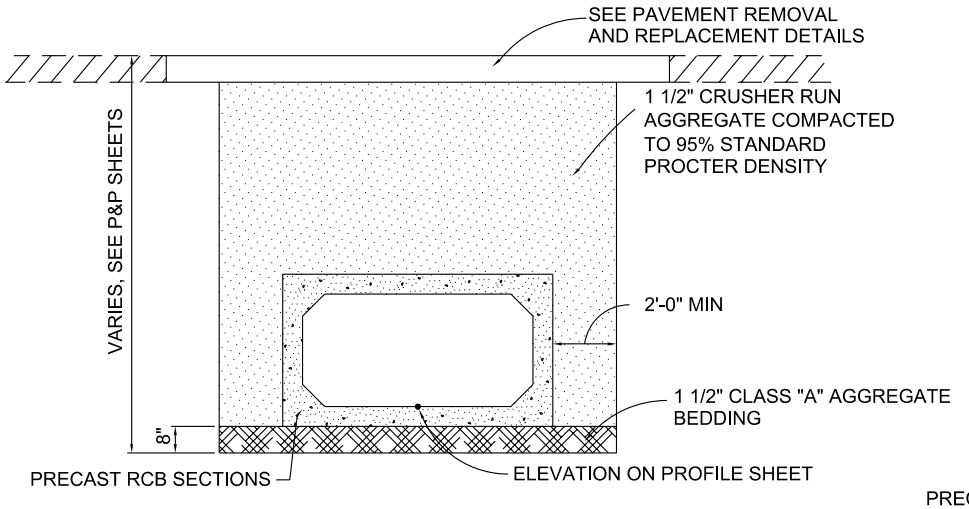
STORM SEWER BOX GRATE

STANDARD DETAILS

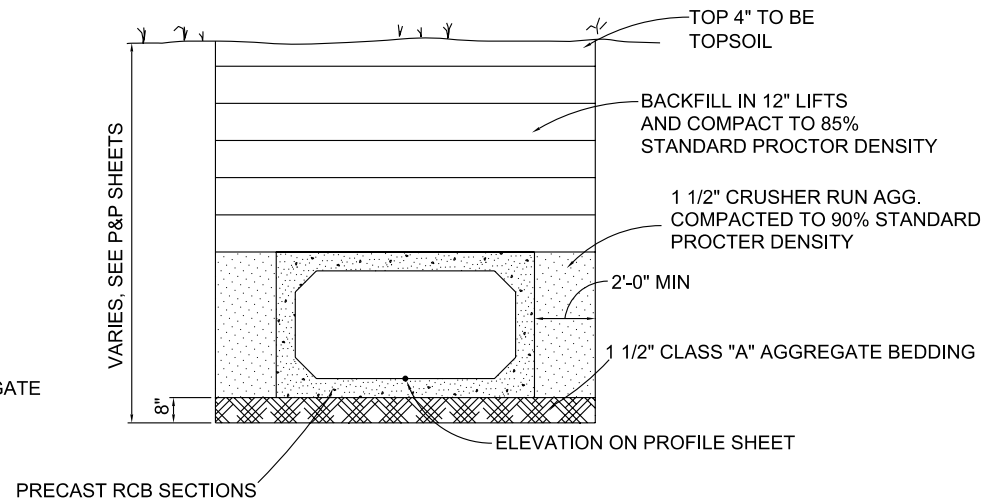
DATE: OCTOBER 2010

STANDARD NO. 3810

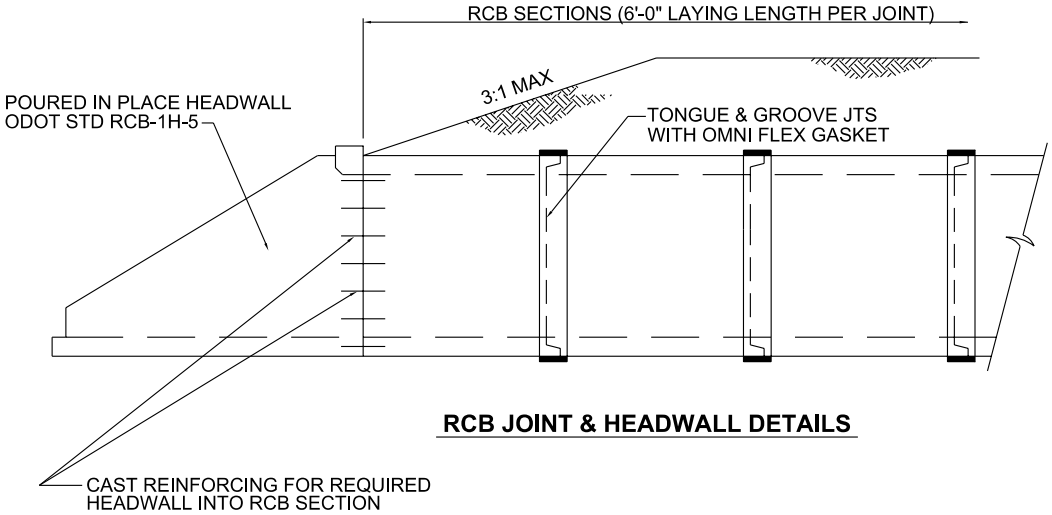
DRAFT STANDARD DETAIL



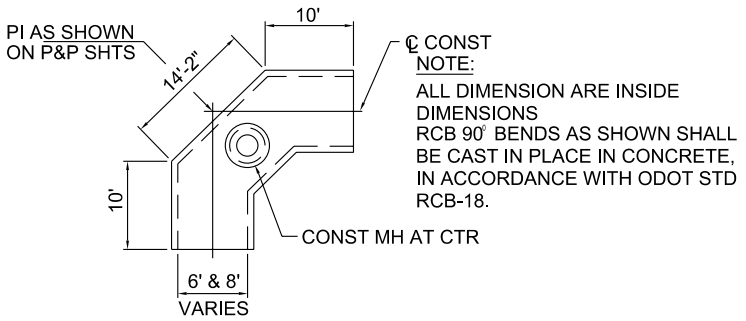
RCB DETAIL - PAVED AREAS



RCB DETAIL - OPEN AREAS



RCB JOINT & HEADWALL DETAILS



RCB 90° BEND DETAIL

REVISION	BY	DATE

City of **stillwater**

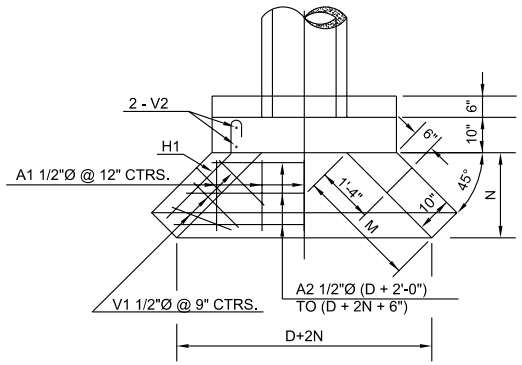
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

STORM SEWER BOX CULVERT

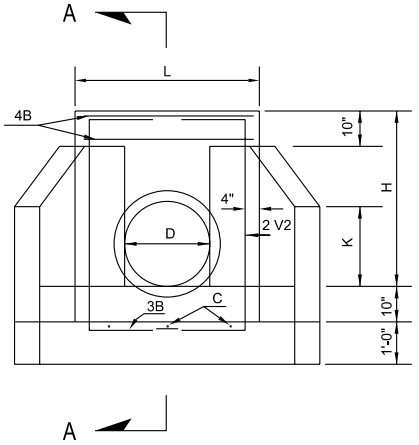
STANDARD DETAILS

DATE: OCTOBER 2010 | STANDARD NO. 3811

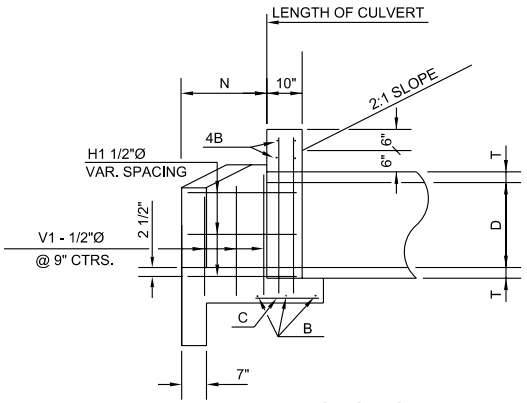
DRAFT STANDARD DETAIL



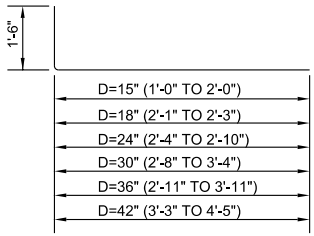
PLAN



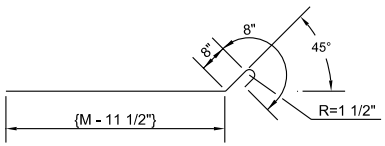
ELEVATION



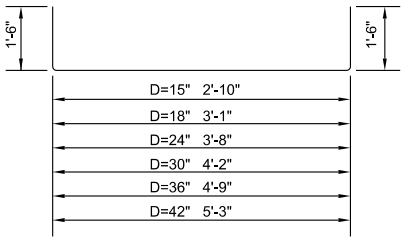
SECTION A-A



BENDING FOR V1 - BARS



BENDING FOR H1 - BARS



BENDING FOR V2 - BARS

DIMENSIONS & QUANTITIES FOR HEADWALLS WITH 45° WINGS

DIMENSIONS								REINFORCING STEEL														QUANTITIES *	
D	AREA SQ. FT.	T	H	K	L	M	N	A1 - 1/2"Ø		A2 - 1/2"Ø		B - 1/2"Ø		C - 1/2"Ø		H1 - 1/2"Ø		V1 - 1/2"Ø		V2 - 1/2"Ø		CLASS "A" CONC., C.Y.	REINF. STEEL, LBS.
								NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.		
15"	1.23	2 1/4"	2'-5 1/4"	1'-5"	3'-7"	1'-9"	1'-3"	4	1'-0"	2	3'-9" AV.	7	3'-3"	3	1'-6"	4	2'-1"	4	3'-5" AV.	4	5'-10"	0.74	57
18"	1.77	2 1/2"	2'-8 1/2"	1'-7"	3'-10"	2'-1 1/2"	1'-6"	4	1'-2"	2	4'-3" AV.	7	3'-6"	3	1'-6"	4	2'-6"	4	3'-8" AV.	4	6'-1"	0.91	61
24"	3.14	3"	3'-3"	1'-10 1/2"	4'-4"	2'-10"	2'-0"	5	1'-8"	3	5'-3" AV.	7	4'-0"	3	1'-6"	6	3'-2"	6	4'-1" AV.	4	6'-8"	1.31	85
30"	4.91	3 1/2"	3'-9 1/2"	2'-2"	4'-10"	3'-6 1/2"	2'-6"	5	2'-2"	3	6'-3" AV.	7	4'-6"	4	1'-6"	6	3'-11"	8	4'-6" AV.	4	7'-2"	1.77	104
36"	7.07	4"	4'-4"	2'-5 1/2"	5'-4"	4'-3"	3'-0"	6	2'-8"	4	7'-3" AV.	7	5'-0"	4	1'-6"	6	4'-7"	10	4'-11" AV.	4	7'-9"	2.29	130
42"	9.62	4 1/2"	4'-10 1/2"	2'-9"	5'-10"	4'-11 1/2"	3'-6"	6	3'-2"	4	8'-3" AV.	7	5'-6"	4	1'-6"	6	5'-4"	12	5'-4" AV.	4	8'-3"	2.89	151

