City of Stillwater Standards

Adopted

5/7/2018

Design Standards

Adopted

5/7/2018

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DESIGN AND CONSTRUCTION STANDARDS

SECTION 0001

INTRODUCTION

Part 1: Introduction

A. The purpose of these standards is to define minimum requirements for public infrastructure improvements, certain private improvements, and private improvements to be constructed in the public way.

B. These standards apply to design and construction of improvements on all public property, within public easements, and on properties to be dedicated to the City.

C. These standards are intended to provide for a 50-year physical lifespan for public improvements. Any public improvements not specifically covered by these standards shall be of similar durability and possess similar maintenance requirements. If, due to unique circumstances, construction of an improvement under these standards will not achieve the intended operational and/or maintenance result, the City Manager may, after a design consultation with the developer, impose a different construction standard or requirement. Said modification may be more stringent than the adopted standard if necessary to achieve the intended construction and/or maintenance result.

D. These standards shall be applied in conjunction with all other laws and regulations of the City of Stillwater.

E. In addition to adopted laws and regulations, the City of Stillwater has adopted plans and guidelines to aid in the development and long-term maintenance of lands and infrastructure. The requirements of these additional plans and guidelines shall be incorporated into the design of public infrastructure. Adopted plans include, but may not be limited to:

1. Stillwater Transportation Enhancement Plan (STEP).
2. Stillwater Urban Drainage Criteria Manual.
3. Water Resources Master and Infrastructure Assets Management Plan.
4. Water Distribution System Analysis Report.
5. Stillwater Wastewater Master Plan.
6. Comprehensive Plan.
7. Best management Practices.

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 Council is not obligated to accept the dedication of any public improvement that is not constructed in accordance with these adopted standards.

H. These standards or any part thereof may be amended by the City Council.

Part 2: Organization

The Standards are divided into four primary Divisions:

A. Division 0 - General: provides general direction, introduction, and information.

B. Division 1 - Design Standards: provides requirements for the engineering design of improvements including design criteria and specific design requirements.

C. Division 2 - Construction Standards: provides minimum requirements for the construction of improvements including materials and construction methods.

D. Division 3 - Details: standard construction details. Abbreviations and Definitions

Part 3: Abbreviations: The following abbreviations are to be used supporting documents and plans when referring to each respectively:

A. AASHO: American Association of State Highway Officials

B. AASHTO: American Association of State Highway and Transportation Officials

C. AIA: American Institute of Architects

D. ASA: American Standards Association

E. ASCE: American Society of Civil Engineers

F. ASTM: American Society for Testing and Materials

G. AWWA: American Water Works Association

H. CAD: Computer Aided Drafting

I. NPDES: National Pollution Discharge Elimination System

J. ODEQ: Oklahoma Department of Environmental Quality

K. ODOT: Oklahoma Department of Transportation

L. NOI: Notice of Intent

M. SWPPP: Storm Water Pollution Prevention Plan

Part 4: Definitions: The following terms shall be used throughout this document and understood to have the meaning as defined herein:

A. City Manager: City Manager of the City of Stillwater or their designee.

B. Day: Calendar Day, unless otherwise specified.

C. Dead End Main: A segment of pipe that is supplied from one direction under normal operating conditions.

D. Flexible Pipe: Any pipe that will deflect 2% of its diameter without permanent damage such as cracking or plastic deformation

E. Full Urbanization: The total anticipated development in an area according to the Comprehensive Plan or applicable zoning requirements.

F. Materials: Any substances specified for use in the construction of the project and its appurtenances.

G. Rigid Pipe: Any pipe that is not considered Flexible Pipe.

H. Transportation Director: Director of the City's Transportation Department or equivalent as designated by the City Manager.

I. Water Resources Director: Director of the City's Water Resources or equivalent as designated by the City Manager.

Part 5: Conflict Resolution

Every attempt has been made to avoid conflicts between the contents of this Design and Construction Standard and other City, State, or federal regulations. Where other applicable standards or regulations, such as ODEQ's, ODOT's, federal regulations, or City Code apply, the more stringent shall apply.

Part 6: Exceptions

A. Exceptions may be allowed by the City Manager on a case by case basis.

B. Requests for exceptions shall be submitted in writing and shall be supported by technical information and an explanation of the particular application to which the exception is intended to apply.

C. When standards listed herein do not cover proposed work, design and construct improvements to the same general level of care and quality.

END OF SECTION

DESIGN AND CONSTRUCTION STANDARDS

SECTION 1010

GENERAL SUBMITTALS

Part 1: General

A. A variety of submittals are required for specific project types. These submittals are required as part of the design process to properly ensure compliance with City standards, laws and regulations and to ensure proper design and construction of infrastructure/improvements for which the public will assume upkeep and maintenance.

B. Reports: This section applies to the following types of reports and all similar written technical summaries, studies, or detailed investigations. This section is not intended to describe when such submittals are required. Please refer to City Code and subsequent sections of these Standards for indications of when such submittals are required. This section describes the contents of submittals, such as:

1. Geotechnical Investigations.
2. Drinking Water System Engineering Reports.
3. Wastewater System Engineering Reports.
4. Street Improvements Engineering Reports.
5. Stormwater Improvements Engineering Reports and studies.
6. Traffic Impact Analysis.
7. Excavation Safety Plans.
8. Traffic Control Plans.
9. Environmental Impact Report.
10. Storm Water Pollution Prevention Plan (SWPPP).
11. Other Reports and Studies as may be required to support design or construction.

C. Permits: includes the required permit applications specific to the project type:

1. City of Stillwater Earth Change Permit.
2. City of Stillwater Right-of-way Permit.
3. US Army Corps of Engineers 404 Permit.

4. FEMA LOMA/LOMR.
5. ODEQ Permit To Construct.
6. Burn Permit.

Part 2: Submittals

A. Construction Plans and Profiles.

B. Grading and Drainage Plans.

C. Drainage Study.

D. Erosion Control Plan.

E. Sewer, water, and/or stormwater plans and profiles.

F. Street and paving plans and profiles.

G. Other supporting documentation in plan form.

Part 3: Format Requirements:

A. Reports:

1. The following information shall be included on all reports submitted:
    a) Cover sheet noting:
        1) Report Title.
        2) Project Title.
        3) Designer/Preparer Name, Address, Contact Information and Seal.
        4) Name of Owner/Developer with Address and Contact Information.
        5) Date of Preparation.
        6) Certification statement, as required by law.
    b) Table of Contents for Report.
    c) Index Sheet for Plans in excess of 2 pages.
    d) Executive Summary of Investigation or Study.

e) Site Description and Location Map.

f) Narrative indicating Purpose of Submittal.

g) Parameters or Methodologies Used in Report, Data Collection, Model, etc.

h) Existing Site Conditions

1) Topography.

2) Infrastructure.

3) Easements.

4) Structures.

i) Analysis of Findings or Results.

j) Conclusions and Recommendations, signed and sealed by designer.

k) Supporting Data including reference documents, analytical data, detailed results of tests, modeling documentation and results, charts, etc.

2. All reports shall be bound or, for reports of less than 10 pages, stapled.

3. Additional Reporting Specifics for Geotechnical Reports:

a) Minimum number and location of trench sites, test wells, or bore holes.

b) Frequency of sampling.

c) Depth of fill, compaction percentage of fill.

d) Depth of trench sites, test wells, or bore holes through fill.

e) Trench site, test well, or bore log and photo of location.

f) Initial water level encountered and water level after twenty-four (24) hours.

B. Design Drawings:

1. Water Distribution and Wastewater Collection System Drawings:

a) Provide an overview map with references to each plan and profile sheet.

b) Plan and Profile:

1) Show all existing and proposed utilities.

2) Show all restraint zones.

END OF SECTION

DESIGN STANDARDS

SECTION 1020

SURVEYING AND DRAFTING

Part 1: General

A. Coordinates:

1. All elevations shall be based on the North American Vertical Datum of 1988 (NAVD 88).

2. All horizontal coordinates shall be based on the National Geodetic Survey (NGS) State Plane, Oklahoma North coordinate system, North American Datum 1983 (NAD 83).

3. False northing, easting, and elevation are acceptable only with written permission from the City Manager.

Part 2: Benchmarks and Surveys:

A. Benchmarks

1. At least two permanent benchmarks shall be noted on any plan set.

2. All temporary bench marks shall be designated on the plans stating elevation, location and description. The nearest such benchmark shall be shown on each sheet.

3. Benchmarks or temporary benchmarks shall be set a minimum of every 1,000 feet of street, water line, sanitary sewer line, and or storm water sewer length.

4. Benchmarks shall be set out of the way of any proposed construction, to ensure that the benchmarks will be available for use throughout the life of the project.

B. Alignment Surveys

1. Water, sewer, storm drainage, and roadway designs shall begin at a station designated to the nearest hundred feet.

2. Station 10+00 shall be the beginning station for all alignment surveys, unless back stationing will be needed. Additional alignments shall begin at station 1010+00, 2010+00, etc. or as appropriate to ensure that no single station reference may be confused with multiple alignments. Stationing shall begin at:

   a) Existing downstream manhole where new sewer line begins.

   b) Downstream drainage structure where the new storm drainage begins.

   c) Existing water main where the new water line begins.

d) Intersection of the center lines of both the proposed new roadway and the existing connecting roadway.

3. Alignment surveys for sanitary sewer and storm drainage projects shall begin at the downstream terminus and proceed upstream, unless these projects are concurrent with a roadway or water line project. Stationing shall be individual to the system under consideration.

4. Alignment surveys for roadway, water line, and sewer line projects shall proceed from west to east or from south to north, unless logic dictates otherwise.

Part 3: Drafting Requirements

All surveying and drafting shall be of such depth and quality as to allow scanning and reproduction to clearly show line work, background, information, screened information, notes, and details. Submitted blue lines or prints shall be of such depth and clarity as to be legible and easily read and worked with in addition to being suitable for reproduction and scanning. Background discoloration, which may show up due to use of exposed or overexposed reproduction paper or film and which may limit legibility of information is not acceptable.

A. Construction plans shall be prepared using CAD or other method to produce a high quality, legible finished product consistent with industry standards.

B. All drawings shall be provided with minimum margins as follows:

1. 22 inch x 34 inch drawings:

a) left side 2 inches.

b) top 1 inch;

c) bottom 1 inch;

d) right side 1 inch.

2. 24 inch x 36 inch drawings:

a) left side 3 inches.

b) top 2 inches;

c) bottom 2 inches;

d) right side 2 inches.

3. 11 inch x 17 inch drawings: reduce 22 inch x 34 inch margins by ½.

C. Provide originals on heavy bond or Mylar.

D. Black ink shall be used on all drawings. Color is acceptable only with written permission from the City Manager.

E. Title Sheet or Cover Sheet:

1. Include a title sheet or cover sheet on all plan sets.

2. Include the following information on all title sheets:

a) Project Title – located across the top center of the drawing sheet in large scale lettering.

b) Project Location Map - A project Location map shall be provided for all drawings referencing plan sheet layout, with adjacent landowners, or subdivision names, as may be appropriate. Location map shall identify major roads and Section, Township, Range.

c) Drawing Index of all drawings contained within the construction plan set.

d) Engineering and/or Architectural Firm Information: On the lower or right side margin, show the responsible professional design firm's name, address, and telephone number and certificate of authorization number with expiration date. If there are several professional design firms participating in the design or in different segments of the design, these firms may be listed separate from and below the drawing index.

e) Professional Firm's Logo: Professional firms may show their company Logo on the drawing. This logo shall be limited in size to no greater than 2 inches in height for 22 inch x 34 inch drawings and shall be located on the bottom or the right of the drawing sheet along the borders.

3. General Notes – While General Notes are generally shown on subsequent drawing sheets, depending on the size and nature of the project and the drawings, General Notes may be shown on the title sheet, but shall clearly be separated from the general title sheet information.

4. Standard Sheet requirements:

a) Provide a 1-inch bar on all sheets for verification that the sheet has been reproduced accurately.

b) Standard sheets shall be 22" x 34" or 24" x 36". 24" x 36" sheets delivered as PDF are not acceptable.

c) Half size sheets: 11" x 17". Ensure that half size sheets produced from standard size sheets are scaled exactly 50%.

d) Oklahoma One-Call System Logo: Locate the OKIE One Call logo with relevant telephone numbers on the title sheet or cover sheet or in a conspicuous location. This logo may also be located again on specific plans, where appropriate.

e) Engineer's Seal: Affix as required by Oklahoma law.

f) Title Block. Title block shall be located in the lower right hand quadrant and shall be readable from the bottom of the sheet towards the top of the sheet. Title block shall have the sheet number with discipline identifier (as appropriate) immediately below the title block and shall include the following:

1) Drawing Sheet Number: Each drawing sheet shall be provided with a distinct sheet number, keyed to the order and sequence of the sheet in the drawing set and keyed to a discipline identifier.

2) Revision Block: A revision block shall be provided on the drawing along the right side margin or across the bottom. Revision block shall be read from the bottom, up. The revision block shall include a place for revision number, date of revision, initials of individual signing off for revision, and space for a brief description of the revision.

3) Seal: the seal of the responsible registered professional(s) shall be located in the lower right hand quadrant of the sheet, as required above.

4) Lettering Size:

A. 22”x34” sheets: minimum 0.12 inches.

B. 11”x17” sheets: minimum 0.06 inches.

5) Scale bars: shall be shown on all construction plans as follows:

A. Congested areas: 1”=20’ horizontal; 1”=5’ vertical minimum.

B. Uncongested areas: 1”=100’ Horizontal; 1”=5’ vertical.

C. Details: 1”=10’ or larger, as appropriate.

D. Cross Sections: 1”=10’ horizontal, 1’=5’ vertical.

5. Layouts, Details and Sections: Layouts, details, and section cuts shall be titled and where appropriate, a scale provided. Details and section cuts shall be called out on the drawing where the detail is identified and the cut made. Reference to the appropriate detail or section cut shall be made on the detail or cut symbol to the drawing sheet where the detail or section is shown. Reference to the sheet where the detail or section cut was taken shall be included under the detail or section cut callout for projects with an extensive number of drawing sheets

6. Section Cuts: All section cuts shall be designated with a Capitalized letter code, consecutively lettered from front of drawing set to back, thus: A for Section A and B for Section B, and so on. Where double lettering is require, Section Cuts shall be designated thus: Section AA or BB, etc. Section cuts shall be made looking to the left or up wherever possible. For extensive drawings with numerous section cuts,

cuts shall be designated with the reference sheet number where the cut detail is shown, thus: Section A/C-1, meaning Section A, detailed on Sheet C-1, or a refinement of this method.

7. Details: All details shall be made using a numerical code and shall be designated in order from front to back of the drawing set, wherever possible, thus: Detail 1, Detail 2, etc. For extensive drawings with numerous details, details shall be designated with the reference sheet number where the detail is shown, thus: Detail 5/C-1, meaning Detail 5, detailed on Sheet C-1, or a refinement of this method.

8. North Arrow: A north arrow shall be shown on all plans where horizontal, planar information is provided. For full sheet layouts, the North Arrow shall be located in the upper right-hand quadrant of the drawing sheet. North shall be oriented to the top or left hand side of all water line and street projects. North shall be oriented as needed on all gravity line projects as long as the downstream end of the line is on the left hand side of the sheet.

9. Notes and Instructions: Notes and instructions not considered a part of a layout, detail, or section cuts should be located strategically where it will be evident it is not a specific part of a particular detail.

10. References: All base and plan maps shall reference existing and proposed land lines.

11. Bench marks: At least one permanent benchmarks (BM) or temporary bench mark (TBM) shall be on a single site plan sheet. On multiple site projects, (such as water, sewer, roadway, and storm drainage projects), the nearest two benchmarks shall be referenced on each plan and profile sheet. All benchmarks or beginning construction stations shall be referenced with at least three land ties for future location.

12. Existing improvements: Each plan sheet shall show the existing and proposed improvements located above and below ground, horizontally and vertically. These should be items that could be affected by construction or a part of the construction. Grayscale (approximately 65% screening) lines shall be used to represent these items.

13. Existing or Proposed Rights-of-Way or Easements shall be indicated by dimensional information and type.

14. Utilities –Label all components for utilities, provide interference information, materials, lengths, stationing.

F. Record Drawings: provide record drawings on Mylar. Include a note signed by the Engineer indicating that the record drawings represent the best information available to the Engineer regarding the in-place disposition of the described infrastructure.

END OF SECTION

DESIGN STANDARDS

SECTION 1101

SITE WORK

Part 1: General

A. Section Includes: general requirements for design of grading and other considerations.

B. Design all sites for ease of maintenance.

C. Design sites to accommodate laws associated with sensitive areas such as flood plains, water quality buffers, endangered species habitat, and cultural resource sites.

Part 2: Grading

A. All site grading designs shall be sealed by a licensed Professional Engineer.

B. Maximum slope of finished grade: 4:1 in any direction, unless defined elsewhere in the Standards. Exceptions may be made by the City Manager, provided that access to the site is maintained and equipment can operate safely as needed for existing and future public facilities.

C. Provide specific direction regarding any stripping, stockpiling, backfill, compaction, soil amendment, or other special techniques to be used.

D. Design all sites to drain completely. Sinks or other areas of standing water are not acceptable unless part of a stormwater collection or treatment system.

E. Include BMPs for control of erosion, sediment and construction-related stormwater pollutants in the design of all site work. Design BMP's to support compliance with the City's MS4 permit.

F. Set backs, step backs and related techniques shall be used where directed by the engineer.

1. The top and toe of cut slopes shall not be made nearer to a site boundary line than the greater of:

    a) One-fifth of the vertical height of cut, or;

    b) 2 feet.

2. Where temporary or permanent terraces are constructed, terrace setbacks shall be a minimum of three 3 feet wide and shall be sloped to the back of the embankment a minimum transverse slope of 2%.

3. Design terrace systems to drain.

END OF SECTION

DESIGN STANDARDS
SECTION 1107
BURIED PIPE DESIGN

Part 1: General

A. General: This section includes requirements for design of buried pipe, including drinking water, wastewater, storm water, casing, and other buried conduit.

B. Engineering Report:

1. Prepare an Engineer Report documenting the assumptions, calculations and considerations made to meet the requirements of this section.

C. Permits: obtain all permits necessary to cross or operate in the right-of-way or easement of ODOT, county, railroad, or other right-of-way owners. Incorporate permit requirements into plans and specifications.

D. Referenced Standards:

1. American Water Works Association (AWWA):

a) C151: AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.

b) C900: AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 in. Through 12 in. (100 mm through 300 mm), for Water Transmission and Distribution.

c) C901: AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ In. (13 mm) through 3 in. (76 mm), for Water Service.

d) C906: AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 in. (100 mm) Through 63 in. (1,600 mm), for Water Distribution and Transmission.

2. Manuals of Water Supply Practices:

a) M23: PVC Pipe – Design and Installation.

b) M41: Ductile-Iron Pipe and Fittings.

c) M55: PE Pipe – Design and Installation.

3. Oklahoma Administrative Code:

a) Title 252, Chapter 656, Water Pollution Control Facility Construction, Oklahoma Department of Environmental Quality (ODEQ).

b) Title 252, Chapter 625, Public Water Supply Construction Standards, Oklahoma Department of Environmental Quality (ODEQ).

4. Water Environment Federation:

a) Manual of Practice FD-5: Gravity Sanitary Sewer Design and Construction.

Part 2: Buried Pipe

A. Alignment:

1. Locate buried pipe so that the pipe can be maintained or installed without disturbing pavement (including base material behind back of curb) and other permanent surface features. Pipe may be located under pavement only with permission from the City Manager.

2. Locate piping system features such as manholes, valves, and outfalls such that they can be accessed by operation and maintenance equipment, including vacuum and cleaning trucks, valve exercising trailers, and other heavy equipment.

3. Locate pipe so that the edge of a 6 foot wide excavation centered on the pipe will be at least 1.5' above the flowline of any adjacent bar ditch, drainage, or channel.

4. Minimum horizontal distance from centerline of pipe to edge of public right-of-way, easement, or permanent surface features:

    a) When flowline to finished grade is less than or equal to 4 FT: minimum 8FT.

    b) The following minimums are based on an assumption of unstable soils that must be excavated at a slope of 1:1 to maintain compliance with PEOSH and OSHA requirements. Reduced distance from centerline of pipe to edge of public right-of-way or easement is acceptable only with approval from the City Manager. Approval may only be based on the sealed recommendation of an Engineer, supported by geotechnical investigation and an assessment of excavation practices that will be compliant with OSHA and PEOSH requirements.

        1) When flowline to finished grade greater than 4 FT and less than or equal to 10 FT: minimum 14 FT.

        2) When flowline to finished grade greater than 10 FT less than or equal to 20 FT: minimum 24 FT.

        3) When flowline to finished grade greater than 20 FT: as required by the Water Resources Director.

    c) Provide additional distance to accommodate non-horizontal slopes of finished grade or other surface features that may restrict or require additional excavation extents.

    d) Locate buried pipe so that excavation will not compromise the structural integrity of adjacent structures or pavement.

5. Separation:

    a) Ensure that ODEQ requirements are met for horizontal and vertical separation from sanitary sewers, other buried utilities, underground storage tanks, other petroleum facilities, and onsite sewage treatment system components.

    b) No less than 2 FT of vertical separation must be provided, unless otherwise allowed by the City Manager.

c) Obtaining ODEQ-required vertical separation will not be considered "impossible" without approval from the Water Resources Director.

d) For the purposes of interpreting ODEQ separation requirements regarding natural gas, telecommunications, and electric lines as a source of contamination, those lines are generally to be considered "equal to water pipe".

e) If less than 2 FT of vertical separation is provided, take additional measures to protect and ensure that both the proposed and existing lines can be excavated with minimal risk of damage. The Water Resources Director shall determine whether or not such measures are adequate.

f) See “Underground Creek Crossings”, below, for clearance beneath creeks.

6. Ensure that City Code requirements are met for location of utilities within easements.

B. Bury Depth and Cover:

1. Ensure that mains are designed in coordination with other infrastructure and final grading to ensure 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 3.25 FT depth of cover.

a) Design of mains with less cover may be acceptable in unusual circumstances, such as un-rip-able bed rock, only with permission from the Water Resources Director.

b) Exceptions may be made for driveway cuts, small swales, and other local features, provided that cover is not reduced to less than 3 FT, with permission from the Water Resources Director.

3. Maximum depth, finished grade to flowline: 12 FT. Deeper mains may be designed only with written permission from the Water Resources Director.

C. Encase all lines under arterial streets. Extend encasement to minimum 1 FT beyond back of curb or ditch flowline, as directed by the Water Resources Director.

D. Underground creek crossings:

1. Completely restrain all joints between creek banks, including future creek bank extents that may be expected within the next 50 years.

2. Install pipe and encasement with minimum 5 FT of cover below the lowest creek flow line that may be reasonably expected within the next 50 years.

3. Stabilize creek bank.

E. Thrust Restraint (pressurized service only):

1. Provide thrust restraint in the form of both restrained joints and thrust blocking, in accordance with AWWA manuals of practice for the pipe materials.

2. Calculate thrust due to pressure, velocity change, thermal expansion (PE pipe only), and other sources of axial force on installed pipe and appurtenances.

3. Assume all existing pipe is not restrained. Provide thrust collars at transition to existing pipe or replace existing pipe with new pipe through the required restraint zone.

4. Restrained Joints:

    a) Restrain all joints within restraint zones. Clearly show extent of restraint required on plan and profile sheets.

    b) Design restraint zones to restrain the full thrust load (ignore thrust blocks).

5. Thrust blocks:

    a) Provide thrust blocks (in addition to restrained joints). Clearly show dimensions and location of thrust blocks on plans. Size thrust blocks for full thrust load.

    b) Design thrust blocks to restrain the full thrust load (ignore restraint zones).

    c) Thrust blocks may be eliminated when no “grip-type” (see section 2107) restraint devices are used for restraint.

F. Joint and Pipe Deflection:

1. All pipe: Do not design pipe to be installed bent.

2. Pressure Pipe:

    a) Design pipe layout to utilize no more than 50% of the manufacturer’s recommended joint deflection.

3. Gravity Pipe:

    a) Do not deflect joints.

G. Thickness Design:

1. General:

    a) Provide thickness design calculations for all proposed piping improvements.

    b) Design pipe to accommodate both internal pressures and external loads.

    c) Design flexible pipe materials for no more than 1% change of diameter deflection in any design condition.

d) External forces and conditions:

1) Live load minimums:

A. General: AASHTO H10.

B. AASHTO H20 under roads or other vehicle traveled areas.

C. AASHTO H20 under state and U.S. Highways.

D. Cooper E-80 under railroads.

2. Polyvinyl chloride (PVC), including fusible PVC:

a) Calculate minimum thickness as described below, but refer to service-specific specifications for required minimum thickness for installed pipe.

b) Design for internal pressure and external forces and conditions in accordance with AWWA Manual of Practice (MOP) M23.

1) Pressure Capacity:

A. Safety Factor: 2.5.

B. Surge Allowance, greater of 2 FPS or flow velocity under maximum system demand.

C. Hydrostatic design basis: greater of 150 PSI or maximum modeled pressure.

3. Ductile iron pipe (DIP):

a) Design for internal pressure and external loads in accordance with AWWA Manual of Practice M41.

b) Internal pressure capacity:

1) Surge Allowance: greater of 2 FPS or flow velocity under maximum system demand.

2) Working pressure: greater of 150 PSI or system pressure at zero demand.

4. Polyethylene (PE) water main and sanitary sewer main:

a) Design for pressure class (pressure pipe only) and external loads in accordance with AWWA Manual of Practice M55.

b) Working Pressure Rating (pressure pipe only): 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 medium to high plasticity. High Density Polyethylene (HDPE) service line: AWWA C-901, PE 3408, DR 9.

5. Corrugated HDPE gravity pipe: Design in accordance with manufacturer’s recommendations.

6. Reinforced Concrete Pipe (RCP): Design in accordance with manufacturer’s recommendations.

Part 3: Encasement:

A. 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.

B. Steel for Encasement: Reserved.

C. PE for Encasement: see thickness design for buried pipe.

END OF SECTION

DESIGN STANDARDS

SECTION 1301

EARTH RETAINING STRUCTURES

Part 1: General

A. This section applies to structures designed to retain earth, whether it is a situation where earth slopes will not be able to remain stable or where cuts in embankments require some form of earth retention and restraint. Retaining walls above 4 FT in height shall require a City permit unless they are included as part of a part of a larger design project, which is itself being permitted. Walls of less than 4 FT in height may require geotechnical and structural design should the City determine the need based on loading, soil conditions, physical features, or sensitive location.

B. Types of wall and earth retaining structures include but are not limited to:

1. Cantilever Wall Systems.
2. Gravity Wall Systems.
3. Bulkheads.
4. Bin Type Retaining Walls.
5. Tie-back Wall Systems.
6. Precast Wall Systems.
7. Specialty Earth Retention Systems.
8. Basement walls or other below ground walls.

Part 2: Design Criteria

A. General Design Considerations: Earth retaining structures shall be designed to consider all forces applied internally and externally to the earth retaining system to ensure that a safe, stable, geotechnically and structurally sound, and cost effective design is achieved. 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, which may require additional design parameters over and above code requirements. The following minimum requirements shall be considered in the design of earth retaining structures:

B. Location: Earth retaining structures for private development cannot be constructed within limits of public right-of-way. Any footings or other features of the structure should be offset a minimum of one foot outside of the right of way.

C. Geotechnical Considerations

1. A foundation and soils investigation shall be conducted. Where questionable soils exist and the safe sustaining power of the earth supporting the earth retaining structure is in doubt, where wall height is above 4 FT, or where groundwater or stable embankment conditions are of concern the City shall require a complete soils investigation. Investigation shall be by a qualified Engineering firm. A geotechnical Report shall be prepared and submitted to the City for review and acceptance.

2. Design shall follow standard Engineering principles and practices to determine earth loading and forces to be designed for to ensure stability of the earth retaining system, including, but not necessarily limited to the following:

    a) Lateral and overturning stability of earth retaining system;

    b) Lateral forces against structural elements of earth retaining system;

    c) Resistance to sliding;

    d) Stability against overturning;

    e) Foundation pressure limitations;

    f) Site bearing conditions;

    g) Wall movement criteria;

    h) Surcharge Loading:

        1) Proximity of and influence by and to structures, both existing and proposed;

        2) Uplift forces;

        3) Impact of surcharge loads;

        4) Impact of retained earth stability;

        5) Hydrostatic forces on earth retaining systems;

        6) Earthquake forces;

        7) External forces;

        8) Factors of safety;

        9) Wall and earth structure drainage considerations and requirements;

i) Dewatering requirements. The Designer shall develop a plan for dewatering the local site when soils investigations identify potential problems or when a field problem is encountered.

j) Shoring. Under circumstances where excavated embankments behind the area requiring the earth retaining structure are of a depth or stability requiring special shoring, the designer shall develop a shoring design and plans, with supporting information from the geotechnical specialist.

k) Special construction considerations, such as excavation and terracing, set-back techniques, dewatering requirements, backfill materials and placement considerations; and,

l) Backfill requirements and procedures and soil stabilizing mechanisms.

D. Construction Plans. Construction plans shall provide adequate detail and instruction for construction of earth retaining structure(s).

E. Other Considerations. Externally applied design forces, loading information, external drainage considerations, bedding and internal drainage considerations shall be developed by an Oklahoma Registered Civil Engineer whose specialty is Engineering. Design criteria shall be contained in a Geotechnical Report, a copy of which along with the wall design documentation. Specialty Instructions: Where special installation instructions are provided as part of the material installation, these shall be made a part of the contract documents and shall be followed as part of the installation process.

F. Structural Considerations: Earth Retaining structures shall be structurally designed to meet or exceed the applied forces developed by the Engineer. Design shall be accomplished by a Professional Engineer licensed in the State of Oklahoma. The following minimum information shall be required to be addressed and detailed, as may be required:

1. Concrete strength requirements;

2. Reinforcement requirements;

3. Material requirements;

4. Earth retaining structure drainage requirements behind the structure;

5. Means of relieving hydrostatic pressure build-up behind the earth retaining system;

6. Stabilization of soils being retained;

7. Mechanism(s) for hydrostatic pressure relief;

8. Placement of backfill and retaining straps, tie-back straps, and other elements used as part of the retention and stability system;

9. Mechanical fastener requirements; and,

10. Coating systems.

G. Specialty Proprietary Wall Systems: Specialty bin-type systems, etc. shall be designed in the same manner as other wall systems using the expertise of an Engineer and, as appropriate, a structural or civil engineer. Proprietary wall system designs shall be supported by installation procedures and supporting installation details and instructions. All proprietary wall system designs shall be sealed by a Professional Engineer licensed in the State of Oklahoma.

H. Civil Design Considerations: Earth retaining structure shall be located on site development plans in plan and, if necessary, with profile(s), sections, and details to clearly define:

1. Earth retaining structure location and extent;

2. Specific elevations, sections, and details pertinent to the construction of the wall;

3. Drainage arrangements – both surface and internal to the earth retaining structure for relief of hydrostatic pressures;

4. Finished surface conditions around and behind the earth retaining structure

5. Interface with existing and new elements of the project; and,

6. Topographic and grading considerations.

I. Aesthetic and Architectural considerations: Aesthetic and architectural consideration shall include, but will not necessarily be limited to the following:

1. Surface architectural fascia design details;

2. Specialty surface materials used for facing, block texture and design;

3. Special applications including coating systems, material colorations, and panel coverings;

4. Concrete and wall colorations; and,

5. Specialty designs and enhancements.

END OF SECTION

DESIGN STANDARDS
SECTION 1400
DRINKING WATER DISTRIBUTION SYSTEM AND PRIVATE BOOSTER PUMP ASSEMBLIES

Part 1: General

A. Definitions:

1. Code: The City of Stillwater's Code of Ordinances.

2. Individual Private Booster Pump Assembly (IPBPA): an assembly of pump(s), tank(s), backflow prevention device, valves, switches, controllers, and other appurtenances, as needed to provide the minimum required water pressure to the customer and protect the public water system.

3. Low Pressure Water Main: A water main designed to operate a less than the Standard Minimum Pressure or an existing water main that operates at less than the Standard Minimum Pressure.

4. Plumbing Code: The applicable plumbing code, as adopted by the City.

5. Residential Code: The applicable residential code, as adopted by the City.

B. ODEQ:

1. Design all water system improvements to meet the requirements of state law, including the standards of Title 252, Oklahoma Administrative Code, Chapter 626, Public Water Supply Construction Standards, Oklahoma Department of Environmental Quality (ODEQ), current version.

2. Secure a Permit to Construct from ODEQ for any water system improvement project.

C. Engineering Report:

1. Prepare an Engineer Report documenting the assumptions, calculations and considerations made to meet the requirements of this section, including ODEQ requirements.

D. Referenced Standards:

1. American Water Works Association (AWWA):

a) C151: AWWA Standard for Ductile-Iron Pipe, Centrifugally Cast.

b) C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN through 60 IN (100 mm through 1,500 mm).

c) C901: AWWA Standard for Polyethylene (PE) Pressure Pipe and Tubing, ½ IN (13 mm) through 3 IN (76 mm), for Water Service.

d) C906: AWWA Standard for Polyethylene (PE) Pressure Pipe and Fittings, 4 IN (100 mm) through 63 IN (1,600 mm), for Water Distribution and Transmission.

2. AWWA Manuals of Water Supply Practices:

a) M14: Backflow Prevention and Cross-Connection Control.

b) M22: Sizing Water Service Lines and Meters.

c) M23: PVC Pipe – Design and Installation.

d) M31: Distribution System Requirements for Fire Protection.

e) M32: Computer Modeling of Water Distribution Systems.

f) M41: Ductile-Iron Pipe and Fittings.

g) M51: Air-Release Air/Vacuum, and Combination Air Valves.

h) M55: PE Pipe – Design and Installation.

3. Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California:

a) Cross-Connection Control Manual.

4. Oklahoma Administrative Code:

a) Title 252, Chapter 625, Public Water Supply Construction Standards, Oklahoma Department of Environmental Quality (ODEQ).

Part 2: Municipal System:

A. General:

1. Design all improvements to provide domestic water service without booster pumping, unless otherwise allowed by the Water Resources Director.

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

B. Modeling of Proposed Distribution System Improvements:

1. General:

a) Analyze proposed system improvements by modeling the proposed improvements in accordance with methods described by AWWA M22, M31, and M32.

b) Perform modeling, using computer software such as EPA's EPANet (free) or other package.

c) Provide a node for each fitting and fire hydrant.

d) Provide nodes for local highs and local lows for the purpose of verifying maximum and minimum pressures.

e) Skeletonizing proposed improvements is not acceptable.

2. Coordinate with the City to obtain, at the connection point of the proposed improvements with the existing system, for each required scenario:

a) The system's diurnal HGL, as predicted by the City's water system model.

b) The design capacity as one or more pressure-demand curves, as predicted by the City's water system model. Verify the model's prediction using results of a recent hydrant flow summary.

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) Any information provided by the City.

   b) Demands:

      1) Include per-connection demand patterns for domestic, irrigation, and zoning-specific or land-use-specific demands. Account for each use type, fire suppression system flow, fire hydrant flow separately.

      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:

      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). Minimum demand (EPS) may be required by the Water Resources Director in lieu of Zero demand scenario.

   b) Most-Future Scenario of City's Water System Model:

      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. Reporting:

a) For peak day peak hour scenarios, report:

1) Minimum pressure at each node.

2) Maximum pipe velocity in each link.

3) Estimated surge pressure for rapidly closed hydrants and isolation valves, if required by the Water Resources Director.

b) For average of peak day with fire flow scenarios, report:

1) Minimum pressure at each node.

2) Fire flow at hydrant nodes.

c) For zero demand scenarios, report:

1) Pressure at each node.

d) For Minimum demand scenarios, report:

1) Maximum pressure at each node.

2) Maximum water age at each node.

C. Water Mains:

1. New water mains shall be designed to operate within the following range of Standard Operating Pressures:

a) Standard Minimum Operating Pressure: 40 psi at all times, at any system condition other than fire flow or flushing.

b) State Minimum Operating Pressure: as set forth by the State.

c) Standard Maximum Operating Pressure: 100 psi at any system condition. Higher pressures may be acceptable, with permission from the Water Resources Director.

d) Low Pressure Water Mains: the City Manager may allow a new water main to be designed to operate at less than the Standard Minimum Operating Pressure, subject to the following conditions: are met:

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, all of which shall be no smaller than 6-inches in diameter

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) The minimum operating pressure in a Low Pressure Water Main shall be 30 PSI.