* FOR ONE HEADWALL

ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4" CHAMFER

STANDARD CONCRETE HEADWALLS

FOR

15" TO 42" PIPE

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

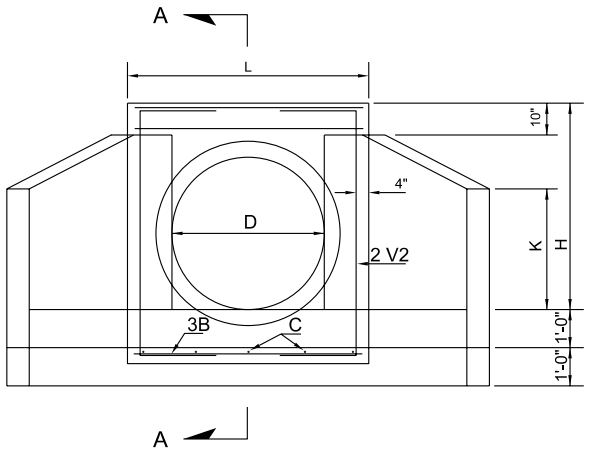
STORM SEWER HEADWALL SHEET 1

STANDARD DETAILS

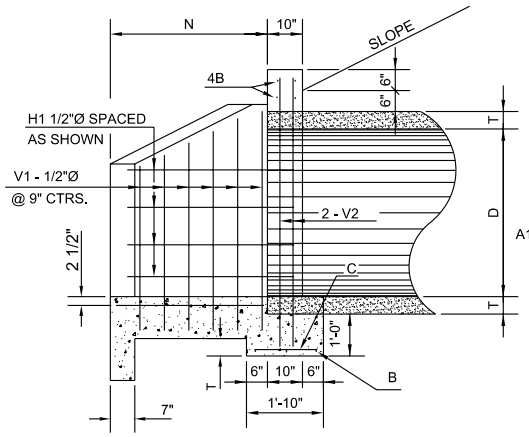
DATE: OCTOBER 2010

STANDARD NO. 3812

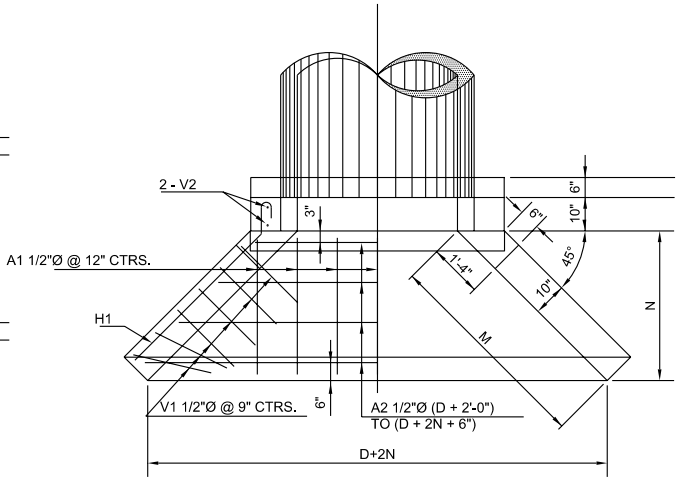
DRAFT STANDARD DETAIL



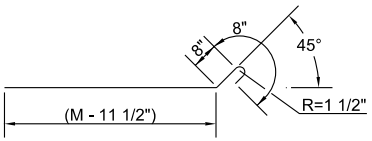
ELEVATION



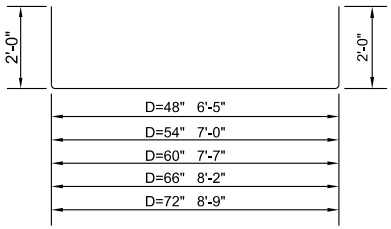
SECTION A-A



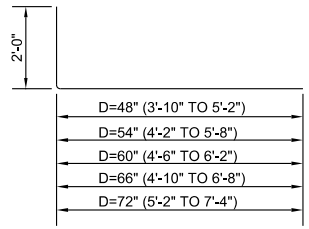
PLAN



BENDING FOR H1 - BARS



BENDING FOR V2 - BARS



BENDING FOR V1 - BARS

DIMENSIONS & QUANTITIES FOR HEADWALLS WITH 45° WINGS

DIMENSIONS								REINFORCING STEEL														QUANTITIES *	
D	AREA SQ. FT.	T	H	K	L	M	N	A1 - 1/2"Ø NO.	A1 - 1/2"Ø LGTH.	A2 - 1/2"Ø NO.	A2 - 1/2"Ø LGTH.	B - 1/2"Ø NO.	B - 1/2"Ø LGTH.	C - 1/2"Ø NO.	C - 1/2"Ø LGTH.	H1 - 1/2"Ø NO.	H1 - 1/2"Ø LGTH.	V1 - 1/2"Ø NO.	V1 - 1/2"Ø LGTH.	V2 - 1/2"Ø NO.	V2 - 1/2"Ø LGTH.	CLASS "A" CONC., C.Y.	REINF. STEEL, LBS.
48"	12.57	5"	5'-5"	3'-2"	6'-4"	5'-3 1/2"	3'-9"	7	3'-5"	4	9'-0" AV.	7	6'-0"	5	1'-6"	8	5'-8"	12	6'-6" AV.	4	10'-5"	3.81	184
54"	15.90	5 1/2"	5'-11 1/2"	3'-6"	6'-10"	5'-10 1/2"	4'-2"	7	3'-10"	5	9'-11" AV.	7	6'-6"	5	1'-6"	8	6'-3"	14	6'-11" AV.	4	11'-0"	4.54	214
60"	19.63	6"	6'-6"	3'-10"	7'-4"	6'-5 1/2"	4'-7"	8	4'-3"	5	10'-10" AV.	7	7'-0"	6	1'-6"	10	6'-10"	16	7'-4" AV.	4	11'-7"	5.33	253
66"	23.76	6 1/2"	7'-0 1/2"	4'-2"	7'-10"	7'-1"	5'-0"	8	4'-8"	5	11'-9" AV.	7	7'-6"	6	1'-6"	10	7'-5"	18	7'-9" AV.	4	12'-2"	6.20	281
72"	28.27	7"	7'-7"	4'-6"	8'-4"	7'-9 1/2"	5'-6"	9	5'-2"	6	12'-9" AV.	7	8'-0"	6	1'-6"	10	8'-2"	20	8'-3" AV.	4	12'-9"	7.22	325