6) A written request to design and construct a new water main at less than the Standard Minimum Operating Pressure is submitted and includes the following:

   A. An explanation of why the Standard Minimum Operating Pressure can't be achieved.

   B. Discussion of alternatives considered

7) An exception to the Standard Minimum Operating Pressure requirement shall be subject to the following conditions, as well as any additional conditions that the City Manager may consider appropriate:

   A. The developer shall enter into a Low Pressure Water Main Agreement with the City. The agreement shall require that the developer of the Low Pressure Water Main:

      1. File a copy of the executed agreement with the Payne County Clerk for each property adjacent to or to be served by the Low Pressure Water Main(s).

      2. Acknowledge that the Minimum Operating Pressure in the water main will be less than the City's Standard Minimum Operating Pressure.

      3. Acknowledge that all properties connecting to the Low Pressure Water Main shall be required to install an IPBPA in accordance with the requirements of this section.

      4. Include the following note on all construction and record drawings: "This (these) water main(s) is (are) designed to operate at less than the City's Standard Minimum Operating Pressure. IPBPAs are required for all service connections where the Standard Minimum Operating Pressure is not available at the point of connection."

8) 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.

2. Bury Depth and Cover:

   1) When connecting to existing mains that have less than the required minimum cover, use fittings to reach the appropriate depth as soon as possible, unless allowed otherwise by the Water Resources Director.

3. Fire Flow Design:

   a) Design system to deliver fire flow in strict accordance with ODEQ regulations and AWWA M31.

b) Required fire flows: Refer to City Code and other adopted codes and standards to define required fire flows.

4. Alignment:

a) In street right-of-way, align water mains on the south or east side of streets, or as otherwise approved by the Water Resources Director.

5. Pipe Diameter:

a) Minimum nominal diameter: 6 IN.

b) Minimum inside diameter: 5.8 IN. Note that the inside diameter of some 6 IN nominal PE and other outside diameter size controlled pipe may be less than 5.8 IN. In such cases, use of a larger nominal size pipe is required.

c) Pipe diameters noted here are minimums. Larger pipe may be required, based on modeling results.

6. Acceptable Pipe and Fittings Materials:

a) General: When it is in the best interest of the City, the Water Resources Director may approve pipe with thinner wall thickness. For consideration, submit a written request containing the following:

1) A description of the benefits of reduced pipe thickness.

2) Pipe thickness design documentation (see section 1107 –Buried Pipe Design). The design must assume minimum support from the pipe embedment material.

3) A discussion of the installation conditions needed to support the reduced pipe thickness and a plan for verification that those conditions are met in the field.

b) In Casing (Bored or Open Cut, Including Creek Crossings):

1) PVC: C900, DR18 minimum.

2) HDPE: C901/C906, DR9 minimum.

3) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR18 minimum.

c) Open Cut, Not Encased:

1) PVC: C900, DR18 minimum.

2) HDPE: C901/C906, DR9 minimum.

3) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR18 minimum.

4) When it is in the best interest of the City, the Water Resources Director may approve use of ductile iron pipe. For permission, submit a written request containing the following:

A. *A description of conditions making use of ductile iron pipe necessary, such as unusually high live loads or shallow bury depth*

B. *A discussion of multiple alternatives considered to address the conditions, such as alternate alignments or installation in casing. Discuss the advantages and disadvantages of each alternative and describe why use of ductile iron pipe is in the best interest of the City.*

C. *A conceptual design of the proposed solution.*

d) Bored, Not Encased:

1) HDPE: C901/C906, DR9 minimum.

2) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR18 minimum.

3) When it is in the best interest of the City, the Water Resources Director may approve use of bell and spigot PVC. For consideration, submit a written request containing the following:

A. *A description of the benefits of using bell and spigot PVC.*

B. *A proposed plan for monitoring installation to ensure a quality finished product, including inspection requirements, recommended restraint devices, and maximum recommended pulling force.*

C. *Proposed plan notes allowing use of bell and spigot PVC, specifying the above recommendations.*

e) Creek Crossings, Not Encased:

1) HDPE: C901/C906, DR9 minimum.

2) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR18 minimum.

f) Exposed: When it is in the best interest of the City, the Water Resources Director may allow exposed or aerial installations, based on a written request. For permission, Engineers should demonstrate that aerial installation is the best or only feasible alternative. Requests should include:

1) A discussion 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.

g) Fittings:

1) HDPE, butt fused to HDPE pipe.

2) PVC, butt fused to Fusible PVC pipe.

3) Ductile Iron.

D. Dead End Mains and Looping:

1. Dead End Mains are acceptable only with permission from the Water Resources Director. Generally, they are not acceptable. Any proposal for adding a dead-end main to the system should be accompanied by a description of why the addition of the dead end is in the best interest of the public system.

2. Provide a hydrant assembly at the end of all Dead End Mains.

3. Pipe on either side of a normally closed valve is considered a Dead End Main.

E. Creek Crossings:

1. Encase all creek crossings unless otherwise approved by the Water Resources Director.

2. Aerial crossings are not acceptable without permission from the Water Resources Director.

F. Service Connections:

1. New service connections shall only be made to water mains that meet the Standard Minimum Operating Pressure requirement and have been accepted by the City.

a) Exception: for non-fire service connections, the Standard Minimum Operating Pressure requirement may be met by providing an IPBPA, subject to the following conditions:

1) Enter into a Non-Domestic Water Use Agreement. The agreement shall include the following:

A. Acknowledgement that the Minimum Operating Pressure in the water main will be less than the City's Standard Minimum Operating Pressure.

B. Acknowledgement that all properties connecting to the Low Pressure Water Main shall be required to install an IPBPA in accordance with the requirements established within this section.

C. Acknowledgement that the service connection shall not be used for domestic or potable uses, excluding yard hydrants, until an IPBPA has been installed in compliance with the requirements established within this section.

D. Acknowledgement that any violation of the above conditions may result in the immediate disconnection of water service.

2) All other requirements for new service connections have been met.

2. Meters:

a) The City shall designate the location of water meters. Customers may request a water meter location, and the City may accommodate this request to the extent reasonably possible. It is generally not

acceptable to locate meters in pavement, including streets, gravel, parking lots, in parking spaces, driveways and sidewalks. Further, it is not acceptable, except in the most extreme circumstances, to locate a meter in areas subject to regular traffic such as parking lots or any driveway other than single family residential. When it is in the best interest of the City and other alternatives are not feasible, the Water Resources Director may approve location of a meter within paved areas or in areas subject to incidental or heavy traffic. A written request for approval should be accompanied by:

1) A discussion of all meter location options, including what is required to make the locations accessible and safe from traffic.

2) A discussion of the type and frequency of traffic that the meter enclosure will be subjected to.

3) A design for a meter enclosure suitable for the type and volume of traffic.

4) Demonstration that the proposed location is readily and safely accessible by City staff, and that the proposed location and meter enclosure is compatible with the City's meter reading system.

b) Show meter size and pavement/traffic condition on the drawings.

c) Equip all service connections, including connections serving only fire protection systems, with a meter or compound meter assembly that will accurately measure from 1/2 GPM through the highest rate of flow that may be demanded. The City will provide and install the meter. Locate the meter vault as directed by the Water Resources Director. Typically, locate the meter or meter assembly where the service line enters private property.

d) If a connection serves only a fire protection system with no private hydrants or other potential uses, the detector part of a detector check assembly may, at the discretion of the Water Resources Director, serve as the required meter. The detector check assembly, although private property, must remain open to inspection to City staff and include test cocks for verifying that the detector assembly is functioning correctly.

3. Provide an isolation valve where the service is connected to the public main.

4. It is not acceptable to connect a service connection to a public main greater than 12 IN nominal diameter. Service via apublic main larger than 12-IN may be accomplished by the following:

a) Construct a public main extension and connect the service connection to the main extension.

b) Construct a new hydrant and connect the service to the hydrant leg. Addition of a new hydrant is subject to the approval of the Water Resources Director.

G. Backflow Prevention:

1. Provide backflow protection in accordance with AWWA M14, and as required by the Plumbing Code.

2. Backflow prevention devices shall not become public property.

3. The following are considered "Health Hazards" for the purposes of interpreting AWWA M14:

a) Private hydrants.

b) Dead water in a fire service line.

c) IPBPA's.

4. For service connections serving fire protection systems, a single check (or backflow prevention device providing a higher level of protection) is acceptable for protecting the public system from dead water in a fire service line. The single check assembly or backflow prevention device must be located where directed by the Water Resources Director, typically as close as possible to the point where the service line connects to the public main. The detector check assembly, although private property, must remain open to inspection to City staff and include test cocks for verifying that the check assembly is functioning properly.

H. Fire Hydrant Assemblies:

1. Meet NFPA, Fire Code, and AWWA MOP M31 requirements.

2. Locate in street right-of-way, where emergency vehicles can gain access.

3. Minimum connection size: 6 IN.

4. Spacing:

a) Locate fire hydrants so that no point on a street is farther than 250 FT from a fire hydrant.

b) Otherwise meet the spacing requirements described by Appendix B of the 2009 or latest adopted edition of the International Fire Code.

5. 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.

6. Fire hydrant barrel drains shall not be connected to the storm drainage or the sanitary sewer.

7. Do not install hydrants on mains less than 6 IN nominal diameter.

8. A hydrant leg longer than 5 LF is considered a Dead End Main.

I. Isolation Valves:

1. Only gate valves are acceptable for water main isolation valves. Other valves, including butterfly valves, are not acceptable without permission from the Water Resources Director.

a) Spacing: Maximum spacing between valves shall be the closer of:

1) ODEQ requirements.

2) Existing or future residential, commercial, industrial and school zoning: 500 FT.

3) Other Areas, including agricultural, park, and rural: 1,320 FT.

4) The City is the sole authority regarding the current and future land use within the design life of the proposed improvements.

b) 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 with permission from the Water Resources Director. An isolation valve is required only on the hydrant leg of a hydrant tee; isolation valves are not required on the main legs of a hydrant tee. A hydrant tee is a tee that serves only a hydrant. A tapping sleeve is considered a tee. It may be acceptable, with approval of the Water Resources Director, to install a tapping sleeve and utilize existing system valves to fulfill the above requirement for a valve on all three legs of a tee.

c) 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.

J. 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. Do not connect blow-off assemblies to storm or sanitary sewers.

3. Adjust grade of lines to eliminate low points and associated required blow-off assemblies wherever possible.

K. Air Valves:

1. Provide air and vacuum relief valves where recommended by AWWA M51. A hydrant may be allowed or required in lieu of an air valve by the Water Resources Director.

2. Locate air valve vents at least 12 IN above the 100-year (1% chance) flood plain or as required by ODEQ, whichever is more restrictive.

3. Air valve vault top slab elevation:

a) Minimum: 3 IN above highest adjacent grade.

b) Maximum: the lower of:

1) 3 FT above highest adjacent grade.

2) The 100-year (1% chance) flood plain.

4. Do not connect air valves to any storm or sanitary sewer.

5. Adjust grade of water main to eliminate 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 extent more than 6 IN above finished grade.

Part 3: Rural Water System

A. System Limitations:

1. Stillwater's rural water systems are operated for domestic use only, not for fire flows.

B. Supported Service Connections:

1. The number of service connections will be 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 will be limited to the number associated with the next smaller listed line size. Other factors such as modeled system behavior and system performance history may further limit the number of connections that can be supported.

Line Size (Inches, Inside Diameter)	Maximum Number of Service Connections
less than 2	2
2	10
2-1/2	25
3	50
4	100
5	150
6	250
8+	per design

C. System Design:

1. General: Design rural mains as required for the municipal system, except as follows:

a) Standard Minimum Operating Pressure: ~~40~~ 25 psi at all times, at any system condition, except flushing (Resolution SUA-201809 passed November 5, 2018).

2. Distribution System Modeling:

a) Although the rural system is not intended to provide fire, irrigation, or other non-domestic service, model the system in a manner consistent with its actual use, including flushing activities, irrigation, agricultural use, fire flow, and other as identified.

b) Minimum nominal pipe diameter: 4 IN.

c) Minimum inside pipe diameter: 3.9 IN.

3. Hydrants: Provide flush hydrants at the ends of all dead end mains, at low points to serve as blow-offs, and as otherwise required by the Water Resources Director to facilitate operation and maintenance of the system. Fire hydrants are not acceptable.

Part 4: Individual Private Booster Pump Assemblies (IPBPA)

A. Individual Private Booster Pump Assemblies (IPBPA)

1. General: The purpose of this section is to provide design, performance and installation requirements for IPBPA's. The requirements in Section 1400, Part 4 shall only apply to IPBPAs that are connected to Low Pressure Water Mains.

2. Design:

a) Backflow Prevention:

1) A Pressure Vacuum Breaker (PVB) or Reduced Pressure Principle Backflow Prevention Assembly (RPZ) (as defined by the Plumbing Code) shall be installed as a backflow preventer (BFP) between the water meter and the pump. The use of Double Check, Dual Check, Vacuum Breaker devices to meet the backflow prevention requirements for an IPBPA is prohibited.

2) The BFP shall be located as shown in detail 3490.

3) The BFP shall be located and housed so that it is freeze protected and accessible for testing and maintenance.

b) Pump Assembly:

1) The IPBPA shall be capable of providing the required minimum pressure boost at the required flow rate.

A. Required flow rate: Shall be calculated by the fixture unit method described in the applicable Plumbing or Residential Code.

B. Required pressure: Shall be the minimum pressure for the plumbing fixtures in the building as prescribed by the applicable Plumbing or Residential Code.

C. Required minimum pressure boost: Shall be the difference between the Required Pressure and the pressure supplied by the public water main. The pressure available in the public main shall be determined by the City.

2) Location:

A. The pump assembly shall be located anywhere between the backflow preventer and the first point of use, excluding yard hydrants.

B. The pump assembly shall be located and housed so that it is freeze protected and accessible for testing and maintenance.

3) Required Components:

A. All components required by the applicable Plumbing Code or Residential Code.

B. Low suction shutoff switch.

C. Pressure tank: sized in accordance with pump manufacturer's recommendations.

D. Bypass: to allow water to flow to the building when the pump is removed or turned off.

E. Appurtenances: test ports, pressure gauges and any other components that are needed to verify required performance.

4) Design Documentation – The following items shall be submitted so that the City can confirm compliance with the design requirements prior to the installation of an IPBPA:

A. Schematic, showing piping (including line size), pumps, control valves, isolation valves, tanks, and other appurtenances.

B. Fixture unit and irrigation demand calculations and elevations of all elements.

C. Calculations for operating points for pump.

D. Pump operating points and pump curve requirements.

E. Operating curve of specified pump.

5) If the installation of the IPBPA is certified by a Professional Engineer as described in the Construction requirements below, submittal of the design documentation is not required.

3. Construction:

a) All IPBPA components shall be installed in accordance with the respective manufacturers' recommendations, the design criteria established in this section and the requirements established in the applicable Plumbing or Residential Code.

b) IPBPA installation compliance conformation: The building contractor or their representative shall make arrangements to have the IPBPA tested for compliance with the installation requirements established above. Compliance testing will be observed by the City. IPBPA shall not be connected to the building plumbing system until the testing has confirmed compliance with the installation requirements. If installation of the IPBPA is certified by a Professional Engineer as described below, the compliance testing requirements in this paragraph shall not apply.

c) IPBPA certification by a Professional Engineer (optional): An IPBPA shall not be considered complete until an Engineer has verified that the IPBPA has been installed in compliance with the installation requirements established above and all IPBPA components perform as a unit. Compliance testing shall be performed or witnessed by an Engineer who shall certify compliance with the design and construction requirements of this section. Compliance certification shall be provided to the City prior

to connection of the IPBA to the building plumbing system. The City may confirm that the backflow device and low suction shut off switch are in place and operating in accordance with the requirements.

END OF SECTION

DESIGN STANDARDS
SECTION 1500
WASTEWATER COLLECTION SYSTEM

Part 1: General

A. ODEQ Design Criteria:

1. Design all wastewater system improvements to meet the requirements of state law, including the standards of Title 252, Oklahoma Administrative Code, Chapter 656, Water Pollution Control Facility Construction, Oklahoma Department of Environmental Quality (ODEQ), current version.

B. Permit Required:

1. Secure a permit to construct from ODEQ prior to constructing any wastewater system improvement.

C. Engineering Report Required:

1. Prepare an Engineering Report documenting the assumptions, calculations and considerations made to meet the requirements of this section.

D. Referenced Standards:

1. Oklahoma Administrative Code:

a) Title 252, Chapter 656, Water Pollution Control Facility Construction, Oklahoma Department of Environmental Quality (ODEQ).

2. Water Environment Federation:

a) Manual of Practice FD-5: Gravity Sanitary Sewer Design and Construction.

Part 2: Gravity System Design

A. General:

1. Design improvements to the collection system without pumping, unless otherwise allowed by the Water Resources Director.

2. Design improvements to the distribution system as a component of a complete system.

3. Design improvements in accordance with section 1107 – Buried Pipe Design.

B. Modeling of Proposed Collection System Improvements:

1. General:

a) Analyze proposed system improvements by modeling the proposed improvements in accordance with methods described by WEF Manual of Practice FD-5.

b) 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. For all other

improvements, modeling must be completed using computer software such as EPA's SWMM (free) or other package.

c) Provide a node for each manhole.

2. Coordinate with the City to obtain the system's diurnal HGL, as predicted by the City's collection system model, at the connection point of the proposed improvements with the existing system, for each required scenario.

3. List and describe all assumptions and boundary conditions, including:

   a) Any information provided by the City.

   b) Demands:

      1) Include per-connection demand patterns for domestic and zoning-specific or land-use-specific demands. Account for each use type separately.

      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.

   c) Inflow and infiltration contribution to flows:

      1) Base infiltration/inflow (I/I) contribution to flows on a widely recognized engineering standard.

      2) Minimum Peaking Factors – (peak hour flow + I/I) / (average daily flow):

         A. Pipes with diameter less than or equal to 12 IN: 4.

         B. Pipes greater than 12 IN: 2.5.

4. Scenarios:

   a) Present day conditions: Peak day EPS or peak day peak hour steady state.

   b) Most-Future Scenario of City's Sanitary Sewer System Model: Peak day EPS or peak day peak hour steady state.

5. Reporting:

    a) For peak day peak hour scenarios, report: velocity, volumetric flow rate, and depth of flow in each pipe segment and manhole.

C. Sewer Mains:

1. Depth of Flow: maximum 80% of full pipe depth in any condition.

2. Flow Velocity:

    1) Maximum 5 FT/SEC at average of peak day.

    2) Maximum 7 FT/SEC at maximum flow.

    3) Minimum 2 FT/SEC, unless otherwise allowed by ODEQ and the Water Resources Director.