* FOR ONE HEADWALL

NOTE:
ALL EXPOSED CONCRETE EDGES SHALL HAVE A 3/4" CHAMFER

STANDARD CONCRETE HEADWALLS
FOR
48" TO 72" PIPE

REVISION	BY	DATE

City of **stillwater**
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

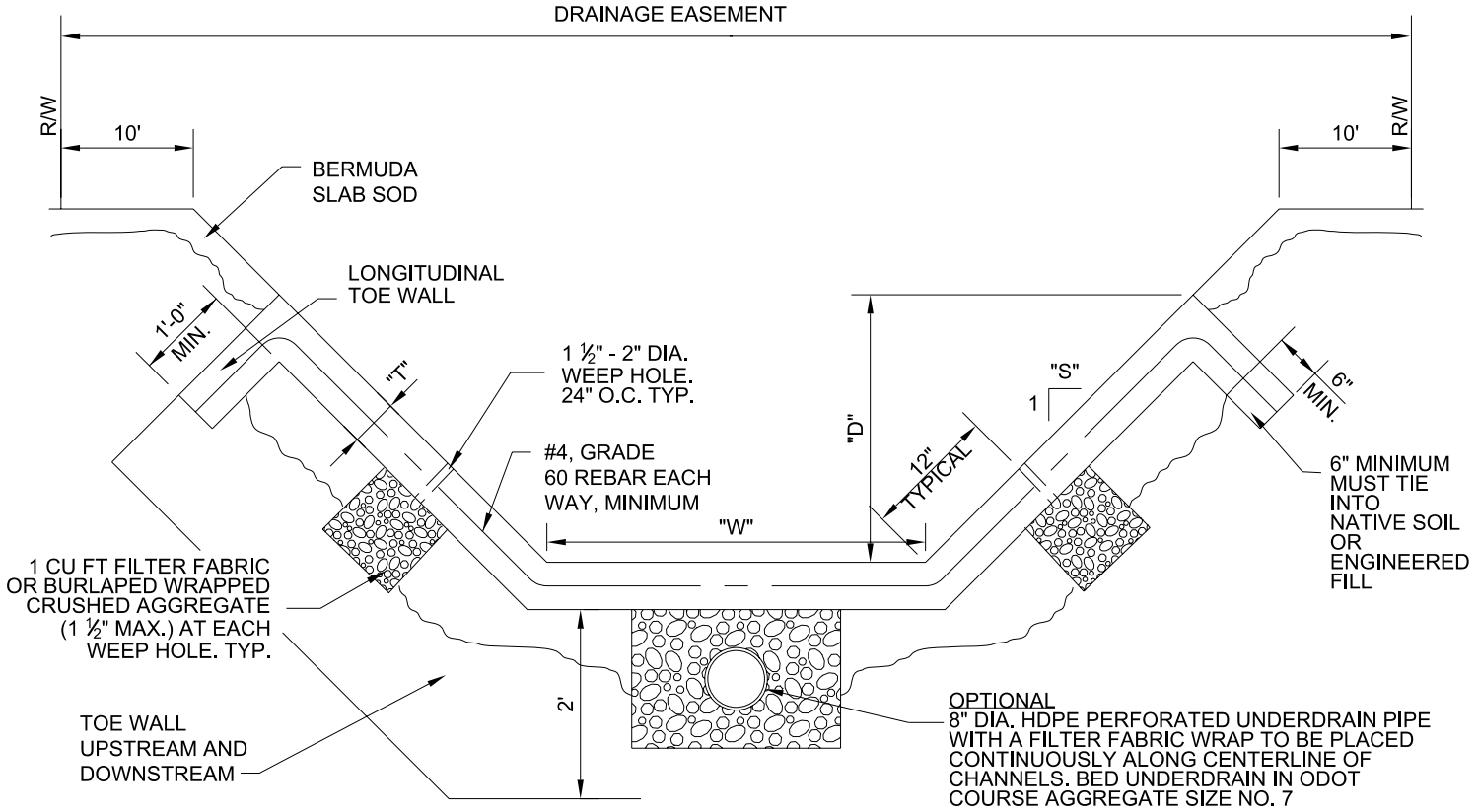
STORM SEWER HEADWALL SHEET II

STANDARD DETAILS

DATE: OCTOBER 2010

STANDARD NO. 3813

DRAFT STANDARD DETAIL



SECTION

* REMOVE UNSUITABLE MATERIALS AND BACKFILL TO FINISHED SUBGRADE WITH COMPACTED STRUCTURAL FILL (95% COMPACTION) OR CLASS "B" BEDDING MATERIAL.

NOTES:
1. 3500 P.S.I. CONCRETE WITH SLUMP < 3".
2. "W", "D", "T", AND "S" TO BE SHOWN ON THE PLAN.
3. FOR WALLS GREATER THAN 4FT, WITH SLOPES LESS THAN 3:1 OR WHERE VEHICLE OR SOIL SURCHARGES OCCUR, DESIGN SHALL BE BY AN ENGINEER.
4. SEALED SAW CUT JOINTS @ 15' C/C.
5. SEALED 3/4" EXPANSION JOINTS @ 60' C/C.
6. TWO FEET (2') DEEP TOE WALL TO BE CONSTRUCTED AT EACH END.
7. EXTEND REINFORCING STEEL INTO TOP WALL AND TOE WALL.
8. WHERE REQUIRED ENERGY DISSIPATORS WILL BE CONSTRUCTED AS PART OF THE CHANNEL.
9. PERIODIC OUTLET POINTS FOR DRAIN SHALL BE BY DESIGN BY ENGINEER, BASE ON LENGTH OF RUN, FLOW AND WATER TABLE CONDITIONS.
10. UNUSUAL SOIL CONDITIONS SHALL BE DESIGNED TO BE ACCOMMODATED BY ENGINEER.

REVISION	BY	DATE

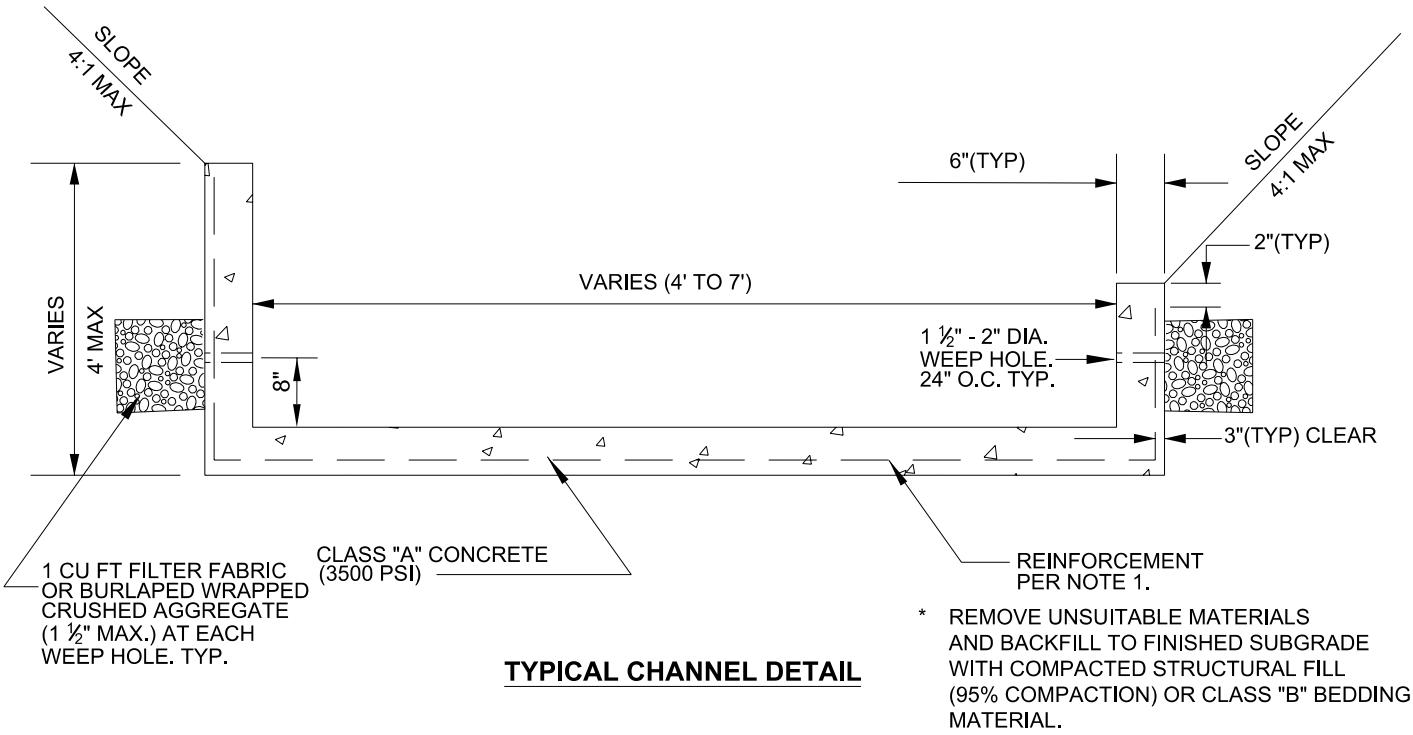
City of **stillwater**

CONCRETE SLOPE-WALL CHANNEL WITH UNDERDRAIN

STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3814



TYPICAL CHANNEL DETAIL

* REMOVE UNSUITABLE MATERIALS AND BACKFILL TO FINISHED SUBGRADE WITH COMPACTED STRUCTURAL FILL (95% COMPACTION) OR CLASS "B" BEDDING MATERIAL.

NOTES:

1. USE #4, GRADE 60 REBAR @ 12" ON CENTER EACH WAY ON FLOOR AND WALLS
2. 3500 PSI CONCRETE 3" SLUMP
3. SEE CROSS SECTIONS FOR PROPOSED CHANNEL ALIGNMENT
4. CONSTRUCTION TO COMPLY TO LOCAL, STATE, AND FEDERAL LAWS.
5. CHANNEL WALLS GREATER THAN 4' IN HEIGHT SHALL BE DESIGNED BY AN ENGINEER.
6. WHERE BACKFILL AGAINST THE WALL EXCEEDS A SIDE SLOPE OF 4:1 OR WHERE SURCHARGE LOADS ARE APPLIED, DESIGN BY AN ENGINEER IS REQUIRED.
7. PROVIDE EXPANSION JOINTS IN WALLS AND SLAB EVERY 60', CONTRACTION JOINTS EVERY 15'.

REVISION	BY	DATE

City of **stillwater**

CONCRETE RECTANGLE CHANNEL, TYPE B

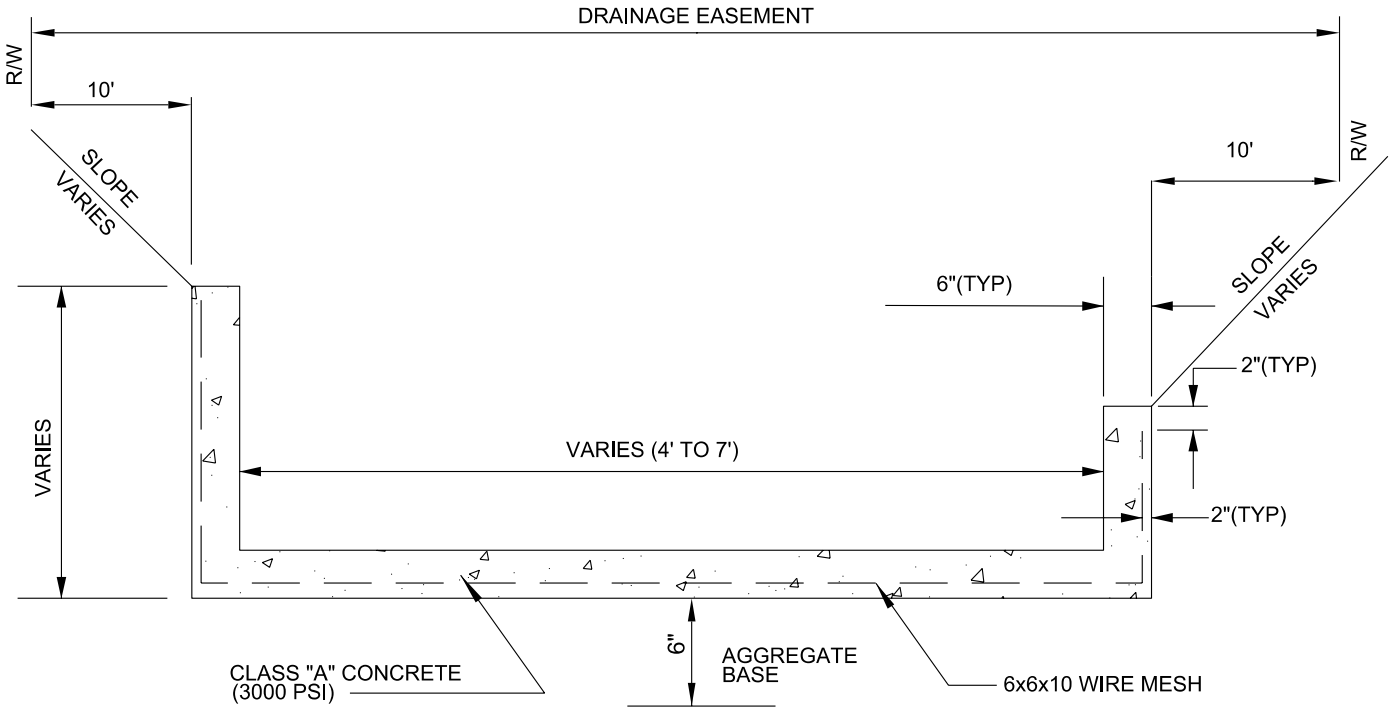
STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3815

DRAFT STANDARD

NOTE:
USE #4 REBAR TO REINFORCE WALL IF OVER
1'-0" IN HEIGHT.