3. Maintain constant grade, direction, and pipe inside diameter between manholes, as required by ODEQ.

4. Minimum slope: as prescribed by ODEQ regulations (based on diameter).

5. Maximum slope: 10%.

6. Bury Depth and Cover:

    a) Design flowlines of sufficient depth to serve not only the proposed system improvement, but also all other areas within the drainage area of the proposed improvement.

    b) Utilize drop manholes to minimize the depth of installed mains.

7. Typical Alignment:

    a) Align sewer mains to minimize disturbance of permanent surface features during installation and maintenance and to optimize access for maintenance.

    b) Along street right-of-way: north or west side of streets, unless otherwise necessary due to location of existing drinking water mains or other conditions.

D. Manholes:

1. Provide a design for precast and cast-in-place manholes, including top slabs where required, sealed by a licensed Professional Engineer.

    a) Minimum wall thickness: 4 IN.

    b) Reinforce with deformed steel bars.

    c) Provide waterstop between the base and bottom wall section.

    d) Flowline drop across manhole: Meet ODEQ requirements.

2. Pipe Connections:

    a) Minimum angle between pipe connections: 90 degrees. When in the best interest of the City, the Water Resources Director may approve closer angles between pipe connections. For approval, designers should demonstrate that the manhole's design is structurally sufficient and that the proposed approach is benefits performance, operation, and future growth.

3. Connect pipe to manhole perpendicular to manhole wall, so that extended pipe centerline intersects center of manhole.

4. Frame and top slab elevation:

    a) In paved or future paved areas (regardless of whether or not the area is flood-prone), the top of the rims shall conform to the slope of the pavement and be flush with the finished pavement.

    b) In non-paved areas, the top of the rim shall be not more than 6 inches above the surrounding ground and not less than finished grade. The final elevation shall be at a point where water will not pond over the manhole cover.

    c) In flood prone areas, the top of the rim shall be between 1 FT and 3 FT above finished grade. See section 2500 for frame and cover requirements when the top of the manhole may be covered by flooding.

E. Pipe:

1. Diameter:

    a) Minimum nominal diameter: 8 IN.

    b) Minimum inside diameter: 7.5 IN. Note that the inside diameter of some 8 IN nominal PE and other outside diameter size controlled pipe may be less than 7.5 IN. In such cases, use of a larger nominal size pipe is required.

    c) Pipe diameters noted are minimums. Larger pipe may be required, based on modeling results.

2. Acceptable Pipe and Fittings Materials:

    a) General: Minimum wall thicknesses: when it is in the best interest of the City, the Water Resources Director may approve pipe with thinner wall thicknesses than required, below. A request for approval should be accompanied by pipe thickness design documentation (see section 1107 –Buried Pipe Design). The design must assume minimum support from the pipe embedment material.

    b) 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 Approved Equal, DR26 minimum.

c) Open Cut, Not Encased:

1) PVC: ASTM D3034, DR26 minimum.

2) HDPE: AWWA C901/906, DR 9 minimum.

3) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR26 minimum.

4) Ductile Iron pipe may be allowed with permission from the Water Resources Director when ductile iron's strength is needed to bear shallow or live loads. For permission, Engineers should demonstrate that the project cannot be adjusted to eliminate the shallow bury depths or high live loads.

d) Bored, Not Encased:

1) HDPE: AWWA C901/906, DR 9 minimum.

2) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR26 minimum.

3) Bell and spigot PVC may be allowed with permission from the Water Resources Director. For permission, Engineers should demonstrate 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. Not Acceptable for Creek Crossings.

e) Creek Crossings, Not Encased:

1) HDPE: AWWA C901/906, DR 9 minimum.

2) Fusible PVC: Underground Solutions FPVC or Approved Equal, DR26 minimum.

f) Exposed: When it is in the best interest of the City, the Water Resources Director may allow exposed or aerial installations, based on a written request. For permission, Engineers should demonstrate that aerial installation is the best or only feasible alternative. Requests should include:

1) A discussion 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.

g) Fittings (force mains only):

1) HDPE, butt fused to HDPE pipe.

2) PVC, butt fused to Fusible PVC pipe.

3) Ductile Iron fittings may be allowed with permission from the Water Resources Director when HDPE and Fusible PVC are not feasible. For permission, Engineers should demonstrate that HDPE and Fusible PVC are not feasible and propose fittings with a durable, highly corrosion resistant interior coating.

F. Acceptable Manhole Types:

1. Precast concrete.

2. Alternative manhole types, such as cast in place concrete, combinations of precast and cast in place concrete, polypropylene, fiberglass, or other composites may be approved by the Water Resources Director. Requests for approval should be accompanied by:

a) A discussion of the site conditions, material type options and how the proposed manhole type is in the best interest of the City.

b) An example design for the proposed manhole type.

G. Creek Crossings:

1. Encase all creek crossings unless otherwise approved by the Water Utilities Director.

a) Aerial crossings are not acceptable without permission from the Water Utilities Director.

H. Service Connections:

1. Do not connect a service connection to a public main greater than 12 IN nominal diameter. To connect to a main greater than 12 IN, provide a main extension and tap the main extension.

2. Do not connect a service connection to a manhole, without written approval from the Water Resources Director

I. Other:

1. Encase all wastewater mains under arterial streets. Extend encasement to minimum 1 FT beyond back of curb or ditch flowline.

2. Inverted siphons are not acceptable.

Part 3: Pumped Sewage System Design

A. Lift Stations:

1. Provide equipment to pump design flows with the largest pump out of service.

2. Size lift station and components for expansion as flows within the development and watershed progress. Ensure that sufficient area is provided at the lift station site for expansion.

3. Design cycle time between successive starts of any single pump with any one pump out of service:

a) Minimum 30 MIN.

b) Maximum 3 HR.

4. Develop system head curves representing when the system is new and when it is 20 years old. The curves shall be prepared on a computer generated graph with the following information:

5. Minimum pumping efficiency at typical operating point: 70% wire to water.

6. Solids handling: all components shall be able to pass a 3 IN sphere.

7. Wet Well:

a) Materials of Construction: precast reinforced concrete.

b) Minimum inside dimension: 8 FT.

c) Provide a minimum of 24 inches between the “pump off” elevation and the “lead pump on” elevation.

d) The minimum water level in the wet well shall be 12 IN above the wet well floor, 6 IN above the minimum submergence of a submersible pump, or 6 IN above the top of the pump volute.

e) The maximum water level shall not exceed the invert of the lowest gravity sewer line entering the manhole. The high water alarm shall be set at the same elevation as the invert of the lowest gravity sewer entering the manhole.

f) Provide at least 12 IN freeboard between the top of the wet well and the maximum water level.

g) Wet well bottom: The bottom of the wet well shall be designed with fillets sloping from the interior wall face to the pump. The fillets shall be at a 1:1 slope, minimum 1 FT high, and be constructed of concrete.

h) Anti-floatation: The wet well shall be designed to account for any ground water found on the site or historically present in the area. Where groundwater is present, the wet well shall be designed with either an over-sized base or walls. The wet well shall be designed to overcome the hydrostatic pressure of the groundwater, with a minimum safety factor of 1.5.

i) Access hatches: All wet wells shall be equipped with locking aluminum access hatches, either one or two leaves that are designed to allow adequate working space and allow the pumps to be removed without modifications to the wet well. Hatches shall be fitted with alarm entry contact switches compatible with the SCADA system.

j) Ventilation:

1) All wet wells shall be vented to allow gases to expel to the atmosphere. The minimum size vent shall be 4 inches and shall be designed with flanged ductile iron pipe and elbows. An insect screen shall be placed between the elbow flanges.

2) All dry wells shall be provided with either continuous or intermittent ventilation. Continuous ventilation shall provide at least 6 complete air changes per hour. Intermittent ventilation shall provide at least 30 air changes per hour. Ventilation equipment switches shall be marked and located at the entrance to the dry well. All intermittently operated ventilating equipment shall be interconnected with the respective pit lighting system. A two-speed fan shall be tied to the light switch such that, when the light is turned on, the system automatically operates at 30 changes per hour and switches to 6 changes per hour after 10 minutes. The fan wheel shall be fabricated from non-sparking material.

k) Piping: All piping in the wet well shall be flanged ductile iron. All penetrations through the wet well wall shall be leak proof.

l) Rail system: The pumps shall be installed and removed using a rail system designed by the pump manufacturer. The rails shall be rigid after installation. Intermediate supports shall be designed to keep the pumps from derailing during installation or removal.

m) Influent manhole: An influent manhole shall be provided within 25 feet upstream of the wet well. All of the branch sewer mains shall flow into this manhole. The influent manhole shall be connected to the wet well with a single sanitary sewer influent pipeline. A plug valve with a dedicated stem riser shall be located on the single influent pipeline to allow workers to enter the wet well safely. The gate valve shall be located within a security fence and provided with a locking lid.

n) Security fencing: An 8-foot-tall chain link security fence shall be provided. Other secure fence types may be provided with approval from the WRD. A 4-foot- wide gate for pedestrian access and a 12-foot-wide (2-leaf) gate for maintenance vehicle access shall be provided. The gate shall be fitted with a contact alarm switch compatible with the SCADA system.

8. Valve Vault

a) Materials: The valve vault shall be precast reinforced concrete pipe or cast-in-place reinforced concrete.

b) Diameter: Valve vault shall be a minimum 5 FT in diameter or equivalently sized rectangular. Piping shall have at least 24 inches of separation, as measured from the exterior walls of the piping. Piping shall also be installed at least 12 inches from the interior concrete walls.

c) Valve vault bottom: The bottom shall be sloped to the interior wall face nearest the exterior wall of the lift station wet well. A sump shall be installed with a 2 IN PVC drain line to the wet well. The drain end line shall be designed with a check valve.

d) Piping: All piping in the valve vault shall be flanged ductile iron pipe.

e) Valving: Valves in the valve box shall have a separate plug valve and check valve for each pump. The plug valves shall be handwheel operated. Taps and pressure gauges shall be provided at strategic locations to confirm operation of valves.

f) Access hatches: All valve vaults shall be equipped with locking aluminum access hatches, either one or two leaves, that are designed to allow adequate working space and allow the valves to be removed without modifications to the valve vault. Hatches shall be fitted with alarm entry contact switches compatible with the SCADA system.

g) Emergency pump connection: Emergency pump connections shall be installed on the piping in the valve vault with an isolation valve. A 4 IN male "Cam- Loc" coupling shall be installed on piping extending through the top of the valve vault.

h) Flow monitoring/flow indication: Magnetic flow meters shall be installed on the common discharge pipe of each valve vault. A recorder totalizer shall be installed in the control panel.

9. Controls

a) Lift station controls shall consist of a telemetry package for monitoring purposes including a remote terminal unit, modems, radios, network devices, cables, and any antenna tower requirements. All components must be suitable for continuous operation in the existing environment including suitable protection devices. The package must contain its own standby power battery system and charger. Monitoring points shall include:

b) Pump run Pump flow Seal fail High temp

c) AC power fail Generator run Pump run time High wet well

High dry well Tamper/intruder detect

d) All controls shall accept Form C dry contact inputs and be compatible with the City's SCADA system.

e) All pumps shall be fitted with dry contact over-temp readout, variable-frequency drive signal and breaker tripped contacts.

f) Level controllers shall be mercury switches.

10. Electrical

a) Automatic control center shall be equipped with individual disconnects, 3-pole manual transfer switch, 4-pole standby generator receptacle to match generator plug, across-the-line starters, alternator, automatic transfer to non-operating pump in event of overload in operation pump, motor overloads complete with isolated contact for telemetering, overload reset, hand-off-automatic pump operation selector switch, 120 volt transformer for alarm light and duplex 120 volt convenience outlet, a normally closed for high-level alarm, motor fail (2) and motor run (2), all components housed in NEMA 4 dead front construction for pole mounting enclosures. A spare single pole 20A circuit breaker shall be provided to power telemetry panel (TP). 120 VAC power shall be brought to the terminal board in addition to alarm and motor run signals. A thermostatically controlled heater and fan and lightning protection will also be included in the motor control center. Also furnish and install four liquid level sensors consisting of mercury switches in a smooth, chemical resistant polypropylene casing, suspended on its own cable. The control center shall be installed in a location

as shown on the drawings. Control panel shall be provided with a keyed locking arrangement. No splicing of electrical cables shall be permitted. All cables and wires must terminate inside the control panel.

b) Electrical systems shall conform to the National Electric Code (NEC).

c) Separate disconnects shall be installed for each pump.

11. Hoist:

a) All lift stations shall be designed with an electrically-operated hoist for pump removal. The hoist shall be capable of lifting the weight of the largest pump with a safety factor of 2. The main voltage will be as required for the service location and power voltage not more than 115/1/60. For pumps less than 20 horsepower, hoists shall be mounted on a pedestal type jib crane with a 360 degree rotation, rotation stops and a manual trolley. The jib crane shall be of sufficient height and span to access removal of all pumps. For pumps 20 horsepower and larger, hoists shall have a motorized trolley mounted from a monorail beam centered over the operations area. Equipment shall be designed for outdoor use and be similar or equal to that manufactured by Americrane and Hoist, LLC, or Gaffey, a division of Crane Equipment Services.

12. Reserve Power:

a) Lift stations shall be equipped with a reserve power generator.

b) The engine powered generator shall be operated with natural gas, if available.

c) The generator shall be designed to automatically start and operate the pumps(s) and other equipment in the lift station under design flow conditions.

d) The generator shall be equipped with a weather-tight removable cover.

e) The generator shall be fitted with a power fail contact and a “generator RUN” contact compatible with the SCADA system.

13. Comminutors and Bar Screens:

a) Where required, mechanically cleaned bar screens and comminutors shall be designed to reduce the amount and size of solids entering lift stations.

14. Variable Speed Pump Control System:

a) Variable frequency drives (VFD) may be required on larger lift stations. Each lift station proposal shall be reviewed on a case-by-case basis. The VFD pump controls must provide status signals to the SCADA system.

15. Alarms

a) Lift stations shall have a visual and audible alarm.

b) Water level based alarms shall be based on separate flow switches, independent of the flow switches used for pump control.

c) They shall activate under the following conditions:

1) When the water level rises above the invert of the lowest gravity sewer entering the manhole.

2) When any pump is called for and does not respond.

3) When the water level lowers to within 6 IN of the minimum suction head level required for any of the pumps.

16. SCADA System

a) Lift station operation is monitored via an integrated remote system with readout panels located at the Wastewater Treatment Plant. All installed equipment shall be fitted with alarm and status readouts compatible with the SCADA system.

b) The design engineer shall coordinate with the City of Stillwater to allow reconfiguration of the SCADA system main computer in order to allow the following conditions to be alerted at the wastewater treatment plant:

1) When the water level rises above the invert of the lowest gravity sewer entering the manhole.

2) When the lead pump is called for and does not respond.

3) When the lag pump(s) are called for and does not respond.

4) When the control panel is entered illegally.

5) When primary power is lost.

6) When the reserve power source is called for and does not respond.

7) When the reserve power source control panel is entered illegally.

17. Force Main Termination

a) Where a force main terminates into a structure, the influent shall be no more than 2 FT from the bottom of the structure, less if practical.

18. Force Main/Water Line Separation

a) Force mains shall not be located within 10 FT of a water main as measured horizontally from the outside of each pipe. Vertical separation shall be a minimum of 24 IN, measured as stated above.

19. Depth

    a) Minimum depth: The minimum force main depth shall be 36 IN from the top of the pipe to the top of the natural ground elevation. Deeper depths may be required in special cases.

    b) Maximum depth: The maximum depth of a force main shall be 8 FT from the top of the pipe to the top of the natural ground elevation, unless otherwise approved by the Engineer.

20. Valves

    a) Check valve(s) shall be installed horizontally.

    b) Sewage air relief valves shall be installed at the high points along the force main.

B. Isolation Valves (force mains only):

1. Acceptable for wastewater force main isolation valves: plug valves and ball valves. Butterfly and gate valveS are not acceptable.

2. Locate valves on each side of a highway or arterial crossing. Locate a valve on one side of collectors. Locate valves outside of ODOT right-of-way wherever possible.

C. Air Valves (force mains only):

1. Provide air and vacuum relief valves at local high points.

2. Locate air valve vents at least 12 IN above the 1% chance flood plain or as required by ODEQ, whichever is more restrictive.

3. Air valve vault top slab elevation:

    a) Minimum: 3 IN above highest adjacent grade.

    b) Maximum: 3 FT above highest adjacent grade.

4. Adjust grade of force main to eliminate high points and associated air valves wherever possible.

5. Adjust grade of force main to ensure that the completed air valve assembly height will require that the valve vault extend no more than 6 IN above finished grade.

END OF SECTION

DESIGN AND CONSTRUCTION STANDARDS

SECTION 1700

STREETS AND APPURTENANCES

Part 1: General

A. Section Includes: requirements relating to the designs for streets, alleys and appurtenances including earthwork, subgrade, base course(s), wearing surfaces, concrete curb and gutters, backfill, sidewalks, bicycle lanes, multi-use paths, and signage. Design of streets, alleys, and appurtenances should conform to the City of Stillwater Land Development Code, locally adopted plans, and appropriate design references listed below:

B. Reference Standards:

1. AASHTO, A Policy on Geometric Design of Highways and Streets, 5th Edition.
2. AASHTO, Guidelines for Geometric Design of Very Low-Volume Local Roads (ADT <400), 1st Edition
3. AASHTO, Roadside Design Guide, 3rd Edition
4. AASHTO, Guide for the Planning, Design, and Operation of Pedestrian Facilities, 1st Edition
5. AASHTO, Manual for Uniform Traffic Control Devices 2009 edition.
6. Institute of Transportation Engineers, Urban Street Geometric Design Handbook
7. Oklahoma Department of Transportation; Roadway Design Manual (most current edition)
8. American Concrete Institute Specification 306.1-90, Standard Specification for Cold Weather Concreting
9. American Concrete Institute Specification 305.1-60, Standard Specification for Hot Weather Concreting

Part 2: Street Functional Classification:

A. The City of Stillwater has designated the functional classification of each street to facilitate a progressive transition in the flow of traffic from access to movement.

B. Functional classification categories for streets in the City of Stillwater include:

1. Principal/Major Arterial
2. Minor Arterial
3. Collector

4. Local Street

5. Alley

C. Map of Functional Classifications: Figure 5-7 of The Stillwater Transportation Enhancement Plan (STEP) provides a map designating the functional classification of each street.

D. When the STEP does not list the functional classification for a street, obtain clarification from the Transportation Department for the appropriate functional classification of the street.

Part 3: Design Criteria

A. The following is a list of minimum design standards for streets and appurtenances within the City of Stillwater. When specific design criteria is not provided in this text, the designer shall refer to guidance and standards provided in the reference material listed Part 1:A of this chapter.