TYPICAL CHANNEL DETAIL

NOTES:

1. SEE CROSS SECTIONS FOR PROPOSED CHANNEL ALIGNMENT
2. CONSTRUCTION TO COMPLY TO LOCAL, STATE, AND FEDERAL LAWS.

REVISION	BY	DATE

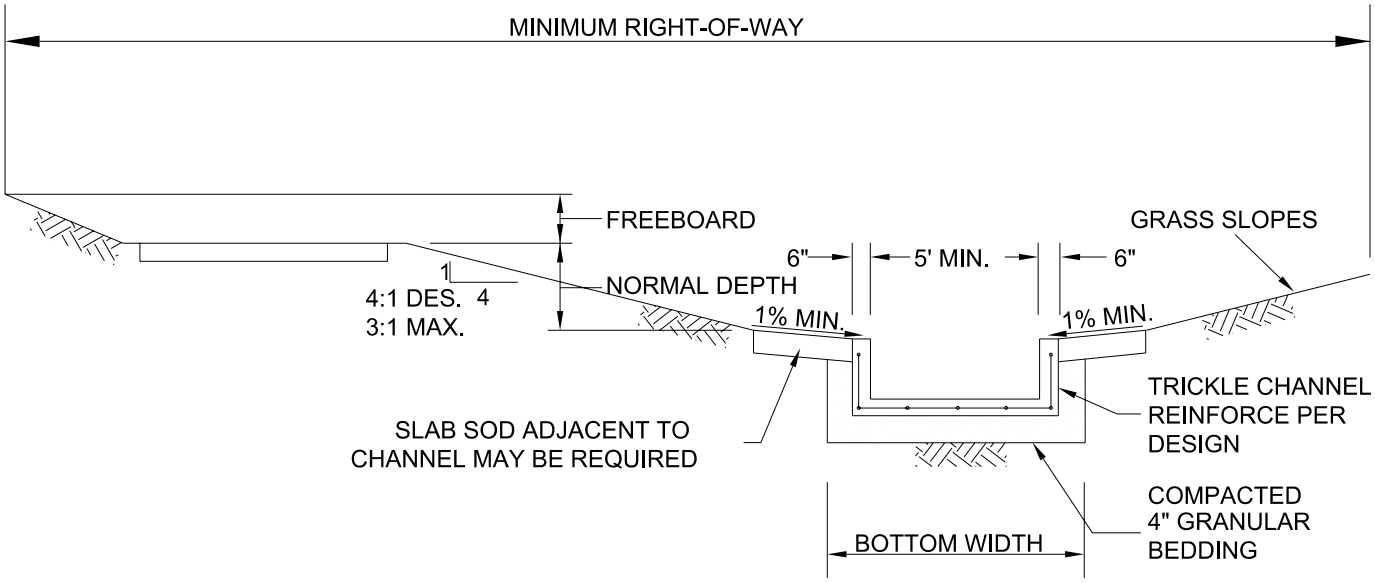
City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CONCRETE "U" CHANNEL

STANDARD DETAILS

DATE: OCTOBER 2010

STANDARD NO. 3815



SECTION

NOTES:

1. BOTTOM WIDTH CONSISTENT WITH MAXIMUM ALLOWABLE DEPTH AND VELOCITY REQUIREMENTS, BUT SHALL NOT BE LESS THAN TRICKLE CHANNEL WIDTH.
2. TRICKLE CHANNEL: MAXIMUM CAPACITY TO BE 1% TO 3% OF 100 YEAR FLOW, BUT NOT LESS THAN 1 CFS. CHANNEL TO BE CONSTRUCTED OF CONCRETE OR OTHER APPROVED MATERIALS.
3. FREEBOARD TO BE 1'-0" MINIMUM.
4. MAXIMUM SIDE SLOPE FOR GRASS-LINED CHANNELS TO BE 3:1.
5. MAXIMUM FLOW VELOCITY TO BE 6 FPS FOR EROSION RESISTANT SOILS.
6. MINIMUM WIDTH OF R/W TO INCLUDE FREEBOARD.

REVISION	BY	DATE

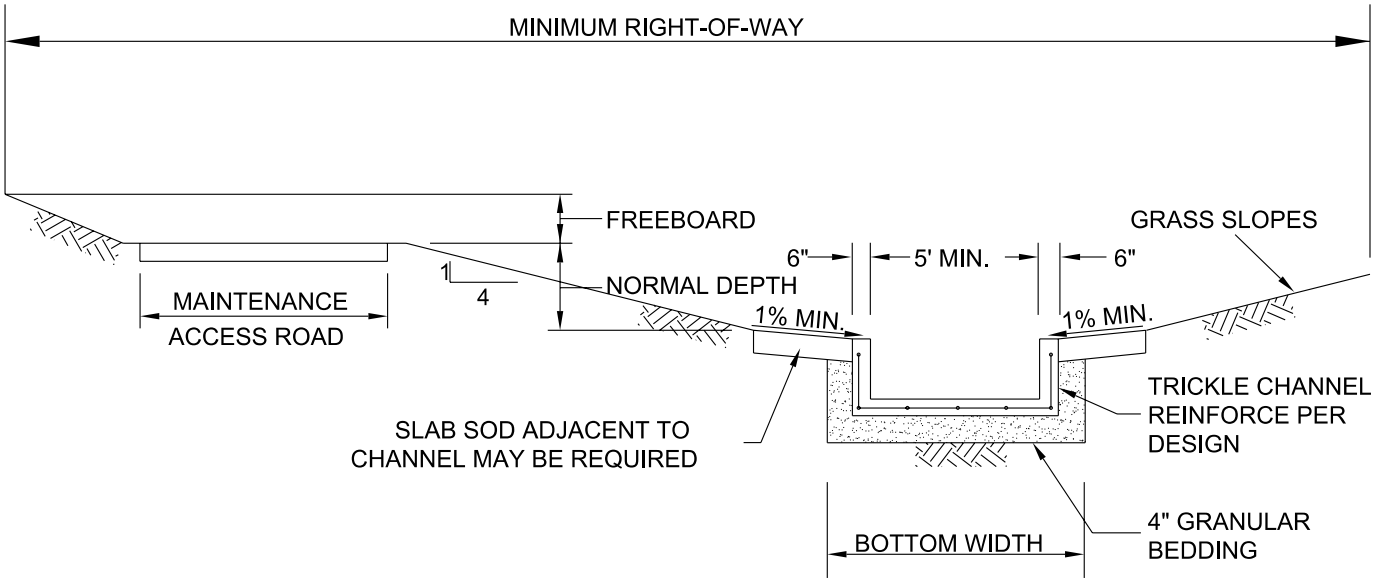
City of **stillwater**

CONCRETE RECTANGLE CHANNEL, TYPE A

STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3816



SECTION

NOTES:

1. BOTTOM WIDTH CONSISTENT WITH MAXIMUM ALLOWABLE DEPTH AND VELOCITY REQUIREMENTS, BUT SHALL NOT BE LESS THAN TRICKLE CHANNEL WIDTH.
2. TRICKLE CHANNEL: MAXIMUM CAPACITY TO BE 1% TO 3% OF 100 YEAR FLOW, BUT NOT LESS THAN 1 CFS. CHANNEL TO BE CONSTRUCTED OF CONCRETE OR OTHER APPROVED MATERIALS.
3. FREEBOARD: FREEBOARD TO BE 1' MINIMUM.
4. MAINTENANCE/ACCESS ROAD: MINIMUM WIDTH TO 10'.
5. R/W WIDTH: MINIMUM WIDTH TO INCLUDE FREEBOARD AND MAINTENANCE ACCESS ROAD.
6. CHANNEL SIDE SLOPE: MAXIMUM SIDE SLOPE FOR GRASS-LINED CHANNELS TO BE 4:1.
7. THE MAXIMUM FLOW VELOCITY TO BE 7 FPS. FOR EROSION RESISTANT SOILS OR 5 FPS. FOR SANDY SOILS.

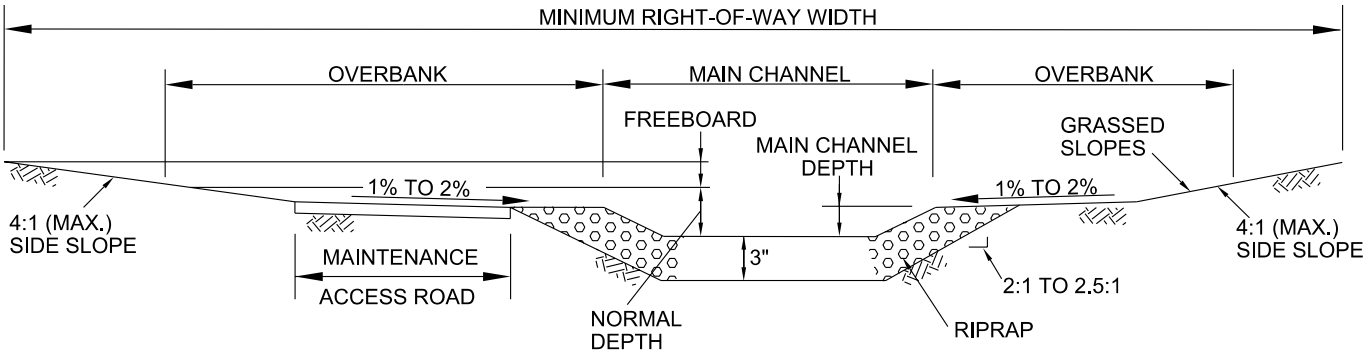
REVISION	BY	DATE

City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

GRASS LINED CHANNEL, TYPE A

STANDARD DETAILS

DATE: OCTOBER 2010 | STANDARD NO. 3816



SECTION

NOTES:

1. THIS SECTION IS REQUIRED FOR CHANNELS WITH SANDY SOILS.
2. MAIN CHANNEL: CAPACITY TO BE FROM 2 YEAR TO THE 5 YEAR. MAXIMUM 100 YEAR FLOW VELOCITY IS 5 FPS. PROTECT SLOPES WITH RIPRAP. USE A MANNINGS N VALUE OF 0.03 FOR HYDRAULIC CALCULATIONS.
3. NORMAL DEPTH: FLOW DEPTH FOR 100 YEAR FLOW SHALL NOT EXCEED 5', NOT INCLUDING THE MAIN CHANNEL DEPTH.
4. FREEBOARD: FREEBOARD TO BE A MINIMUM OF 1'.
5. MAINTENANCE/ACCESS ROADS: MINIMUM WIDTH TO BE 10'. COUNTY MAY REQUIRE ALL OR PART OF THE ROAD TO BE SURFACED.
6. R/W WIDTH: MINIMUM WIDTH TO INCLUDE FREEBOARD AND MAINTENANCE/ACCESS ROAD.
7. OVERBANK: FLOW IN EXCESS OF MAIN CHANNEL TO BE CARRIED IN THIS AREA. AREA MAY BE USED FOR RECREATIONAL PURPOSES.

REVISION	BY	DATE

City of stillwater

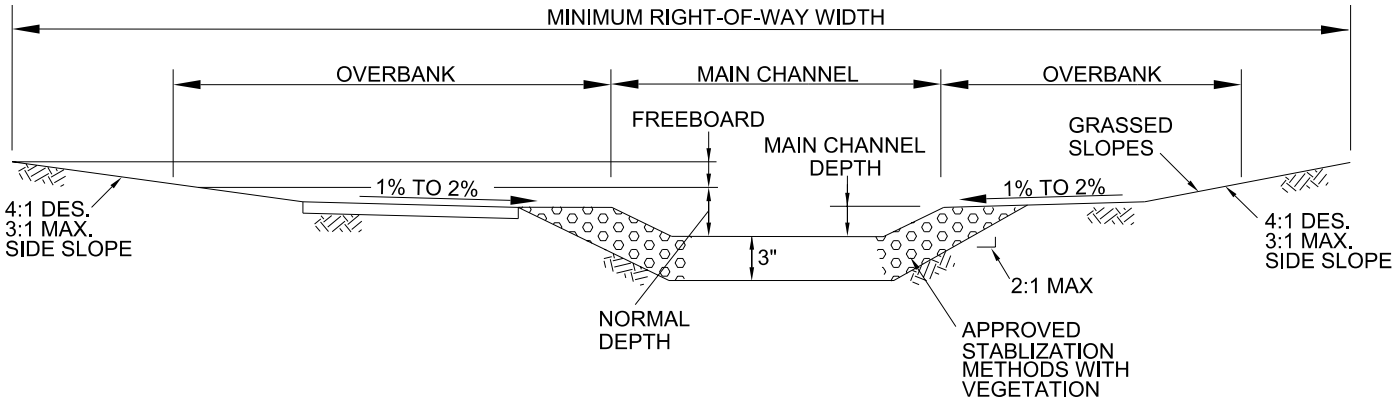
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

GRASS LINED CHANNEL, TYPE B

STANDARD DETAILS

DATE: OCTOBER 2010

STANDARD NO. 3817



SECTION

NOTES:

1. THIS SECTION IS REQUIRED FOR CHANNELS WITH SANDY SOILS.
2. MAIN CHANNEL CAPACITY TO BE THE 5 YEAR STORM.
   PROTECT SLOPES WITH APPROVED STABLIZATION METHOD.
3. NORMAL DEPTH FOR 100 YEAR FLOW SHALL NOT EXCEED 5'.
4. FREEBOARD TO BE A MINIMUM OF 1'.
5. MINIMUM WIDTH OF R/W TO INCLUDE FREEBOARD.
6. 4:1 SLOPE WILL BE ACHIEVED WHENEVER POSSIBLE

REVISION	BY	DATE

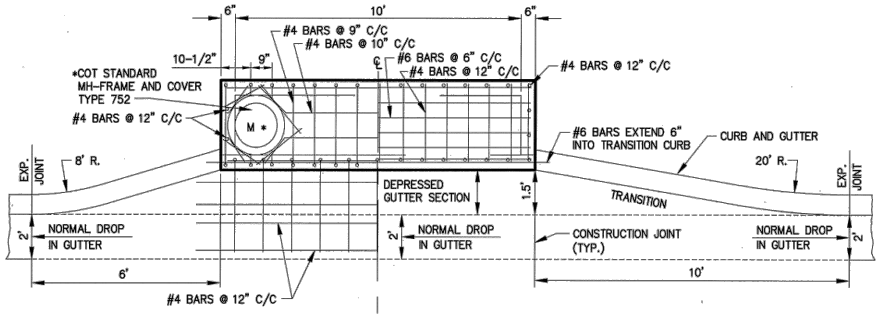
City of **stillwater**

GRASS LINED CHANNEL

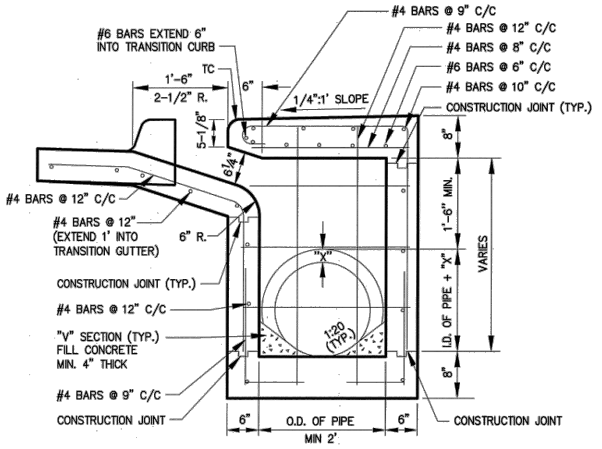
STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3817

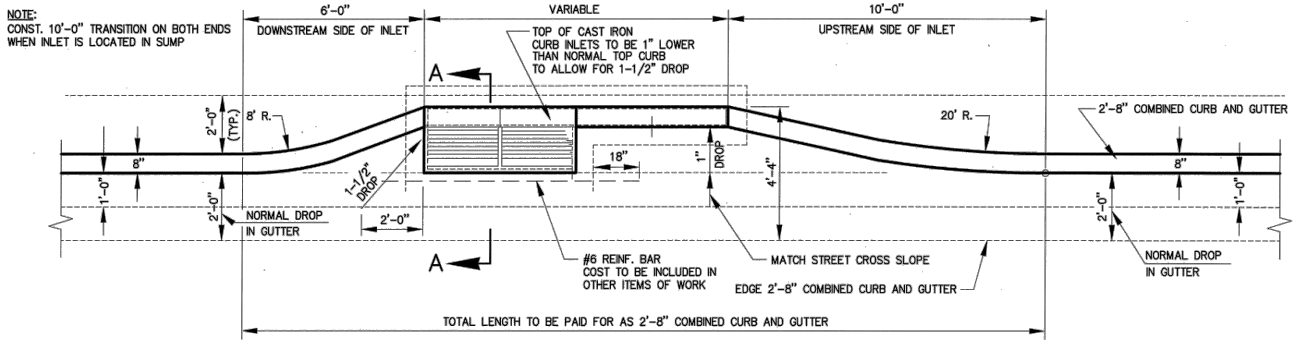


PLAN – SECTION



ELEVATION – SECTION A–A

RECESSED CURB INLET



CURB TURNOUT FOR RECESSED CAST IRON CURB INLET

NOTE:
1. THE CONTRACTOR MAY PROPOSE ALTERNATE PROCEDURES UNITS. PLANS FOR SUCH PROPOSED ALTERNATES SHALL BE FOR THE CONSTRUCTION OF INLETS, INCLUDING PRECAST SUBMITTED TO THE ENGINEER FOR REVIEW AND APPROVAL BEFORE CONSTRUCTION.
2. REINFORCING STEEL SHALL CONFORM TO STANDARD SPECIFICATIONS FOR "REINFORCING STEEL."
3. INLET WILL BE PAID FOR AS "EACH."