B. Roadway Design:

1. Widths:

a) Right of way widths are provided for in the Land Development Code.

b) The minimum lane widths for each functional classification are as follows:

Minimum Travel Lane Width (Feet)

Functional Classification	Pavement Travel Lane Width*
Major Arterial	12
Minor Arterial	12
Collector	11.5
Local	10
Alley**	16

* Lane widths do not include width of curb and gutter, medians, tapers, turn-lanes, bike lanes, on-street parking, or shoulders.

** Alley width is for the full width of alley. 16 FT is the minimum paved width for newly constructed alleys. Wider paving widths may be required for commercial or industrial land use.

c) Reduced lane widths on arterial and collectors may be used for the addition of bike lanes, safety enhancements, or traffic calming measures.

2. Shoulders: Roadway shoulder shall have a minimum width of 8 FT. Where curb and gutter is not used, the shoulder shall slope away from the pavement at a slope of 6%. For roadway sections with curb and gutter, the shoulder shall slope towards the curb at a slope of 4%.

3. Design speeds:

   a) Major Arterials: 45 mph.

   b) Minor Arterials: 35 mph.

   c) Collectors: 30 mph.

   d) Local: 25 mph.

4. Horizontal curves:

   a) 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.

   b) Super Elevation: Super elevation is not required for local or collector streets. All other streets will be reviewed on a case by case basis.

5. 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.

   a) Minimum grade: The minimum profile grade for gutters and centerline shall be no less than 0.5% provided curb and gutter and adequate storm sewer drainage is provided, otherwise minimum grade shall be 1.5%

   b) Maximum grade: The maximum grade for non-arterial streets shall be limited to 8%. Where the topography is hilly, grades will be permitted up to a maximum of 12% providing such grade does not exceed 500 FT in length from PT to PC.

6. Roadway Centerline: Design the centerline of paving to be the proposed centerline of right-of-way.

7. Roadway Cross Slope:

   a) All roadways, except alleys, shall be designed with a normal crown.

   b) A minimum 2% cross slope from centerline to edge of pavement is required on all streets, except alleys.

c) Alleys may be design with an inverted crown, provided that an adequate drainage and collection system is designed and installed to prevent discharge into the adjoining street.

8. Roadway drainage:

a) Gutter Spread:

1) Gutter spread shall be measured from face-of-curb, and all calculations shall utilize a Manning's roughness coefficient ("n" value) of 0.016. Inlets shall be placed to limit flow spread to the following:

A. Collector & Arterial Roadways: One-half of the travel lane on a 2-lane roadway or one travel lane on a 4-lane roadway.

B. Local streets do not have a specific gutter spread requirement, but must meet design criteria in Section 1800 –Stormwater Collection Systems

b) Inlets:

1) 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.

2) Inlets in Sag shall be designed so that gutter spread is maintained within the limits specified for the 50-year return frequency storm.

c) Culverts and Cross Drains: Culverts and roadway cross drains shall be designed to minimize flooding of roadway and adjoining properties. These pipes must be designed with a minimum of two feet of freeboard elevation at upstream edge of pavement for the following design frequencies:

1) Local Streets: Culverts and cross drains must be designed to pass the 50 year storm event without overtopping the roadway. The 100 year design frequency event shall be used on dead end local streets.

2) Collector and Arterial: culverts and cross drains must be designed to pass the 100 year storm event without overtopping the roadway.

9. Intersection Design

a) General:

1) Streets shall intersect one another at right angles (90º).

2) Proposed residential areas shall use three (3) leg intersections.

3) Grades for collector streets at intersections with arterials shall not exceed 3% within 50 FT of the nearest arterial travel lane.

4) Grades for all legs of residential/residential intersections shall not exceed 4% within 50 FT of the nearest intersecting travel lane.

5) Grades for residential streets at intersections with all arterials shall not exceed 2% within 50 FT of the nearest arterial travel lane.

6) The minimum radii on curb returns at intersections are as follows:

   A. At intersections of local streets, the minimum radius on curb returns shall be 25 FT.

   B. At intersections with collector streets, the minimum radius of curb returns shall be 35 FT.

   C. At intersections with arterial streets, the minimum radius on the returns shall be 45 FT.

   D. Intersections with higher truck traffic, may require larger radii if specified by the City of Stillwater.

7) Points of access to arterial streets from new residential streets shall be limited in number and shall be no closer than 600 FT from arterial street intersections, unless otherwise approved by the City of Stillwater.

b) Sight distance:

1) Intersection shall be designed with adequate corner sight distance in accordance with the LDC. All other sight distance triangle requirements shall be designed in accordance with AASHTO's A Policy on Geometric Design of Highways and Streets.

c) Additional Right-of-way:

1) For principal arterial/minor arterial intersections, the minimum right-of-way shall be maintained on all legs in proximity to the intersection. The right-of-way for the minor arterial leg shall maintain the full arterial ROW width for 200 FT from the center of the intersection and, from that point, shall have a 150-foot-long transition from the full arterial ROW width right-of-way to the normal minor arterial right-of-way width.

2) Provide additional right of way to accommodate topography, drainage, and tie-ins to existing streets.

3) Variations to this right-of-way requirement shall be granted in accordance with the procedure for plat variations contained in the LDC of the City of Stillwater, Oklahoma.

10. Traffic Impact of Developments

    a) A traffic impact analysis shall be required for any proposed development that can be reasonably 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 hour. Trip Generation rates shall be calculated using Institute of Transportation Engineers Trip Generation Rates.

    b) The project owner shall provide a traffic impact analysis prepared, signed and sealed by a Professional Engineer licensed in Oklahoma.

    c) The impact analysis will be used to determine the extent of improvements or enhancements to the transportation system due to impact of the development. Each development will be evaluated based on the trip generation rates for the proposed development, including future phases of development and capacity of the transportation system.

    d) The traffic impact analysis may recommend alternative access configurations such as roundabouts or signalization. For studies considering these alternatives, the study should include analyses of both configuration alternatives with respective efficiencies of each.

    e) The Engineer should recommend a preferred configuration of access and improvements based on the analysis. The recommendation of final access configuration should consider types of traffic control at adjacent intersections for corridor consistency.

    f) All calculations for the traffic impact analysis shall be shown within the engineering report.

    g) The traffic impact analysis shall include at a minimum the following areas:

        1) All proposed site access points.

        2) All intersections bordering or adjacent to the site frontage including the closest intersecting collector or arterial street.

        3) Any street segment or intersection where the proposed development can be expected to generate more than 25 additional vehicle trips during a single hour.

        4) 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).

        5) The analysis shall include the following study time frames: existing conditions, full site buildout conditions, and a five-year forecast from point of full site buildout.

11. Geometric design criteria for traffic improvements:

    a) 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.

    b) Roundabout design shall be based on the FHWA publication; Roundabouts: An Informational Guide (FHWA-RD-00-67, June 2000 or most current edition.

    c) Auxiliary turn lanes

        1) Pavement section for turn lanes shall meet the minimum paving standards listed in this section. Pavement material for widening shall be consistent with existing paving (i.e. asphalt widening adjacent to asphalt street, concrete widening adjacent to concrete street)

        2) Right Turn Deceleration Lanes will be required if the daily site development generated right turn volumes (RTV) based on ITE Trip Generation (assuming a reasonable distribution of entry volumes) meet or exceed the values on the following Table:

Right Turn Lane Volume Criteria

Posted Speed	AADT	
	<6,000	>=6,000
30 to 35 MPH	200 RTV per day	100 RTV per day
40 to 50 MPH	150 RTV per day	75 RTV per day
55 MPH or greater	100 RTV per day	50 RTV per day

3) Left Turn Lanes will be required if the daily site development generated left turn volumes (LTV) based on ITE Trip Generation (assuming a reasonable distribution of entry volumes) meet or exceed the values on the following Table:

Left Turn Lane Volume Criteria

	AADT 2 LANE ROADWAY		AADT 3 LANES OR MORE ON MAIN ROAD	
Posted Speed	<4,000	>=4,000	<6,000	>=6,000
30 to 35 MPH	200 LTV per day	125 LTV per day	200 LTV per day	100 LTV per day
40 to 50 MPH	100 LTV per day	75 LTV per day	150 LTV per day	75 LTV per day
55 MPH or greater	75 LTV a day	50 LTV per day	100 LTV a day	50 LTV per day

4) Acceleration lanes: are generally not required on urban streets. Acceleration lanes may be required at locations where grade, sight distance or traffic is such that the City of Stillwater determines they are needed

5) Dual Left Turn Lanes are often needed to satisfy high volume demands. Capacity analysis should be used to identify the need for dual left turn lanes. Dual left turn lanes are typically considered when the peak hour left turn volume is 300 vehicles or greater.

6) Turn lanes should provide a full-width lane that is long enough to allow for vehicles to decelerate from the operating speed to a full stop in addition to the length of full-width lane that is needed to store vehicles waiting to turn. When traffic studies are conducted, the length of full-width lane needed for storage should be determined. If the length of full-width storage is greater than the length of full-width storage shown in the following Tables, the longer length should be provided.

12. Pavement Design

a) General: All pavement sections for roadways must be based on a project specific pavement design. Designs for pavement, base, and sub-grade treatments streets must be prepared by a Professional Engineer licensed in the state of Oklahoma in accordance with the following criteria.

1) Perform a geotechnical investigation of existing roadway site conditions, including adequate number of borings (maximum 500 FT between bore locations along roadway alignments) to depth sufficient to characterize subsurface soils and proposed sub-grade conditions. The geotechnical investigation should also identify any sub-grade treatments necessary to meet

compaction specifications. Information shall be submitted in form of geotechnical report signed and sealed by a licensed professional engineer.

2) Pavement design shall specify thickness to meet thirty (30) year traffic load,

3) Pavement design shall be prepared in accordance with AASHTO Guide for Design of Pavement Structures.

b) In lieu of performing a pavement design, projects may use standard minimum thickness in accordance with the following tables specifying minimum pavement thickness for Asphalt or Concrete Streets. Use of standard minimum thickness still requires performance of a geotechnical investigation as specified in previous section.

1) The minimum thickness of an asphalt street section shall be as indicated below:

Minimum Thicknesses for Asphalt Street Construction			
	Local Street	**Collector Street**	**Arterial Streets (Primary and Minor)**
Surface Course	2 inches SP-3 (PG 64-22 OK)	2 inches SP-4 (PG 70-28 OK)	2 inches SP-4 (PG 70-28 OK)
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)	3 inches SP-3 (PG 64-22 OK) 5 inches SP-2 (PG64-22 OK)
Compacted Aggregate Base (Type A) (w/separator fabric)	8 inches	10 inches	10 inches
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) The minimum thickness of a concrete street section shall be as indicated below and as shown in the Standard Details.

Minimum Thickness for Concrete Street Construction			
	Local Street & Alleys	**Collector Street**	**Arterial Streets (Primary and Minor)**
Concrete	6 inches	8 inches	10 inches
Compacted Aggregate Base (w/separator fabric)	8 inches	10 inches	10 inches
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.

c) Pavement parameters:

1) Asphalt: Asphalt pavements for roadways shall be Superpave Type in accordance with ODOT standards, most recent version.

2) Concrete: Concrete pavements for roadways shall be ODOT Class A designed and proportioned in accordance with ODOT standards, most recent version.

3) Designers shall reference American Concrete Institute Specification 306.1-90, Standard Specification for Cold Weather Concreting and American Concrete Institute Specification 305.1-60, Standard Specification for Hot Weather Concreting for concrete placement specifications.

d) Compacted Aggregate Base: Aggregate shall be Type A in accordance with ODOT standard specifications, most recent version.

e) Subgrade:

1) Treated subgrade: A geotechnical report shall be performed to determine condition and classification of existing soils at proposed subgrade. The geotechnical report shall specify depth and extents of any necessary subgrade treatment to meet designed pavement section compaction specifications. Subgrade material shall be modified to produce a plasticity index (PI) of 10 or less.

f) Road sections in rock cuts: A full, uniform roadway section shall extend full depth through rock cut areas. The rock shall either be removed and replaced with material conforming to the designed

section or the rock may be pulverized by rolling to produce a homogeneous material with no rock nodules larger than 2 inches in diameter. The resulting material must meet plasticity requirements.

g) Separator fabric and fabric reinforcement: Separator fabric shall be placed between the aggregate subbase (when applicable) and subgrade and shall conform to ODOT standard 712.05.

h) Subbase Drainage System: Where saturated soil conditions exists or continuous seepage of water is present within the subgrade, a subbase drainage system is required.

i) Curb and gutter:

1) Concrete streets: Portland cement concrete streets shall have an integrally placed curb or doweled-joint curb and gutter section of the same mix design as for street paving. Curbs shall be in accordance with the City of Stillwater Standards.

2) Asphalt streets: Asphaltic concrete streets shall have a portland cement concrete curb and gutter. The curb shall be in accordance with the City of Stillwater Standards.

3) Types: All curb sections shall be barrier curb or mountable type curbs.

j) Construction joints:

1) Joints in portland cement concrete shall be located in accordance with Standard Details. A joint layout plan shall be reviewed by the City of Stillwater.

2) Joints in portland cement concrete paving, curbs and gutters shall be constructed in accordance with ODOT standards unless otherwise accepted by the City of Stillwater.

C. Street Appurtenances:

1. Storm Sewer

a) Storm sewer mains (running parallel to street) shall not be located under street pavement unless accepted by City of Stillwater.

b) 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
Reinforced concrete low-pressure pipe	M242	C361
High Density Polyethylene (HDPE)	M252	D3350

c) 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. Pipe shall be fitted with concrete wingwalls and apron or slope walls.

d) For roadways with greater than 250 ADT, all storm sewer under roadway pavement shall be reinforced concrete pipe.

2. Structures and Specific Details

a) Loading: All structures subject to vehicular traffic shall be designed for H-20 loading.

b) Bridges: All bridge design shall meet the requirements in the latest edition of Standard Specifications for Highway Bridges prepared by AASHTO.

3. 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 directly to 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 should include adequate structural measures, such as energy dissipaters or concrete paving 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. The opening must be properly reinforced and protected. 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 directly or indirectly such that the flow crosses a sidewalk, bike path, trail or any other structure.

f) Sheet flow drainage onto roadway pavements will not be allowed for flows of greater than 1 cfs or flows less than 1cfs that exceed gutter spread requirements. Flows that meet the preceding criteria shall be tied directly to storm sewer system.

4. Sidewalks:

a) Designs for sidewalks within public rights of way and public easements shall conform to guidelines in the publication: Accessible Rights of Way: A Design Guide most recent edition, published by the U.S. Architectural and Transportation Barriers Compliance Board

b) The standard cross slope shall be1/4 IN per foot toward the curb or ditch as applicable.

c) All sidewalks shall be of Class A portland cement concrete.

d) Sidewalks shall include pedestrian bridges across creeks and streams where applicable.

e) The finished thickness of portland cement concrete sidewalks shall not be less than 4 IN. Sidewalks across driveways shall be 6 IN thick.

f) In general, sidewalks shall be constructed within the dedicated right-of-way except at intersections or as required by the City.

g) In right-of ways for arterials and collectors, sidewalks shall be separated from the street by a minimum of three feet measured from the back of curb line except in situations approved by the City of Stillwater where seven-foot-wide or greater sidewalks may abut the outside curb line.

h) Residential sidewalks shall be aligned so sidewalk edge is one foot from property line, except along arterial street frontage where utilities or other structures may require variations.

i) For roadways without curb and gutter, the sidewalks shall be located behind the back slope of the ditch line. When the sidewalk must be located on the roadway shoulder a 7 FT offset is required from edge of pavement to edge of sidewalk.

j) Wheelchair ramps shall be constructed in accordance with the Standard Details and the Americans with Disabilities Act (ADA) requirements for public rights of way.

k) Transverse crack control joints shall be placed at 5 FT intervals. Joints shall be tooled or sawed to a depth of one inch.

l) Expansion joints shall be placed at curbs, driveways, or abutting structures but shall not exceed 50 FT intervals.

5. Bicycle Paths and Lanes

a) Bicycle paths and lanes shall be designed in accordance with the AASHTO Guide for the Development of Bicycle Facilities.

b) Pavement sections for bike lanes adjacent to roadway shall match adjacent roadway pavement section.

6. Driveway Approaches

a) General:

1) All private roads, driveways, or streets serving residential, commercial, or industrial developments within the City, the use of which is not restricted, but is open to the public, either by connection with an existing street or because the design thereof, constitutes a thoroughfare accessible to the public and shall be constructed to specifications required for local streets.

b) Approach types:

Description	**Approach Type**
Local Street with side ditches and drainage pipe	I
Street with side ditches, no drainage pipe	I
Streets with curb and gutter	II

1) 1. Type I driveway approach:

A. Neither the intersection point of the driveway approach with the edge of pavement or the end of drainage culvert pipe shall extend past the projected side property line, unless written permission is given by the affected property owner.

B. Type I driveway approaches shall be Portland Cement Concrete (ODOT Class A) strength, 6 IN minimum thickness. For driveway thickness of 8 IN or greater, dowels are required at contraction joints and at joint connections with the street.

C. The minimum driveway pipe diameter shall be 15 IN. All driveway pipes shall include metal/aluminized end sections, concrete culvert end sections, or appropriate sloped concrete end sections.

D. Elevations/inverts of driveway pipe and end section shall conform to the Master Drainage Plan.

E. A drainage culvert pipe may not be required if the proposed driveway is located in an area with little to no contributing drainage area and has a shallow ditch, 12 IN depth or less. The design Engineer shall investigate the need for drainage culvert pipe and present findings to the City of Stillwater.

2) Type II driveway approach:

A. Type II driveway approaches shall Portland Cement Concrete (ODOT Class A), 6 IN minimum thickness. For driveway thickness of 8 IN or greater, dowels are required at contraction joints and at joint connections with the street.

B. At right-of-way line, the drive shall be at least the same elevation as the top of the existing curb.

C. New curb returns shall meet and match the existing curb. Driveway approach shall tie into existing gutter elevation,

D. Removal of the existing curb to receive the driveway approach shall be per the Standard Details.

c) Approach grades and dimensions:

1) Minimum approach width is 10 FT for residential and 24 FT for commercial.

2) Grades suggested for driveway conditions are listed below.

3) The maximum difference between the downward cross slope of the street (usually 2.0% or less) and the upward slope of the driveway approach shall not exceed 12.0%.