Detail No. 3820

Issued: 8/02/2021

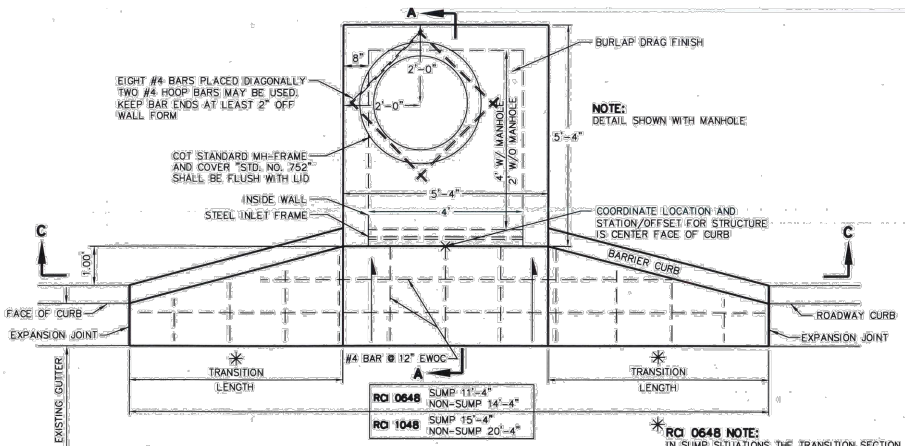
Adopted: 8/02/2021

The City of Stillwater OKLAHOMA

Standard Recessed Curb Inlet

CITY OF STILLWATER STANDARDS

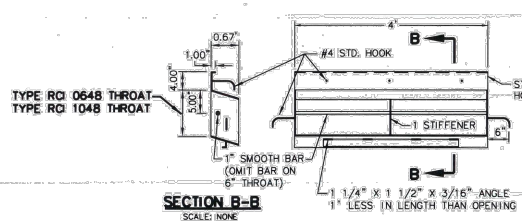
REV	DATE	DESCRIPTION	BY



RCI PLAN VIEW
SCALE: NONE

RCI 0648 NOTE:
IN SUMP SITUATIONS THE TRANSITION SECTION BOTH U/S AND D/S SHALL BE 3 FEET. IN NON-SUMP SITUATIONS THE D/S TRANSITION SECTION SHALL BE 3 FEET WHERE AS THE U/S TRANSITION SECTION SHALL BE 6 FEET.

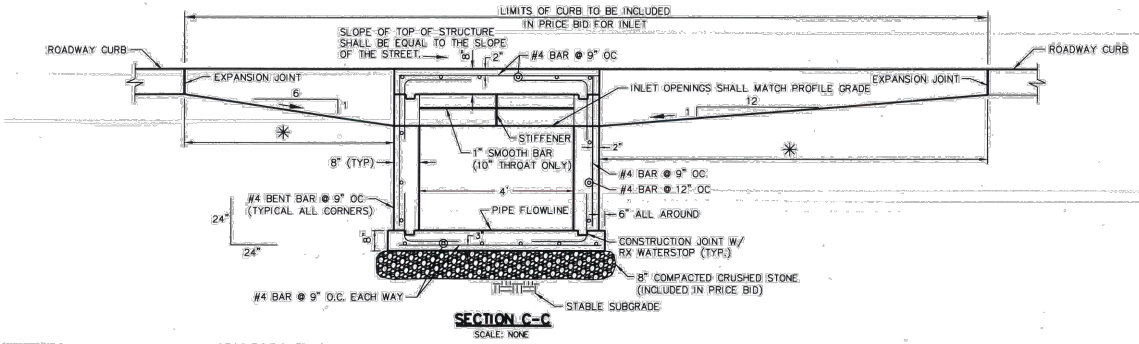
RCI 1048 NOTE:
IN SUMP SITUATIONS THE TRANSITION SECTION BOTH U/S AND D/S SHALL BE 5 FEET. IN NON-SUMP SITUATIONS THE D/S TRANSITION SECTION SHALL BE 5 FEET WHERE AS THE U/S TRANSITION SECTION SHALL BE 10 FEET.



SECTION B-B
SCALE: NONE

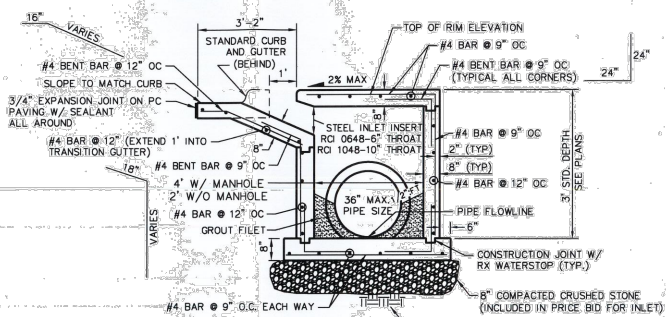
FRONT VIEW
STEEL INLET INSERT DETAIL
SCALE: NONE

STEEL INLET FRAME NOTES
1. STEEL INLET INSERT SHALL BE AS MANUFACTURED BY SHAWNEE STEEL & WELDING, INC. OF MERIAM, KS. OR APPROVED EQUAL. REFER TO THE STEEL INLET INSERT DETAIL.
2. COST OF INLET INSERT SHALL BE INCLUDED IN THE PRICE BID FOR INLET.
3. ALL WELDS SHALL BE PERFORMED IN ACCORDANCE WITH APPROPRIATE AWS SPECIFICATIONS AND PROCEDURES.
4. ALL STEEL SHALL BE 7 GAGE OR 3/16" THICK.
5. ALL WELDS ON EXPOSED SURFACES SHALL BE DRESSED SO AS TO PROVIDE A PLEASING FINISHED APPEARANCE.
6. THE ENTIRE FRAME SHALL BE HOT DIP ZINC COATED IN ACCORDANCE WITH ASTM A-123.



SECTION C-C
SCALE: NONE

CAST IN PLACE CONCRETE NOTES
1. ALL CONCRETE SHALL BE CLASS A, AS DESIGNATED IN SECTION 509 OF THE ODOT SPECIFICATIONS, LATEST EDITION.
2. ALL EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 3/4" UNLESS OTHERWISE NOTED.
3. CLEAR DISTANCES FROM CAST-IN-PLACE CONCRETE SURFACES TO REINFORCING SHALL BE 2" FOR WALLS, 1-1/2" FOR SUPPORTED SLABS, 3" FROM THE BOTTOM OF FOOTINGS AND 2" FROM THE TOP OF SLABS, UNLESS OTHERWISE NOTED.
4. REINFORCING STEEL SHALL MEET ASTM SPECIFICATION A615, GRADE 60.
5. ALL BARS SHALL LAP A MINIMUM OF 30 BAR DIAMETERS OR 18", WHICHEVER IS GREATER, UNLESS OTHERWISE NOTED BY THE ENGINEER.
6. ALL EXPOSED CAST IN PLACE CONCRETE SURFACES SHALL HAVE ALL VOIDS FILLED, BURRS AND FINS REMOVED.
7. ALL JOINTS SHALL BE SEALED WITH AN APPROVED SILICONE SEALANT.
8. MINIMUM CONCRETE COVER OF REINFORCING STEEL SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE STANDARD OR BE 2" FOR EXTERIOR WALL STEEL OR 3" FOR THE BOTTOM FLOOR STEEL.



SECTION A-A
SCALE: NONE

NOTE:
RCI STRUCTURES W/O MANHOLES SHOULD BE LIMITED TO CASES WHERE A SINGLE INLET IS EXTENDED BEYOND A JUNCTION BOX.

BASIS OF PAYMENT		
ITEM NO.	ITEM	UNIT
611.06 (G)	INLET, TYPE "RCI 0648 & RCI 1048"	EA.
611.06 (H)	ADDITIONAL DEPTH IN INLET TYPE "RCI 0648 & RCI 1048"	V.F.

NOTE:
DETAIL SHOWN WITH MANHOLE

RCI 0648 (6" THROAT)

	SUMP W/ MANHOLE		SUMP W/O MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/O MANHOLE	
	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.
STD. DEPTH 3'	3.1	290	2.3	215	3.3	299	2.6	225
ADD. VERT. FT.	1	31	.7	24	1	31	.7	24

RCI 1048 (10" THROAT)

	SUMP W/ MANHOLE		SUMP W/O MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/O MANHOLE	
	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.
STD. DEPTH 3'	3.5	295	2.6	221	3.7	307	2.8	236
ADD. VERT. FT.	1	31	.7	24	1	31	.7	24

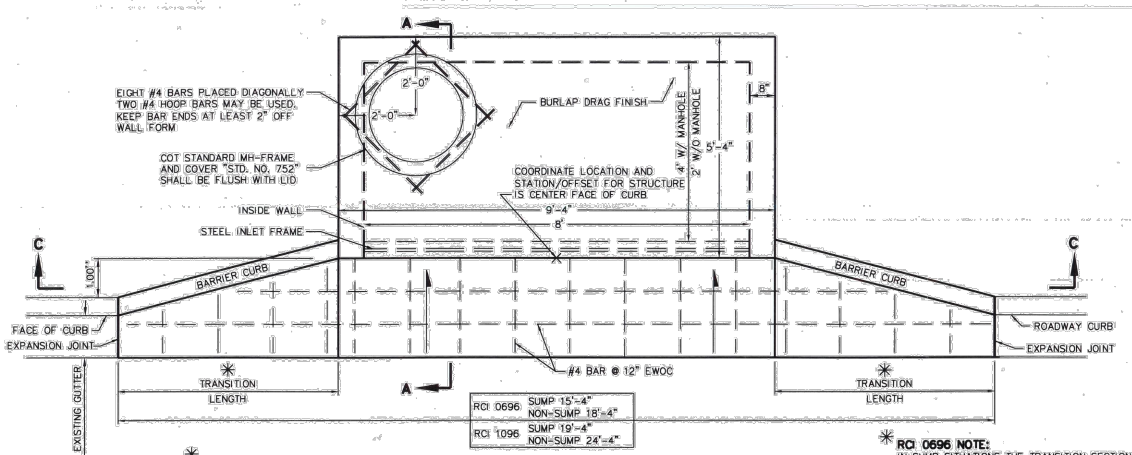
Detail No. 3821A
Issued: 8/02/2021
Adopted: 8/02/2021

The City of Stillwater OKLAHOMA

Recessed Curb Inlet Details

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

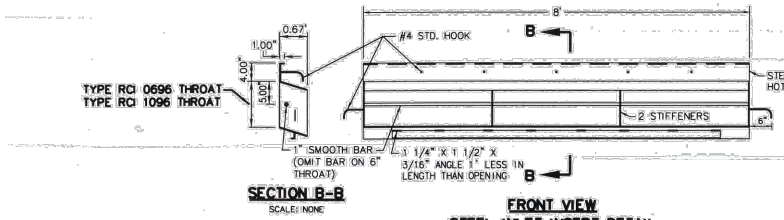


RCI PLAN VIEW

SCALE: NONE

RCI 0696 NOTE:
IN SUMP SITUATIONS THE TRANSITION SECTION BOTH U/S AND D/S SHALL BE 3 FEET. IN NON-SUMP SITUATIONS THE D/S TRANSITION SECTION SHALL BE 3 FEET WHERE AS THE U/S TRANSITION SECTION SHALL BE 6 FEET.