	Maximum Grade Change		
Condition	Approach	Desirable	Maximum
High Volume Driveway	0.06	0	0.03
Low Volume Driveway on Arterial or Collector Streets	0.06	0.03	0.06
Low Volume Driveway on local street	0.1	0.06	0.12

4) Any driveway approach exceeding the stated grades shall require City of Stillwater approval. A drawing of the proposed approach is required demonstrating that the appropriate design vehicle will be able to clear the transition from street to driveway.

7. Signage

a) Engineer shall design street signs (type and location) based on the latest version of the Manual of Uniform Traffic Control Devices (MUTCD) (list may not include all applicable signs):

Designation	Description
--	Street Names
OM	Object Markers
R1-1	Stop
R1-2	Yield
R2-1	Speed Limit
R4-7	Keep Right
R4-8	Keep Left
R5-1	Do Not Enter
R5-9	Wrong Way
R6-1	One Way
W8-5	Bicycle Crossing
W11A-2	Pedestrian Crossing Symbol
W14-1	Dead End or Not a Through Street
W15-1	Playground Ahead
	School Crossing

b) Street signage: Street signs shall be placed at each intersection. Signs shall designate the street names in both directions.

1) Sign height: Six (6) IN

2) Sign width alternatives: 24 IN or 36 IN depending on the length of the street name. Developer shall allow a one-inch margin on each end of the sign.

3) Sign Blade Thickness: 0.08 IN

4) Orientation: Double-sided

5) Color:

A. Green (Public streets)

B. White with Green Lettering (Private streets) and include "Private Drive" at the top or end of the blade.

6) Signs shall be extruded.

c) Sign posts:

1) Sign posts shall be 2 IN galvanized round steel tubing.

2) Lettering: Letters for street signs shall meet the following criteria:

A. Street name: 4 IN, white, heat activated reflective letters

B. Street designation: 4 IN, white, heat activated reflective letters (i.e., ST, E AVE, ST NO, etc.)

8. Striping

a) All striping and other traffic control symbols shall be full-thickness thermoplastic including striping for deceleration (or acceleration) lanes.

9. Lighting

a) General:

1) Street lights shall be installed by the franchised vendor providing the electrical service and shall be shown on preliminary and final street plans. Lighting shall comply with the LDC or the City's terms and conditions.

2) Street light placement shall be based on the function of the street to be lighted.

A. For primary and minor arterials, the primary objectives of street lights are traffic safety, street intersection illumination, and illumination of roadway geometry changes.

B. For minor streets and collectors, the primary objectives are street intersection identification.

3) Light poles shall be located a minimum of 5 FT to back of curb or future curb, including turn lanes and not obscure the sight triangle.

4) Street lights shall be co-located on pole where feasible.

5) Wooden poles shall not be used in residential neighborhoods.

10. Off-Street Driveway and Parking Areas:

a) Permeable Pavement Systems. A permeable pavement system may be substituted for concrete or asphalt for the construction of a driveway, parking area and/or parking space, provided the design and construction of such paving system meets the following performance standards:

1) Such paving system is installed in a manner that prevents water from standing for longer than forty-eight (48) hours in, on, or below the pavement following a rainfall event.

2) Such paving system is installed in a manner which allows for proper and adequate drainage to a designated stormwater collection area or conveyance system.

3) Such paving system is designed to direct and/or convey water flow away from a structure.

4) Innovative or specialized permeable pavement systems may be utilized provided the design and construction thereof strictly adheres to the manufacturer's specifications for installation and use. Such specifications and/or drawings shall be submitted to the City of Stillwater for review and approval prior to start of construction.

5) Design and construction of such paving systems shall conform to all other requirements of the Stillwater City Code or Stillwater Standards not specifically excepted by this section.

b) Westwood Overlay District: Temporary Gravel Construction: Gravel parking surface construction authorized by Section 23.275.13 shall conform to the general requirements of the Stillwater City Code Sections 27-128 and 37-129, except as follows:

1) The approach shall be a minimum of ten feet (10 FT) in width, five feet (5 FT) in depth, and constructed of concrete.

2) Mirafi Fabric No. #RS380i or an equivalent liner shall be placed from the back of the concrete approach to the edge of any area covered by rock.

3) Large aggregate for ODOT Class A concrete, or larger, shall be used.

4) All fabric and rock shall be free of fines to allow the infiltration of water.

5) Rock shall be placed at a minimum depth of four inches (4 IN) and contained within firm edge protection.

END OF SECTION

DESIGN STANDARDS

SECTION 1800

STORMWATER COLLECTION SYSTEMS

Part 1: General Requirements

A. Regulatory Requirements:

1. Develop all stormwater design plans to ensure all applicable regulations are met:

   a) Any applicable City of Stillwater Municipal Codes

   b) Any applicable State of Oklahoma statutes

   c) Any applicable United State of America federal regulations

2. Develop all stormwater system plans with applicable Oklahoma Department of Environmental Quality (ODEQ) design standards and to ensure proper permits are obtained.

B. Alignment Surveys

1. Alignment surveys for street projects shall be performed as specified in *Section 1020, Surveying and Drafting and Section 1700 Street and Appurtenances Design.*

C. Design all improvements in accordance with the Urban Drainage Criteria Manual, as adopted by the City Council as the City Drainage Standards prior to August 15th, 2011, unless otherwise specified by these standards.

Part 2: Definitions

A. Backwater: Backwater is the rise in a water surface elevation due to a constriction of flow. This may be caused by a reduction in the cross-sectional area of a channel or pipe system or by the presence of an obstruction within a stormwater drainage system such as dams, bridge abutments and support structure(s) installed within the channel or accumulation of debris.

B. Bridge: A bridge is constructed with abutments, intermediate supports (if required), and a superstructure, and is typically constructed of concrete, steel, wood, or a combination of these materials. The hydraulic criteria for bridges with regard to

C. dimensional clearances, impact on the bridge abutments and local supports that may be within the channel over which the bridge is established is different from that applied to culverts. Channels where bridges cross are usually constructed with natural earth or rock inverts, whereas culverts are typically the same material throughout the waterway opening.

D. Culvert: A culvert is defined as a closed conduit for the passage of water under an embankment, such as a road, railroad, or driveway. The distinction between a culvert and a storm sewer is the means by which flow enters the conduit. Flow normally enters a culvert from an open channel, generally at a similar elevation and a culvert usually crosses a street or driveway.

E. Flume: A flume is an open, artificial water channel, in the form of a gravity chute, which conveys stormwater.

F. Freeboard: The distance between the design frequency flood water surface elevation to the lowest structural member of a bridge superstructure, to the highest point of pipe, or to a set elevation within a channel system.

G. Full Urbanization: The total anticipated development in an area according to the Comprehensive Plan or applicable zoning requirements.

H. Impervious Surface: A paved or other hard surface that does not allow water to penetrate. Depending on the material, texture, and configuration of the material over which water runs, various surfaces exhibit different degrees of *imperviousness*.

I. Pervious Surface: A surface which will allow water to penetrate into the ground.

J. Post-Project Conditions: The planned physical characteristics to be attributed to a project area as a result of completed development activities.

K. Pre-Project Conditions: The physical characteristics attributed to a project area prior to starting development activities.

L. Stormwater Drainage System: All components of the municipal separate storm sewer system (MS4), both public and private, and includes but is not limited to the following: storm sewers (closed conduits); channels; drainage ways; areas covered by restricted drainage easements for the purpose of providing overland flow; street system; curbs and gutters; stormwater storage basins; underground stormwater storage structures; inlets; manholes; junction boxes; catch basins; headwalls; energy dissipater; sediment traps; culverts; and/or other appurtenances.

M. Stormwater Drainage Swale: A stormwater drainage swale or roadside swale refers to the drainage areas and related channels commonly referred to as barrow ditch, bar ditch or ditch.

Part 3: Construction Plan Requirements

A. Construction plan drawings shall include:

1. Plans shall provide the following information for the site:

a) contour lines and spot elevations to support construction;

b) existing and proposed elevations;

c) existing and proposed structures with elevation information;

d) obstructions;

e) storage basins;

f) roadways, pavement, parking areas or other impervious surfaces;

g) curbs/gutters;

h) all utilities (buried, elevated and/or abandoned);

i) easements, property lines, and rights-of-ways;

j) Best Management Practices (BMPs) for erosion and sediment control

k) all work limits;

l) FEMA regulatory floodplain zones (floodway, 100-YR, 500-YR)

m) appropriate profiles and section details; and

n) directions of flow.

B. Building Elevations

At a minimum, plans shall include ground elevations and grade at the buildings perimeter. Where buildings are within the FEMA regulatory floodplain, base floor elevations shall be identified.

C. Hydraulic Gradient

Plans shall include hydraulic gradient lines and/or 100-year floodplain water surface elevations, where applicable.

D. Site Context

Plans shall include any additional information for areas outside of the site limits that may require modification as part of the project to mitigate adverse impacts downstream.

E. Easements and Rights-of-Way

1. All restricted drainage easements shall be clearly shown detailed as to type, location, and width on the construction plans, record drawings, and final plats, as well as described in the conditions and restrictions of the plat or by separate instrument.

2. Adequate right-of-way shall be provided for access and maintenance to the drainage easement. Location and width shall be identified on the construction plans, record drawings, and final plats, as well as described in the conditions and restrictions of the plat or by separate instrument.

Part 4: Requirements for Drainage Reports and Plans

A. Drainage Report Certification and Submittal

1. The report to be submitted shall include a cover letter presenting the study for review.

2. Drainage reports shall be prepared in accordance with Article 15 of the City of Stillwater's Land Development Code (Chapter 23).

3. The report to be submitted shall follow standards contained within Section 1010: General Submittals.

4. Large drawings, which cannot be easily folded in with the report, may be folded and included in a pocket file at the end of the report.

Part 5: Drainage System Requirements

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 under full urbanization. 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. When roadways are used as a part of the stormwater drainage system, all street design requirements shall be followed.

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 easement as platted. City code prohibits structures from being located within restricted drainage easements.

3. The adjacent water surface elevation produced from a 1% (100-year) storm shall be no closer than 1 foot from the finished floor of any structure.

4. Drainage easement language shall state on the plat that the restricted drainage easement is provided for stormwater flow, and that the area shall be maintained by the property owner in accordance with the Land Development Code.

C. Bridges, Culverts, and Swales

1. All bridges 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 bridge. All culverts determined to be bridge box culverts, 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 inside top of the culvert.

2. All culverts under roadways, regardless of size, shall be designed to pass the flow produced by the regulatory 1% (100-year) storm with 1 FT of freeboard from the water surface to the upstream edge of pavement, for which backwater from 100% blockage would flood upstream structures. Backwater analysis shall be provided to illustrate compliance with this requirement.

3. 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.

4. 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.

5. Culverts shall be designed such that backwater from the culvert does not inundate any structure.

6. Provide protective measures for culverts and embankments to minimize embankment damage during overflow.

7. When roadside swales without storm sewers are to convey stormwater, the swales shall convey the regulatory 1% (100-year) flow and have a maximum depth of 30 IN to limit traffic and pedestrian safety hazards, regardless of right-of-way width, slope or paved bottom. If a greater depth is required, by design and/or site conditions, an alternative stormwater conveyance system must be used. Special considerations will be made for use of engineered bioswales which require a greater depth than 30 IN; traffic and pedestrian safety will be required to be addressed as part of the design. Roadside swale cross-slopes shall be no steeper than 3:1 (H:V). Wherever practical, side slopes of 4:1 (H:V) shall be required to allow for maintenance safety.

8. Roadside swales with vegetative cover shall have a longitudinal slope of no less than 2% to ensure drainage. When slopes greater than 2% are used, the channel must be designed to ensure that surfaces are protected from erosion.

Part 6: Rainfall

A. Introduction

The design rainfall data contained in *Table 1800.1 Total Rainfall Depth in Inches* 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 U.S. Weather Bureau Technical Paper No. 40, Rainfall Frequency Atlas of the United States is the basis for cumulative rainfall data of storm durations greater than one hour. The National Oceanic and Atmospheric Administration (NOAA) Technical Memorandum NWS HYDRO-35 is the basis for cumulative rainfall data of storm durations from 5 to 60 minutes.

Table 1800.1

Total Rainfall Depth (IN)

	Frequency (Return Period)							
Duration	1-Year	2-Year	5-Year	10-Year	25-Year	50-Year	100-Year	500-Year
5-Minute	0.42	0.48	0.57	0.63	0.72	0.80	0.87	1.00
10-Minute	0.69	0.79	0.94	1.04	1.20	1.33	1.45	1.70
15-Minute	0.88	1.01	1.20	1.34	1.73	1.70	1.86	2.20
30-Minute	1.17	1.41	1.73	1.96	2.29	2.61	2.81	3.30
1-Hour	1.42	1.83	2.29	2.61	3.08	3.44	3.80	4.70
2-Hour	1.65	2.14	2.75	3.28	3.84	4.37	4.88	6.00
3-Hour	1.80	2.23	3.09	3.60	4.19	4.75	5.36	6.65
6-Hour	2.15	2.68	3.63	4.25	5.00	5.55	6.18	7.86
12-Hour	2.65	3.25	4.29	5.06	5.89	6.55	7.36	9.00
24-Hour	3.10	3.77	4.96	5.74	6.75	7.61	8.56	10.50

Source: U.S. Weather Bureau Technical Paper No. 40 and NOAA NWS HYDRO-35

Part 7: RUNOFF

A. General

1. A drainage study which compares pre-project conditions to proposed conditions and shall be developed and submitted as a report as part of the design submittals.

2. For new construction projects, “pre-project conditions” refers to the natural state.

B. Soil Conservation Service (SCS) Unit Hydrograph Method

The method of runoff analysis that shall be used for the design of storm drainage

system components is the SCS Method.

1. Soil-Cover Complex Number (CN) Determination

   When using the SCS unit hydrograph method for a sub-basin, the SCS basin lag time shall be used in conjunction with the CN value to determine runoff. The soil type and vegetative covers of a watershed are generally classified separately. A combination of a specific soil type and a specific cover is referred to as a Soil-Cover Complex Number (CN) and a measure of this complex can be used as a watershed parameter in estimating runoff. The CN for each area in the hydrologic analysis can be derived by first determining the classification of the soil, and then choosing the CN from Table 1800.2 for the applicable cover type and hydrologic condition.

Table 1800.2 NRCS 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[2]**	**A**	**B**	**C**	**D**
Fully developed urban areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc)[3]:					
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)[4]		63	77	85	88
Artificial desert landscaping (impervious weed 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
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acres	12	46	65	77	82
Developing urban areas					
Newly graded areas (pervious areas only, no vegetation)[5]	77	86	91	94	
Idle lands (CN's are determined using cover types similar to those in Table 3)					

1 Average runoff condition and I_a=0.2S.
2 The average percent impervious area shown was used to develop the composite CN's. 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. CN's for other combinations of conditions pay be computed using Figures 3 or 4.
3 CN's shown are equivalent to those of pasture. Composite CN's may be computed for other combinations of open space cover type.
4 Composite CN's for natural desert landscaping should be computed using Figures 3 or 4, based on the impervious area percentage (CN=98)
and the pervious area CN. The pervious area CN's are assumed equivalent to desert shrub in poor hydrologic condition.
5 Composite CN's to use for the design of temporary measures during grading and construction should be computed using Figures 3 or 4 based
on the degree of development (impervious area percentage) and the CN's for the newly graded pervious areas.

2. Basin Characteristics

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)

3. Time of Concentration

The Time of Concentration (T_c) for the basin is made up of two time components, according to the following equation:

$$T_c = T_o + T_t$$

Where:

T_c = time of concentration (minutes)

T_o = initial, inlet, or sheet flow time (minutes)

T_t = travel time in the ditch, channel, gutter, storm sewer, etc. (minutes)

a) For urban areas, the time of concentration consists of an overland sheet flow time (T_o) plus the time of travel (T_t) in the storm sewer, paved gutter, roadside drainage ditch, or drainage channel.

b) For non-urban areas, the time of concentration consists of an overland sheet flow time (t_o) plus the time of travel (T_t) in a combined form, such as a small swale, channel, or drainage way.

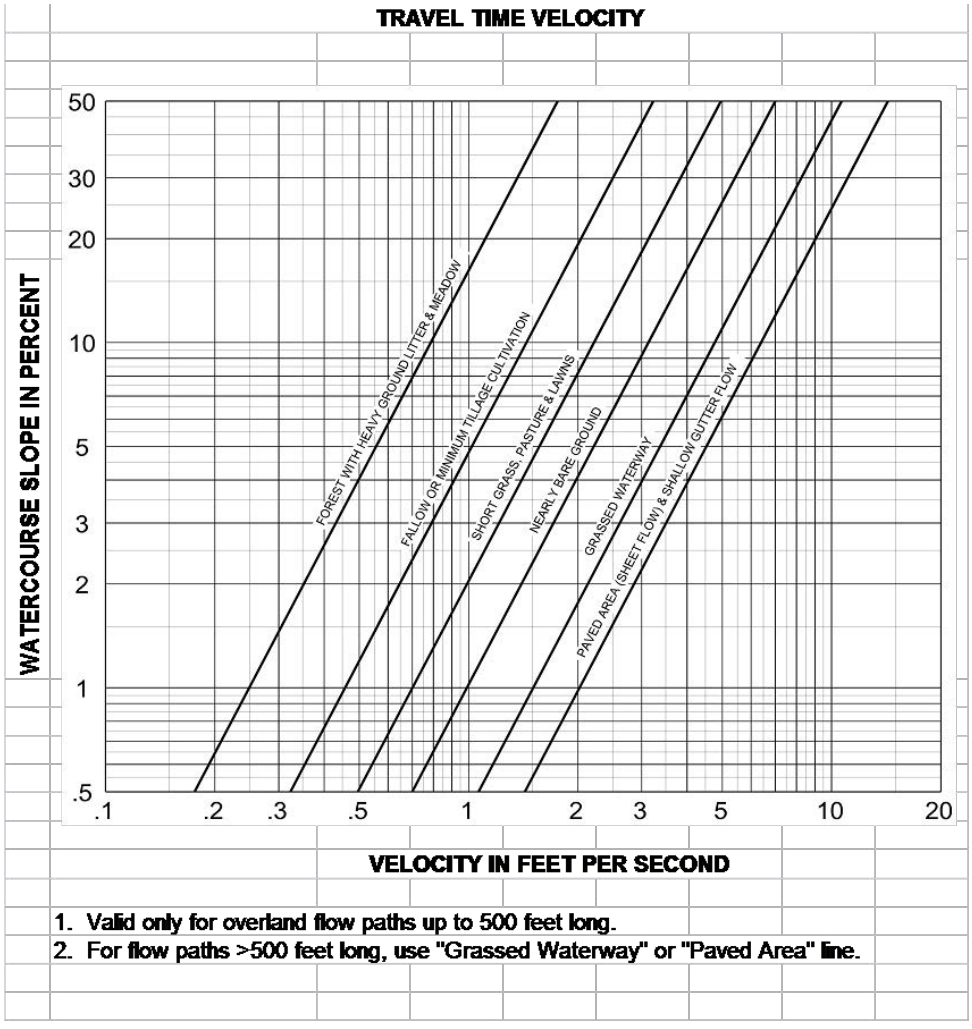
c) Overland sheet flow time, T_o, varies with surface slope, surface coverage and distance of surface flow. T_o is estimated using the appropriate line in Figure 1800.1.

d) If the distance of the overland sheet flow reach exceeds 500 FT, then the “Grassed Waterway” or “Paved Area (Sheet Flow) & Shallow Gutter Flow” line in Figure 1800.1 should be used. This occurs because the runoff is combined and the sheet flow assumption is no longer correct.

e) The Time of Travel, (T_t), of the time of concentration can be estimated from the hydraulic properties of the storm sewer, gutter, swale, ditch, or drainage way, or may be calculated using the "Paved Area (Sheet Flow) & Shallow Gutter Flow" line in Figure 1800.1.

f) A one-minute time increment shall be used in developing the rainfall distribution.

Figure 1800.1



C. Rational Formula

The Rational Method shall only be used to determine pipe sizes for stormwater drainage systems. It shall not be used for any routing calculations for stormwater storage facilities.

1. The Rational Method, using the Wright-McLaughlin modifier (correction factor) is based on the formula:

$$Q = C_f * CIA$$

Where:

Q = peak discharge, (cubic feet per second, cfs)

C_f = Wright-McLaughlin modifier

C = runoff coefficient (dimensionless) (see Table 1800.2 or 1800.3)

I = rainfall intensity for a duration equal to the time of concentration, (inches/hour)

A = watershed area (acres)

2. Runoff Coefficient

Runoff coefficients for different land use or surface characteristics are found in Table 1800.3. 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.

Table _1800.3 - 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	4 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. Use values in Table 1800.2.		

3. 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. As described in the February 1988 ODOT Drainage Design Manual, the following equations shall be used. The most current ODOT Intensity-Duration-Frequency curves shall supersede this information.

$$I = a/(T_c+b)^c$$

Where: I = rainfall Intensity (inches per hour)

T_c = time of concentration (minutes)

a, b, c = parameters defined in Table 1800.4

Table 1800.4

1988 ODOT Rainfall Intensity Parameters

Design Storm	Parameter		
	a	b	c
2 Year	56.43	11.5	.81
5 Year	72	15	.80
10 Year	82	15	.80
25 Year	95	15	.80
50 Year	108	15	.80
100 Year	120	15	.80

Part 8: Street Drainage

A. 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) Use of streets for conveyance of stormwater runoff shall only be allowed within the following limitations. Please refer to Design Standard, Sec. 1700 – Streets and Appurtenances.

b) 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.

c) Drive to street transition shall be designed to prevent gutter flow from flowing down the driveway. Design the driveway with the same freeboard required for the street section.

3. Location of Stormwater Sewer

Stormwater sewers shall not be placed beneath the wheel path of any driving lane of the pavement. The driving lane is defined as the normal width provided for each lane and delineated by pavement stripes. The preferred location of the storm sewer is according to the following order of priority:

a) Behind the curb

b) Down the center of the traffic lane (only with permission from the City Manager).

c) On centerline (only with permission from the City Manager).

B. Drainage Impact on Streets

1. Cross Flow

Cross flow over the crown of a street surface from one side of the street to the other side shall not be permitted without written permission from the City. Acceptance shall be based on documented exhaustion of all alternative means of design. Should cross flow be permitted, it shall be accounted for in the drainage calculations and shall be limited to intersections.

2. Concrete Valley Gutters

   Concrete valley gutters shall not be permitted unless authorization is given by the City of Stillwater.

C. Hydraulic Evaluation

1. Curb and gutter capacity shall be design in accordance with in the FHWA publication Urban Drainage Design Manual, Second Edition, summarized herein:

   a) The allowable storm capacity of each street section with curb and gutter shall be calculated using the modified Manning's formula:

$$Q = 0.56(Z/n)S^{1/2}Y_T^{8/3}$$

Where: Q = discharge is in cubic feet per second (cfs)

Z = reciprocal of the street cross slopes (S_x,ft/ft)

Y_T= depth of flow at the gutter (feet)

S = longitudinal grade of street (ft/ft)

n = Manning's roughness coefficient

Manning's roughness coefficient, n, shall be used according to the applicable construction condition as shown below in Table 1800.5

Table 1800.5

Manning's n-values for Street Gutters

Construction Type	n
Concrete gutter - troweled finish	0.012
Asphalt Pavement	

Table 1800.5

Manning's n-values for Street Gutters

Construction Type	n
Smooth texture	0.013
Rough texture	0.015
Concrete gutter with asphalt pavement	
Smooth	0.013
Rough	0.015
Concrete pavement	
Float finish	0.014
Broom finish	0.016
Brick	0.016

Note: For gutters on flat grade where sediment may accumulate, increase all above values of N by 0.002.

Source: Drainage Design Manual, ODOT, February, 1988

b) When the street cross-section has different cross slopes, capacity computation shall take into account the various cross slopes.

D. Roadside Swale Capacity

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. Where the design flow exceeds the capacity of the roadside swale, a storm sewer system shall be required.

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.

Part 9: STORM SEWER INLETS

A. General

1. Inlet Types

Multiple inlets occur when more than one inlet (of the same type) are used in a continuous series, resulting in greater flow interception capacity. Four types of inlets shall be allowed:

a) curb opening inlets;

b) combination grated with curb opening inlets;

c) median inlets; and,

d) area inlets.

2. Inlet types shall be in accordance with the ODOT standards.

3. Arterial streets shall use offset type inlets in accordance with ODOT standards.

4. Location of inlets:

a) Inlets shall be required to prevent the allowable depth and width of flow in the gutter from being exceeded.

b) Inlets shall be located at all low points in the gutter grade, 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.

c) Inlets at intersections shall be located in such a manner that no part of the inlet encroaches upon a curb return.

d) No drainage structure shall be permitted within a wheelchair ramp or crosswalk.

e) Parking lots shall be designed to have internal drainage systems so as to reduce concentrated flows into streets.

f) Curb inlets shall be located such that:

1) On all streets, at a minimum:

A. The depth of flow does not exceed curb height during the 10% chance (10-year) storm.

B. Concentrated flow is contained within the street right-of-way or easement during the 1% chance (100-year) storm.

2) On collector streets, at least one driving lane is free of concentrated flow during the 4% chance (25-year) storm.

3) On arterial streets and other four lane streets, at least two driving lanes (one in each direction) are free of concentrated flow during the 4% chance (25-year) storm.

g)

h) A maximum time of concentration, T_c, of 5 minutes to the first inlet shall be used for commercial and industrial areas.

i) Spacing between inlets shall be such that depths of flow and widths of spread requirements are not violated. Maximum spacing between inlets shall be 600 feet.

5. Interception and Bypass:

a) No more than 10% of street runoff shall be allowed 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 FHWA publication Urban Drainage Design Manual, Second Edition.

c) When inlets are placed in a sump, emergency overflow shall be provided.

6. Clogging Factors

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 shown in Table 1800.6 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).

c)

Table 1800.6 Clogging Factors		
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	0.7
Median	Sump(1)	0.8
Grate only(2)	Continuous grade	0.6
Grate only(2)	Sump	0.5

Notes: (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.

7. Grated Inlets

a) Curb/grate inlet capacities shall be in accordance with the FHWA publication, Urban Drainage Design Manual, Second Edition.

b) All grates shall be bicycle safe.

c) When a grate is used in conjunction with a curb opening directly behind the grate, only the hydraulic capacity of the grate shall be utilized to estimate the flow that is intercepted. The curb inlet is reserved to serve as overflow when the grate is blocked by debris.

d) Grate interception capacities shall be determined for the specific grate to be used in the project. For example, if the grate inlet is manufactured by Neenah Foundry, then the designer shall use Neenah's method of computing the capacity.

B. 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 to prevent violation of the criteria in Part 7:

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.

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.

2. Design Requirements

a) Minimum Cover Requirements

1) The minimum cover shall not be less than one foot from the top of pipe to the finished grade at any point along the pipe.

2) It is not acceptable for the pipe to encroach into the street base section without permission from the City.

b) Manholes

1) Manholes 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.

2) For storm sewers equal to or larger than 60 inches in diameter, provide pre-formed smooth transitions.

3) The maximum spacing between manholes for various pipe sizes shall be as shown in Table 1800.7.

Table 1800.7 - Storm Sewer Alignment and Size Criteria		
Manhole Spacing		
Pipe Size	**Maximum Spacing- 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 Feet	8 Feet
>66 Inches	500 Feet	Junction Structure
Minimum Radius For Pipe:		
Short radius bends shall not be used on 36-inch diameter or less for public systems.		
Minimum Pipe Diameter:		
Type	**Minimum Equiv. Pipe Dia.**	**Minimum Cross-Section**
Main trunk	15 Inches	1.23 SF
Lateral from Inlet	15 Inches	1.23 SF

Source: *Stormwater Criteria Manual*, City of Tulsa

4) See Section 1107 – Buried Pipe Design for horizontal and vertical separation requirements.

c) Siphons

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

d) Grade Lines

1) The hydraulic grade line (HGL) and energy grade line (EGL) 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) No outlets shall be designed to discharge below the normal pool.

4) The hydraulic grade line (HGL) shall be shown on all profiles of storm sewers including more than one pipe section.

5) The energy grade line (EGL) for the design flow shall be no more than one foot above the final grade at manholes, inlets, or other junctions.

6) 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.

e) Horizontal Alignment

1) Storm sewer alignment between manholes shall be straight except when accepted in writing by the City. If approved, storm sewers may be constructed only by deflecting joints.

2) Fittings may not be used to construct non-straight storm sewers.

3) The storm sewer shall be located behind the curb within the street right-of-way.

4) Centerline Georeferencing

A. Manholes and catch basins shall be stationed on the plan sheets using centerline stationing with left or right offset dimensions.

B. Inlets with grates shall be stationed from the centerline of the road to the back of the curb.

f) 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.

2) Storm sewer shall be closed conduit up to 60 IN in diameter pipe or its hydraulic equivalent.

3) Stormwater drainage systems that carry a flow greater than the capabilities of a 60 IN conduit system may be designed as an open system or as an unimproved channel, such as an existing stream.

g) Storm Sewer Capacity and Velocity:

1) The storm sewer capacity and velocity shall be based on the Manning's n-values.

2) The maximum full flow velocity shall be less than 20 feet/sec.

3) The minimum velocity in a pipe based on full flow shall be 2.5 feet/sec to avoid excessive accumulations of sediment.

4) If seeking approval for higher velocities, provide verification that the design includes adequate provisions for uplift forces, dynamic impact forces and abrasion. Acceptance shall be based on a documented exhausting of all alternative means of design.

h) Miscellaneous Criteria

1) No pipe shall be installed downstream having a smaller capacity than the upstream pipe or combination of upstream pipes.

2) The horizontal clear distance between multiple storm sewer pipes being placed in the same trench shall be a minimum of 24 IN or one-third the diameter of the largest pipe, whichever is greater. This application includes multiple pipes for culverts.

3) The largest diameter storm sewer entering or exiting a 4 FT diameter manhole shall be 24 IN. Junction boxes shall be installed when 4 FT diameter manholes cannot be used.

4) Drainage pipes shall not enter manholes within the corbel-section.

5) 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.

6) Discharge points with 18 IN pipe or larger shall be fitted with a protective grate to prevent access into the pipe.

7) In no case shall the storm sewer outlets, drain pipe, or any other drainage structure discharge directly or indirectly such that the flow crosses a sidewalk, bike path, or trail.

Part 10: OPEN CHANNELS

A. Channel Types

1. Trapezoidal Channels

a) Trapezoidal channels shall have a minimum bottom width of 4 FT with side slopes not to exceed 4:1 cross-slope for vegetated sections.

b) Trapezoidal channels shall have a minimum bottom width of 4 FT with side slopes not to exceed 1:1 cross-slope for paved or rock-lined sections.

2. Rectangular Channels

a) Rectangular channels are not acceptable without written permission from the City.

b) All rectangular channels are to be concrete on all sides.

3. Trickle Channels

a) All channels altered or improved from the natural state shall require a paved trickle channel.

b) Trickle channels shall be constructed of concrete, shall be a minimum of 24 IN wide and 5 IN deep at the center, and shall be constructed with a “V” shape.

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.

B. Channel Design Criteria

1. Concrete Flumes

a) Concrete flumes are required for emergency overflow protection for storm sewer systems at sump locations.

b) All concrete flumes shall discharge into a drainage facility, channel or storm sewer system.

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) The thickness of the vertical concrete walls shall be a minimum of 6 IN.

3. Manning's n-value: Manning's equation in the calculations of hydraulic characteristics of channels shall be acceptable. The "n" value used for channels shall be based on the individual channel characteristics, as shown below in Table 1800.7. Designers should anticipate growth of future vegetation as a natural maturation process of the channel. Values less than 0.05 shall be justified by the design engineer in writing.

Table 1800.7 - Manning's n-Value for Open Channels

Channel Type	**n-Value Range**	**Recommended Value**
Grass-lined, maintained	.029 to .100	
Grass-lined, not maintained	.045 to .10	.035
Natural Streams	.025 to .100	Note (1)
Riprap Lined		
1. Ordinary riprap	.025 to .050	.035
2. Gabions	.025 to .050	.035
3. Grouted riprap	.023 to .030	.027
4. Slope mattress	.025 to .033	.028
Concrete Lined		
1. Float finish	.013 to .016	Note (2)
2. Slip formed	.013 to .016	Note (2)
3. "Gunite" or "Shotcrete"	.016 to .023	Note (2)

Notes:

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

2. High value used for capacity determination and low value used for velocity consideration

4. Minimum Longitudinal Slope: Channels shall have minimum slopes of 0.5% for concrete-lined channels and 2% for grass lined channels and cross-slopes.

5. Minimum Velocity: Minimum velocity in a drainage system, having a roughness coefficient less than or equal to 0.015, shall be 2.5 feet/sec to avoid sedimentation.

6. 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 flowing supercritically shall not exceed 15 feet/sec. Minimum Froude Number shall be 1.2.

7. 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 Drainage Manual*.

8. Freeboard:

    a) For subcritical flow, the straight-channel freeboard requirement is 1 FT above the water surface elevation.

    b) For supercritical flow, the straight-channel freeboard requirement shall be calculated with the following formula:

$$H_{FB} = 2.0 + 0.025V\,(d)^{1/3}$$

Where: H_{FB} = freeboard height (feet)

V = velocity (fps)

d = depth (feet)

c) 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

9. 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.

C. Deep 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. 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.

3. Closure of ends shall be made in such a manner as to not impede flow of stormwater.

4. Fencing shall be a minimum of 6 FT high chain link fence in compliance with the National Chain Link Fence Institute.

5. Posts shall be embedded in concrete a minimum of 1.5 FT in depth.

D. 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. Such protection shall be considered added protection over and above controlling channel flows by reduction of velocities and turbulent conditions to meet open channel design requirements. Such protective measures shall be required, but are not necessarily limited to the following:

a) confluence point(s) of one or more channels;

b) outlet(s) of a storage or sediment catch basin which directs flows into an open channel or swale;

c) points of entry or exit from culverts or storm sewers which direct flows into an open channel or swale;

d) points within an open channel where significant changes in direction or elevation can result in localized erosion; and

e) points within an open channels where soils are prone to erosion due to the nature of soil(s) and/or vegetative protection is not possible due to physical constraints.

2. Types of Acceptable Channel Protection

a) Channel protection may consist of:

1) established vegetation;

2) permanent turf reinforcement mats (TRMs);

3) concrete liners;

4) armored protection such as rock gabions;

5) specialized bank stabilization products; or

6) any acceptable combination.

b) When lining channels, no resulting backwater effects shall create adverse impacts upstream due to increased bank saturation and subsequent erosion.

c) Methods used for channel protection shall be reviewed by the City for acceptance.

d) Criteria used for acceptance will include but will not necessarily be limited to:

1) applicability to specific design conditions;

2) durability of product in application;

3) historical performance of the application; and

E. longevity and maintainability of the protective measures. Bridge-Channel Interface Considerations

1. Channel Sizing at Bridge Crossings

The sizing criteria for channels at bridge crossings shall follow standard modeling and drainage analyses included for channel designs and shall ensure all drainage criteria are met.

2. Freeboard

    a) The minimum freeboard shall be 2 FT for the 1% (100-year) flood event.

3. Backwater

    a) The maximum backwater allowed upstream from a bridge shall be 1 FT for the 1% (100-year) flood event.

    b) In all cases, floodplain requirements shall be met.

    c) When lining channel cross-sections at bridges, no resulting backwater effects shall create adverse impacts upstream due to increased bank saturation and subsequent erosion.

4. 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.

    b) Riprap shall not be placed in the thalweg, or deepest point, of the channel.

5. Inlet and Outlet Configuration

    a) The design of channel crossings at bridges shall include adequate wing walls, as extensions of the abutments which are of sufficient length, position and slope to prevent abutment erosion.

    b) Slope stabilization shall be provided from the embankment to the channel in a manner which provides smooth transition between the portion of the channel affected by the bridge and the upstream and downstream segments of the channel.

    c) Channel inlet and outlet transition slopes shall be protected from the erosive forces of eddy currents. Please refer to *Part 10.D, Channel Erosion Protection*.

6. 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) Any necessary temporary modifications to the channel configuration shall be designed and submitted for review and acceptance by the City.

    c) During construction phase, intermediate bridge support(s) shall be designed and detailed to resist scour and provide protection to the support structure as well as the channel from the erosive forces.

    d) Intermediate bridge supports shall be designed to limit debris entrapment at the supports.

e) Best Management Practices (BMPs) for erosion and sediment control shall be provided.

f) 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.

Part 11: Culverts

A. 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. Please refer to Part 5.C for specific design criteria.

2. Size Requirements:

a) Round culverts will have a minimum diameter of 18 IN unless installation is below a driveway. The minimum diameter for driveway culverts is 15 IN. 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

b) Box culverts will have minimum inside dimensions of 3 FT wide by 3 FT high.