RCI 1096 NOTE:
IN SUMP SITUATIONS THE TRANSITION SECTION BOTH U/S AND D/S SHALL BE 5 FEET. IN NON-SUMP SITUATIONS THE D/S TRANSITION SECTION SHALL BE 5 FEET WHERE AS THE U/S TRANSITION SECTION SHALL BE 10 FEET.



SECTION B-B

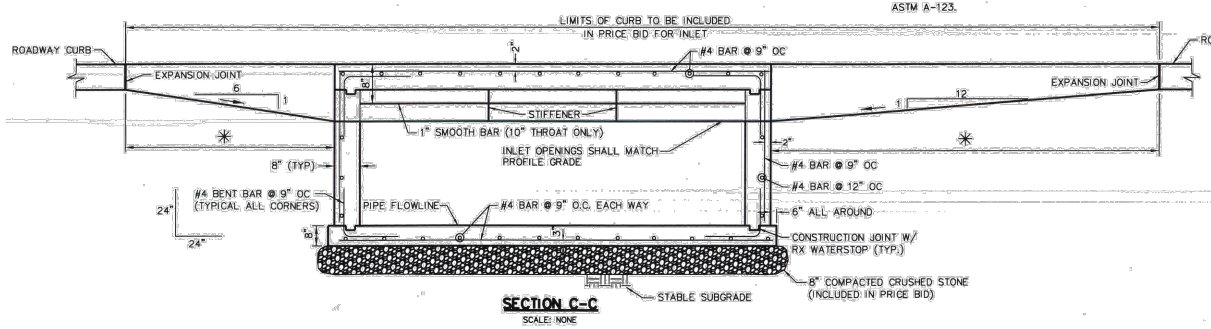
SCALE: NONE

FRONT VIEW STEEL INLET INSERT DETAIL

SCALE: NONE

STEEL INLET FRAME NOTES

1. STEEL INLET INSERT SHALL BE AS MANUFACTURED BY SHAWNEE STEEL & WELDING, INC. OF MERIAM, KS. OR APPROVED EQUAL. REFER TO THE STEEL INLET INSERT DETAIL.
2. COST OF INLET INSERT SHALL BE INCLUDED IN THE PRICE BID FOR INLET.
3. ALL WELDS SHALL BE PERFORMED IN ACCORDANCE WITH APPROPRIATE AWS SPECIFICATIONS AND PROCEDURES.
4. ALL STEEL SHALL BE 7 GAGE OR 3/16" THICK.
5. ALL WELDS ON EXPOSED SURFACES SHALL BE DRESSED SO AS TO PROVIDE A PLEASING FINISHED APPEARANCE.
6. THE ENTIRE FRAME SHALL BE HOT DIP ZINC COATED IN ACCORDANCE WITH ASTM A-123.

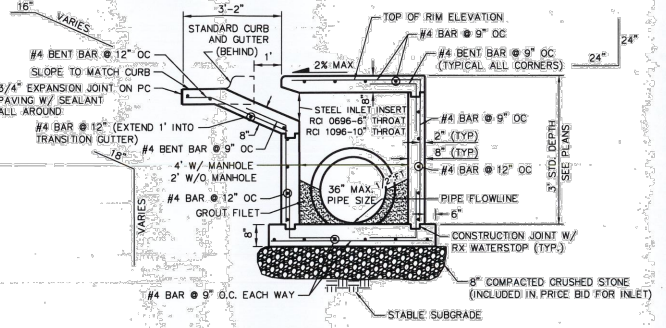


SECTION C-C

SCALE: NONE

CAST IN PLACE CONCRETE NOTES

1. ALL CONCRETE SHALL BE CLASS A, AS DESIGNATED IN SECTION 509 OF THE ODOT SPECIFICATIONS, LATEST EDITION.
2. ALL EXPOSED EDGES OF CONCRETE SHALL BE CHAMFERED 3/4" UNLESS OTHERWISE NOTED.
3. CLEAR DISTANCES FROM CAST-IN-PLACE CONCRETE SURFACES TO REINFORCING SHALL BE 2" FOR WALLS, 1-1/2" FOR SUPPORTED SLABS, 3" FROM THE BOTTOM OF FOOTINGS AND 2" FROM THE TOP OF SLABS, UNLESS OTHERWISE NOTED.
4. REINFORCING STEEL SHALL MEET ASTM SPECIFICATION A615, GRADE 60.
5. ALL BARS SHALL LAP A MINIMUM OF 30 BAR DIAMETERS OR 18", WHICHEVER IS GREATER, UNLESS OTHERWISE NOTED BY THE ENGINEER.
6. ALL EXPOSED CAST IN PLACE CONCRETE SURFACES SHALL HAVE ALL VOIDS FILLED, BURRS AND FINS REMOVED.
7. ALL JOINTS SHALL BE SEALED WITH AN APPROVED SILICONE SEALANT.
8. MINIMUM CONCRETE COVER OF REINFORCING STEEL SHALL CONFORM TO AMERICAN CONCRETE INSTITUTE STANDARD OR BE 2" FOR EXTERIOR WALL STEEL OR 3" FOR THE BOTTOM FLOOR STEEL.



SECTION A-A

SCALE: NONE

NOTE:
RCI STRUCTURES W/O MANHOLES SHOULD BE LIMITED TO CASES WHERE A SINGLE INLET IS EXTENDED BEYOND A JUNCTION BOX.

BASIS OF PAYMENT

ITEM NO.	ITEM	UNIT
611.06 (G)	INLET, TYPE "RCI 0696 & RCI 1096"	EA.
611.06 (H)	ADDITIONAL DEPTH IN INLET TYPE "RCI 0696 & RCI 1096"	V.F.

NOTE:
DETAIL SHOWN WITH MANHOLE

RCI 0696 (6" THROAT)

	SUMP W/ MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/O MANHOLE	
	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.
STD. DEPTH 3'	5.3	451	4	268	5.6	457	4.2	275
ADD. VERT. FT.	1.3	45	.8	38	1.3	45	.8	38

RCI 1096 (10" THROAT)

	SUMP W/ MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/ MANHOLE		NO SUMP W/O MANHOLE	
	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.	CONC. CY	STL. LBS.
STD. DEPTH 3'	5.7	464	4.3	281	6.1	477	4.7	295
ADD. VERT. FT.	1.3	45	.8	38	1.3	45	.8	38

Detail No. 3821B

Issued: 8/02/2021

Adopted: 8/02/2021

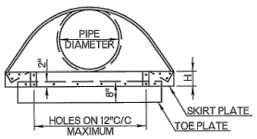
The City of Stillwater OKLAHOMA

Recessed Curb Inlet Details

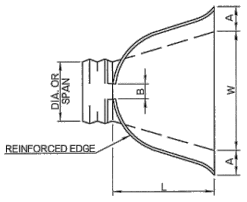
CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

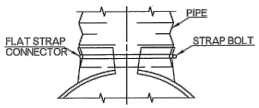
DIMENSIONS OF END SECTIONS FOR ROUND METAL PIPE								
PIPE DIA.	GA.	A	B	H	L	W	APPROX. SLOPE	BODY TYPE
12"	16	6"	8"	6"	21"	24"	1:2 1/2	1 PC.
15"	16	7"	8"	6"	26"	30"	1:2 1/2	1 PC.
18"	16	8"	10"	6"	31"	36"	1:2 1/2	1 PC.
21"	16	9"	12"	6"	36"	42"	1:2 1/2	1 PC.
24"	16	10"	13"	6"	41"	48"	1:2 1/2	1 PC.
30"	14	12"	16"	8"	51"	60"	1:2 1/2	1 PC.
36"	14	14"	19"	9"	60"	72"	1:2 1/2	2 PC.
42"	12	16"	22"	11"	69"	84"	1:2 1/2	2 PC.
48"	12	18"	27"	12"	78"	90"	1:2 1/4	2 PC.
54"	12	18"	30"	12"	84"	102"	1:2	2 PC.
60"	12	18"	33"	12"	87"	114"	1:1 3/4	3 PC.
66"	12	18"	36"	12"	87"	120"	1:1 1/2	3 PC.
72"	12	18"	39"	12"	87"	126"	1:1 1/3	3 PC.
78"	12	18"	42"	12"	87"	132"	1:1 1/4	3 PC.
84"	12	18"	45"	12"	87"	138"	1:1 1/6	3 PC.



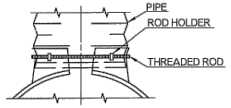
ROUND METAL PIPE END SECTION
END VIEW



METAL END SECTION
PLAN VIEW

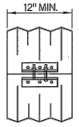


TYPE 1
FOR 12" TO 24" ROUND AND EQUIVALENT ROUND PIPE ARCH SIZES.

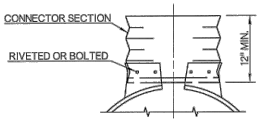


TYPE 2
FOR 30" TO 36" ROUND AND 30" TO 48" EQUIVALENT ROUND PIPE - ARCH SIZES.

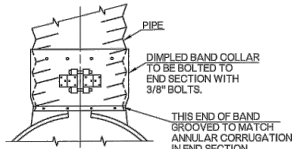
COUPLING BAND



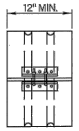
STANDARD COUPLING BAND



TYPE 3
FOR 42" TO 84" ROUND AND 54" TO 72" EQUIVALENT ROUND PIPE - ARCH SIZES.



TYPE 4
FOR USE WITH ALL ROUND AND PIPE ARCH SIZES.