3. Velocity Limitations: In design of culverts both the minimum and maximum velocities shall be considered.

a) A minimum velocity of 2.5 feet/second at the outlet shall be required to encourage passage of all sediment and debris through the culvert.

b) 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. Velocity Limitations

4. 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) The engineer shall detail all aspects of the culvert, including headwalls, wing walls, seating and bedding and cover material, culvert material selection, reinforcement (if applicable), and specifications.

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. Minimum cover over top of the pipe shall be 12 IN. If 12 IN coverage cannot be obtained, special design details shall be provided to ensure proper distribution of load.

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 formed from corrugated metal (CMP), high density polyethylene (HDPE), or an equivalent commercially-available material shall be provided with appropriate, pre-fabricated end-sections. As an alternative, concrete may be used for constructed headwalls, slope walls or wing walls for these culverts.

g) Headwalls, slope walls and wing walls shall be no less than 6 IN in thickness and shall be uniformly reinforced. Reinforcement shall be done in such a manner which ties all parts of the inlet or outlet structure together.

h) When walls are greater than 2 FT high, walls shall be designed to meet overturning considerations from lateral, saturated soil pressures. 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 encouraged.

j) Energy dissipaters shall be provided, as required.

5. Restrictions for Use of High Density Polyethylene (HDPE) Pipe Culverts

a) HDPE may be allowed if the design engineer has specifically designed the material for loading conditions and has detailed proper placement and burial procedures.

b) Use of HDPE in the right-of-way shall conform with provisions stated in Section 1700 and shall require the acceptance of the Transportation Department.

c) Bedding and proper placement of backfill, as well as development of adequate design cover, shall be required and all placement procedures shall follow the manufacturer's recommendations.

Part 12: STORAGE AND INFILTRATION

A. General Design Considerations

1. Whereas urbanization results in more impervious area and a reduction in floodplain storage, both of which contribute to increased flow rates in streams, development plans and/or engineering report shall incorporate permanent, post-construction stormwater features which support storage and infiltration to the maximum extent practicable.

2. Designs shall encourage stormwater infiltration, support reduction of stormwater pollutants and minimize erosion and sediment transport.

3. The following permanent stormwater features may be used in design:

   a) stormwater catchment basins with treatment devices;

   b) stream buffers and riparian area preservation;

   c) open space and green-space preservation, especially within floodplains;

   d) wet ponds or wetlands;

   e) bioretention cells ('raingardens'), bio-swales, and infiltration trenches;

   f) dry wells, sand cisterns, and pervious pavement or pavers;

   g) other commercial systems or products which demonstrate low-impact development techniques.

B. 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. The excess runoff is that runoff generated due to urbanization, as determined in the accepted drainage, which is greater than the runoff historically generated under pre-project conditions for a given frequency storm must be retained on site.

4. Stormwater storage facilities shall be designed so that the peak rate of discharge does not exceed that of the pre-development conditions for the 1-, 2-, 5-, 10-. 25-, 50-, and 1% (100-year) storm events under full urbanization.

5. Designs shall demonstrate that discharge is conveyed downstream in a system, as accepted by the City, and in a manner which does not create adverse impacts.

6. Freeboard Requirements

   Table 1800.8 outlines the various freeboard requirements for stormwater storage facilities.

Table 1800.8 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 (100-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. 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.

8. Final record drawings of the stormwater storage area(s) indicating final topography and field-verified, volumetric calculations of design capacity shall be provided to the City to ensure design capacity has been met or exceeded.

C. Design Criteria

1. Design of flows to storage facilities shall be determined using the methods expressed in this chapter.
2. All calculations for stormwater storage facilities shall be included in the drainage study.
3. Existing pond and channel storage capacities shall be considered in pre-project condition evaluations.
4. Design of each facility shall incorporate methods which minimize bank erosion and support facilitation of future maintenance.
5. Stormwater storage facilities shall be located outside of existing channel storage.
6. Stormwater storage facilities shall be located with outlet elevations above the 1% (100-year) water surface elevation of existing channel storage areas. Any design which considers storage below the 100-year water surface elevation shall be designed to ensure no adverse impacts..
7. Stormwater storage facilities shall be designed for construction within the project area from which stormwater runoff is to be collected.
8. Any dam or berm shall be designed in accordance with the dam safety criteria of the Oklahoma Water Resources Board.
9. The use of permanent pool stormwater storage basins or ponds shall be designed to discharge as described in this section.
10. 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.
11. The permanent pool arrangements shall be designed to ensure stability of the structure and surroundings. Considerations shall be given to address potential for leakage from the permanent pool and its affects on the surroundings, including any planned structures, which may be constructed adjacent or in the proximity of the basin pool.
12. An access way at least 20 feet wide shall be provided to any required stormwater storage area. Access may be provided by frontage on a dedicated public street or by a restricted access easement from a dedicated public street to the stormwater storage area.

D. Geotechnical Considerations

1. Movement of large amounts of earth shall consider the requirements to construct stable, permanent earthen structures,

2. Large embankments shall be constructed with proper founding materials, lift thicknesses, and compaction requirements which allow for stable layering of soils and interlocking lifts.

3. Where more than 50 cubic yards of soil is moved and where heights of an embankment are to exceed more than 48 IN above the surrounding grade, the professional engineer shall evaluate the stability of the embankment under consideration and the method and materials used in its construction. Consideration shall be given to the water table level, local settlement, and surrounding soils stability as part of the evaluation. The professional engineering evaluation and resulting related construction considerations shall be for review and acceptance by the City to ensure that stability of the structure and the surrounding site is met.

4. In no case shall embankments be placed in lifts exceeding 6 IN in thickness.

5. Each lift shall be placed and compacted to at least 95% standard proctor density.

6. All vegetative material and soft soils shall be removed from the existing grade in accordance with the direction of the professional engineer to establish a sound foundation for the embankment prior to placing the initial lift.

7. The initial lift of the embankment fill placed over natural foundation material shall be locked into the base material by scarifying and blading to provide a rough surface to which successive lifts will be interlocked.

8. Each successive lift shall be interlocked with the previous lift to ensure continuity in the earthen embankment.

E. Physical Features

1. Spillways shall be constructed to pass the 100-year flood event with a minimum of 12 IN of freeboard on the earth dam structure.

2. Cross-sections shall be provided indicating the 5-, 100- and 500-year pool elevations.

3. Side slopes on stormwater storage facilities shall not be steeper than 4:1. Conditional acceptance of steeper slopes shall be based on a documented exhausting of all alternative means of design.

4. Stormwater storage facilities intended to function solely as detention basins shall include a low flow concrete trickle channels with a minimum slope of 0.5% from the inlet(s) to the outlet structure to transmit low flows in an effort to remove all runoff and to prevent channel formation in the base of the facility.

5. Inlet structures shall be designed to direct stormwater flows from storm sewer pipes and channels into the storage basins.

6. Inlet point(s) shall be protected by the installation of reinforced concrete wing walls or headwalls.

7. All surfaces of a storage basin shall be protected to avoid erosion and to support facility structures by application of permanent vegetative cover, turf reinforcement mats (TRM), riprap or other commercial armoring.

END OF SECTION

Construction Standards

Adopted

5/7/2018

Division 2: Construction Standards

2001 General

2101 Site Work

2102 Care of Trees

2103 Clearing and Grubbing

2104 Earth Work

2105 Demolition

2106 Restoration

2107 Buried Pipe Construction

2108 Bored or Encased Pipe Construction

2110 Construction Stormwater Pollution Prevention

2200 Concrete

2301 Earth Retaining Structures

2400 Drinking Water Distribution System Construction

2500 Wastewater Collection System Construction

2700 Streets and Appurtenances

2800 Stormwater Collection System

Division 3: Details

3100 General Details

3400 Drinking Water Distribution and Treatment Details

3500 Wastewater Collection and Treatment Details

3700 Streets and Appurtenances Details

3800 Stormwater Collection System Details

CONSTRUCTION STANDARDS

SECTION 2001

GENERAL

Part 1: General

A. Construct improvements to a high standard of care and quality consistent with the specified design life.

B. Install all materials in strict accordance with the manufacturer's written instructions.

C. Refer to City of Stillwater Municipal Code, Chapter 9, for requirements associated with stormwater pollution prevention.

D. Do not occupy right-of-way, public property, or easements without permission from the City Manager.

E. All earth changes requiring an Earth Change, Grading and Flood Control Permit or improvements of the stormwater collection system within the City of Stillwater shall be done under the guidance of a professional engineer or other accepted design professional and in keeping with an accepted design.

F. Notify the City immediately if conditions in the field are identified that may prevent installation of the infrastructure in accordance with the design and construction standards.

G. Comply with all restrictions placed on easements.

H. If specific information required by the Design Standards is not included in the drawings, bring the omission to the attention of the City immediately so that the omission can be corrected. It is not acceptable to assume that by omitting such information the Engineer intended that any material or procedure is acceptable.

Part 2: ODOT Standards

A. References are made in these standards to certain ODOT standards. When such references are made, certain terms are redefined to be applicable to the type of project.

1. Resident Engineer: the director of the respective City of Stillwater department that manages the subject type of infrastructure.

2. Project: the project as it relates to the installation of infrastructure that is or will become the property of the City of Stillwater or Stillwater Utilities Authority.

3. Plans: the construction drawings and specifications for the project.

4. Department: the respective City of Stillwater department that manages the subject type of infrastructure.

5. Contract: a code requirement or agreement with the City governing the construction of public infrastructure.

6. Contractor: Any party responsible for construction of public infrastructure.

7. When the ODOT standards make references to road construction, these references should generally be regarded as references to the complete breadth of infrastructure to be installed and not roads exclusively.

8. When the ODOT standards make references to right-of-way, these references should generally be regarded as references to right-of-way, easements, or other property, owned or proposed to be owned by the City, on which the subject infrastructure is proposed for installation.

Part 3: Stored Materials

A. Store all materials in strict accordance with the manufacturer's recommendations.

B. Maintain the sanitary condition of all components of drinking water systems.

C. Store all materials in a manner that does not block drainage ways.

CONSTRUCTION STANDARDS

SECTION 2101

SITE WORK

Part 1: General

A. Section Includes:

1. General requirements for construction activities on public property or on property to be dedicated to the public.

Part 2: Products (Not Used)

Part 3: Execution

A. General Requirements:

1. Preserve all property corners, pins or markers. In the event any property corners, pins, or markers are removed, such property points shall be replaced at the Contractor's expense and reset by a Licensed Surveyor. In the event such points are section comers or federal land corners, they shall be referenced and filed with the appropriate authority.
2. See Section 2102 for tree protection measures.
3. Clear, clean, and install driveways and other access facilities as necessary to allow inspection.
4. Dispose of all waste in a manner complying with local, State and Federal regulations.
5. Mark edges of temporary and permanent public right-of-way and easements prior to disturbing site. Maintain markings throughout construction.
6. Provide stormwater pollution prevention controls in accordance with City Code.

B. Additional Requirements for work on public property:

1. Confine operations to that area provided through easements, licenses, agreements and right-of-way.
2. Keep all grassed areas mowed during construction.
3. Prior to disturbing site, contact the City directly for utility location of buried storm sewer.
4. Keep the premises free from the accumulation of waste materials and rubbish. Provide adequate waste receptacles about the site and shall promptly empty the containers when full.

C. Care of Water:

1. Maintain dry and stable excavations at all times, including during rain events and when work is not in progress or the site is unattended.

2. Provide and maintain adequate dewatering equipment to remove and dispose of all surface and groundwater entering excavations, trenches or other parts of the work.

3. Remove water from excavations in a manner that will not damage property or compromise the integrity of work in progress. Obtain necessary permits, and provide for an appropriate method of discharging such water from the work site.

4. Make adequate provisions to prevent the inflow of storm water into open excavations. Construct temporary works, including dams, flumes or other, to keep the excavation clear of water.

5. Maintain graded areas to be well drained at all times. Maintain roadway ditches, channel changes, inlet and outlet ditches and other ditches in connection with the roadway. Keep all ditches and channels free of debris or obstructions.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2102

CARE OF TREES

Part 1: General:

A. Section Includes: temporary facilities for the protection of trees during construction activities.

Part 2: Products

A. Type B Wood Fence:

1. Vertical planking: any.
2. Stringers: 2x4 lumber.
3. Vertical Supports: 4x4 lumber for every fourth vertical support, 2x4 otherwise.

B. Type C Fence:

1. High Visibility Plastic Construction Fence:
    a) Fence material:
        1) Height: 4 FT.
        2) Material: high density polyethylene resin, extruded and stretched.
        3) Color: high visibility international orange.
        4) Fabric pattern may vary from diamond to circular. Maximum opening 2 IN.
        5) Minimum weight 0.4 LBS per FT for 4 FT tall section.
    b) Fence supports:
        1) Steel pipe, tee posts, u posts, or 2x4 lumber.
        2) Minimum height: 66 IN.

C. Trunk Protection:

1. 2x4 or 2x6 lumber.

D. Tree Dressing: any asphaltic tree dressing paint.

Part 3: Execution:

A. General:

1. On property to be dedicated to the public: Identify trees that the current property owner intends to leave on site when dedicated to the public.

2. On public property, easement or right-of-way: obtain permission from the City prior to removing trees.

3. All trimming, dressing, and damage repairs shall be performed by or under the direct supervision of a Certified Arborist.

B. Prior to beginning site work:

1. Protect all trees to remain from:

a) Scarring, barking, and other injuries.

b) Soil compaction in the root zone area resulting from vehicular traffic or storage of equipment or materials.

c) Root zone disturbances.

d) Damage to exposed roots, trunks or limbs by mechanical equipment.

e) Other activities detrimental to trees such as chemical storage, concrete truck cleaning, and fires.

2. Remove trees in the work zone that are not to remain.

3. Trim trees to make way for construction operations and protect trees from damage.

4. If tree protection interferes with sight triangles, provide traffic control.

C. Protection:

1. Type A Fence:

a) Minimum height: 4 FT.

b) Maximum spacing between support posts: 8 FT.

2. Type C Fence:

a) Set fence supports so that fence fabric is within 2 IN of the ground and the fence posts do not extend more than 2 IN above the top of the fence fabric.

b) Maximum spacing between support posts: 8 FT.

c) Secure fence to posts with at least three zip ties (or bands or tie wires) per post.

3. Trunk Protection: Completely protect trunk within 72 IN of ground. If construction operations pose a threat of additional injury above 72 IN, protect trunk accordingly.

4. Repair of Damage:

a) General: disinfect all trimming tools with alcohol or 5 ppm chlorine solution prior to use.

b) Root Trimming:

1) Cut cleanly and cover with topsoil.

2) When roots are pruned, remove a comparable portion of branches from the opposite side.

c) Branch Trimming:

1) Cut at the branch collar.

2) Cut all branches greater than 1 IN in accordance with ANSI 300 pruning methods to prevent splitting.

3) Apply tree dressing to all cut limbs.

d) Tree Dressing: Apply tree dressing immediately after damage occurs, in accordance with manufacturer's recommendations.

e) Fertilize all trees damaged during construction.

D. During and after completion of site work: Repair all damage to trees.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2103

CLEARING AND GRUBBING

Part 1: General:

A. Section Includes: Removal and disposal of all above and below ground obstructions, including, but not limited to trees, brush, fences, retaining walls, patios, signs, mail boxes, lamp posts, outbuildings, stumps, logs, and large rocks above the ground level, with the exception of paved areas.

B. Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 201 (Clearing and Grubbing). Exceptions: Method of Measurement and Basis of Payment do not apply. Other exceptions, additional requirements, and clarifications are noted below.

Part 2: Products: Not used.

Part 3: Execution

A. Avoid stripping ground cover where practical.

B. Clearly mark all objects to remain in place during construction.

C. Backfill all holes remaining after removal of objectionable materials with select embankment material.

D. Do not leave debris or extra materials in the right-of-way or easement.

E. When removing trees, remove stump and large roots unless, in the opinion of the City Manager, such removal may result in damage to existing buried utilities. If all of the stump is not to be removed, grind to a minimum of 12 IN below finished grade.

F. For work conducted on City property, offer right of first refusal to the City for all removed construction materials such as brick, signs, manhole components, etc.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2104

EARTH WORK

Part 1: General

A. Section Includes: trench excavation and backfill, excavating material and constructing embankments, including stockpiling, hauling, placing, disposing, sloping, shaping, compacting, and finishing earth materials on public property or on property to be dedicated to the public.

B. Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 202 (Earth Work). Exceptions: Method of Measurement, Basis of Payment, and other exceptions and clarifications, as noted below.

C. Municipal Code Compliance: Disturbance of earth requires the issuance of an Earth Change, Grading and Flood Control (ECP) in accordance with municipal code, prior to commencement of construction activities.

Part 2: Products:

A. CLSM (also known as "flowable fill"): Controlled Low Strength Material (CLSM) as defined by the American Concrete Institute (ACI).

Part 3: Execution

A. Salvage topsoil before beginning any excavation.

B. Replace all materials excavated below the bottom of concrete footings, slabs on grade, foundations and pavements with CLSM.

C. In ODOT 202.02.A, delete the reference to Field Divisions 4, 5, 6, and 7. The requirements regarding sulfate content in borrow for subgrade treatment apply, regardless of which ODOT Field Division the project is located in.

D. In ODOT 202.04, delete the reference to Section 107, "Legal Relations and Responsibility to the Public." Perform the work in accordance with applicable law.

E. In ODOT 202.04.A(1)(a), obliterate old roadways to provide a pleasing appearance from *any location on the project site* and in such a manner that future maintenance of above and below grade infrastructure is not impeded.

F. Site Stability and Stormwater Pollution: during construction, protect against erosion, land subsidence, and mass movement.

G. Establish dedicated and managed stockpile areas.

H. When performing improvements near structures, survey the nearby structures before and after construction of the improvements to determine if there is any structure movement or related adverse impacts.

I. Do not bury or dispose of organic materials such as grubbed vegetation, tree branches and boles, root masses, etc. on site.

J. Do not bury rubble greater than 6 IN in any dimension.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2105

DEMOLITION

Part 1: General

A. Section Includes: removal and disposal of pavement, buildings, foundations, and other structures and improvements.

B. Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 210 (Obliterating Abandoned Road.). Exceptions: Method of Measurement, Basis of Payment, and other exceptions, additional requirements, and clarifications, as noted below.

Part 2: Products: Not Used.

Part 3: Execution

A. For work conducted on City property, offer right of first refusal to the City for all removed construction materials such as brick, signs, manhole components, etc.

B. Backfill all holes remaining with select embankment material.

C. Portland cement concrete pavement:

1. Break pavement into pieces no larger than 12 IN in any dimension.
2. Cut off protruding