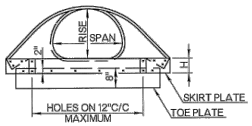


DIMPLED COUPLING BAND

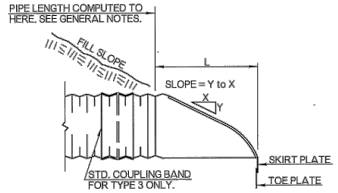
TYPICAL METAL END SECTION CONNECTIONS

DIMENSIONS OF END SECTIONS FOR METAL PIPE - ARCH								
SPAN x RISE	EQUIV. ROUND	GA.	A	B	H	L	W	APPROX. SLOPE	BODY TYPE
17" x 13"	15"	16	7"	9"	6"	19"	30"	1:2 1/2	1 PC.
21" x 15"	18"	16	7"	10"	6"	23"	36"	1:2 1/2	1 PC.
24" x 18"	21"	16	8"	12"	6"	28"	42"	1:2 1/2	1 PC.
28" x 20"	24"	#16	9"	14"	6"	32"	48"	1:2 1/2	1 PC.
35" x 24"	30"	14	10"	16"	8"	39"	60"	1:2 1/2	1 PC.
42" x 29"	36"	#14	12"	18"	8"	46"	75"	1:2 1/2	1 PC.
49" x 33"	42"	12	13"	21"	9"	53"	85"	1:2 1/2	2 PC.
57" x 38"	48"	12	18"	26"	12"	63"	90"	1:2 1/2	2 PC.
64" x 43"	54"	12	18"	30"	12"	70"	102"	1:2 1/4	2 PC.
71" x 47"	60"	12	18"	33"	12"	77"	114"	1:2 1/4	3 PC.
77" x 52"	66"	12	18"	36"	12"	77"	126"	1:2	3 PC.
83" x 57"	72"	12	18"	39"	12"	77"	138"	1:2	3 PC.

FOR ALUMINUM END SECTIONS THE 28" x 20" SHALL BE 14 GAGE AND THE 42" x 29" SHALL BE 12 GAGE.



ARCH METAL PIPE END SECTION
END VIEW

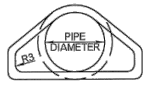


METAL END SECTION
SIDE VIEW

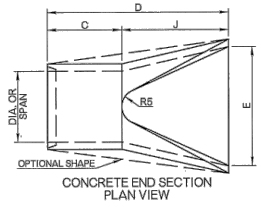
GENERAL NOTES

1. ALL CONSTRUCTION AND MATERIAL REQUIREMENTS SHALL BE IN ACCORDANCE WITH THE 2009 ODOT STANDARD SPECIFICATIONS.
2. CULVERT END SECTIONS SHALL BE OF THE SAME MATERIAL AND SHAPE (ROUND, ARCH, OR ELLIPTICAL) AS THE PIPE ON WHICH THEY ARE INSTALLED.
3. DIMENSIONS SHOWN FOR END SECTIONS ARE SUBJECT TO MANUFACTURER TOLERANCES.
4. TOE PLATE WILL BE REQUIRED ON ALL METAL END SECTIONS UNLESS SOLID ROCK IS ENCOUNTERED. HOLES IN TOE PLATE TO BE PUNCHED TO MATCH HOLES IN SKIRT PLATE, 3/8" BOLTS TO BE FURNISHED. LENGTH OF TOE PLATES FOR ROUND PIPE END SECTIONS SHALL BE W=10" FOR 12" TO 30" DIAMETER PIPE. W=20" FOR 36" TO 84" DIAMETER PIPE. LENGTH OF TOE PLATES FOR ARCH PIPE END SECTIONS SHALL BE W=10" FOR A RISE OF 13" TO 29" AND W=20" FOR A RISE OF 33" TO 57".
5. CONNECTOR SECTION, SKIRT PLATE, AND TOE PLATE ON METAL END SECTIONS SHALL BE THE SAME GAGE AND MATERIAL AS THE SKIRT AND SHALL BE INCLUDED IN PRICE BID FOR END SECTION.
6. IF TYPE 3 METAL END SECTION IS USED AS OPTIONAL PIPE, THE LENGTH OF PIPE TO BE REDUCED BY 12" FOR EACH END SECTION. IF CONCRETE PIPE OPTION IS USED, THE LENGTH OF PIPE TO BE REDUCED BY THE C DIMENSION FOR EACH END SECTION.

DIMENSIONS OF PRECAST END SECTIONS FOR ROUND PIPE										
DIAMETER	R3	R4	R5	T	K	J	C	D	E	SLOPE
18"	3"	3"	6"	2 1/2"	9"	2.25'	3.83'	6.08'	3.00'	1:3
24"	3"	3"	7"	3"	9 1/2"	3.63'	2.50'	6.12'	4.00'	1:3
30"	3"	3"	8"	3 1/2"	12"	4.50'	1.65'	6.16'	5.00'	1:3
36"	3"	3"	10 1/2"	4"	15"	5.25'	2.90'	8.15'	6.00'	1:3
42"	3"	3"	10 1/2"	4 1/2"	21"	5.25'	2.92'	8.17'	6.50'	1:3
48"	6"	6"	14"	5"	24"	6.00'	2.17'	8.17'	7.00'	1:3
54"	6"	6"	-	5 1/2"	27"	5.42'	2.92'	8.33'	7.50'	1:2 1/2
60"	6"	6"	-	6"	30"	5.00'	3.25'	8.25'	8.00'	1:2
66"	6"	6"	-	6 1/2"	24"	6.50'	1.75'	8.25'	8.50'	1:2
72"	6"	6"	-	7"	24"	6.50'	1.75'	8.25'	9.00'	1:2

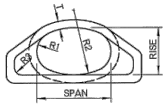


ROUND CONCRETE PIPE
END SECTION
END VIEW

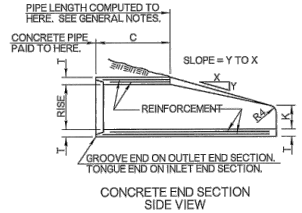


CONCRETE END SECTION
PLAN VIEW

APPROX. EQUIV. DIAMETER	DIMENSIONS OF PRECAST END SECTIONS FOR ELLIPTICAL PIPE													
	RISE	SPAN	R1	R2	R3	R4	R5	T	K	J	C	D	E	SLOPE
18"	14"	23"	6"	20"	3"	3"	6"	2 3/4"	8"	2.25'	3.75'	6.00'	3.00'	1:3
24"	19"	30"	8 1/4"	26 1/4"	3"	3"	7"	3 1/4"	8 1/2"	3.25'	2.75'	6.00'	4.00'	1:3
30"	24"	38"	10 1/4"	32 3/4"	3"	3"	9"	3 3/4"	9 1/2"	4.50'	1.50'	6.00'	5.00'	1:3
36"	29"	45"	12 1/4"	39 1/4"	3"	3"	12"	4 1/2"	11 1/4"	5.00'	3.00'	8.00'	6.00'	1:3
42"	34"	53"	14 1/2"	46"	6"	6"	13"	5"	15 3/4"	5.00'	3.00'	8.00'	6.50'	1:3
48"	38"	60"	16 1/2"	51 1/2"	6"	6"	14"	5 1/2"	21"	5.00'	3.00'	8.00'	7.00'	1:3
54"	43"	68"	18 3/4"	58 1/2"	6"	6"	16"	6"	25 1/2"	5.00'	3.00'	8.00'	7.50'	1:3
60"	48"	76"	20 3/4"	65"	6"	6"	36 11/16"	6 1/2"	30"	5.00'	3.25'	8.25'	8.00'	1:2
66"	53"	83"	22 3/4"	71 1/2"	6"	6"	36 1/8"	7 1/2"	24"	6.50'	1.75'	8.25'	8.50'	1:2
72"	58"	91"	24 3/4"	78"	6"	6"	38"	7 1/2"	24"	6.50'	1.75'	6.25'	9.00'	1:2



ELLIPTICAL CONCRETE PIPE
END SECTION
END VIEW

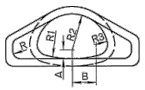


CONCRETE END SECTION
SIDE VIEW

BASIS OF PAYMENT		
ITEM NO.	ITEM	UNIT
613 (L)	▼ PREFAB. CULVERT END SECTION, ROUND	EA
613 (L)	▼ PREFAB. CULVERT END SECTION, ARCH	EA
613 (L)	▼ PREFAB. CULVERT END SECTION, ELLIPTICAL	EA

▼END SECTION DIMENSION(S) SHALL BE SPECIFIED.

APPROX. EQUIV. DIAMETER	DIMENSIONS OF PRECAST END SECTIONS FOR ARCH PIPE															
	SPAN	RISE	A	B	R	R1	R2	R3	R4	R5	T	K	J	C	D	E	SLOPE
18"	22"	13"	- 1/4"	5 3/4"	2"	27 1/2"	13 3/4"	5 1/4"	3"	13"	2 1/2"	7"	2.25'	3.75'	6.08'	3.00'	1:3
24"	28"	18"	3 7/16"	9 21/32"	3"	40 11/16"	14 9/16"	4 29/32"	3"	16 19/16"	3"	9 1/8"	3.58'	2.50'	6.08'	4.00'	1:3
30"	36"	22"	3 3/4"	12 3/32"	3"	51"	18 3/4"	6 1/32"	3"	18 1/2"	3 1/2"	12"	4.50'	1.58'	6.08'	5.00'	1:3
36"	43"	26"	4 1/8"	15 1/2"	6"	62"	22 1/2"	6 9/16"	3"	24 9/16"	4"	16"	5.25'	2.90'	8.15'	6.00'	1:3
42"	51"	31"	5 1/16"	18"	6"	73"	26 1/4"	7 9/16"	3"	27 1/2"	4 1/2"	21"	5.25'	2.92'	8.17'	6.50'	1:3
48"	58"	36"	6"	20 1/2"	6"	84"	30"	8 3/4"	3"	28 1/2"	5"	24"	6.00'	2.17'	8.17'	7.00'	1:3
54"	65"	40"	6 5/8"	22 11/16"	6"	92 1/2"	33 3/8"	9 13/16"	6"	33 1/8"	5 1/2"	27"	5.42'	2.92'	8.34'	7.50'	1:2.4
60"	73"	45"	7 1/2"	25 9/32"	6"	105"	37 1/2"	11 7/32"	6"	33 11/16"	6"	30"	5.00'	3.25'	8.25'	8.00'	1:2
72"	88"	54"	9"	31 7/16"	6"	126"	45"	12 9/16"	6"	38 15/16"	7"	24"	6.50'	1.75'	8.25'	9.00'	1:2



ARCH CONCRETE PIPE
END SECTION
END VIEW

Detail No. 3825

Issued: 8/02/2021

Adopted: 8/02/2021

The City of Stillwater OKLAHOMA

Prefabricated Culvert End Sections

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY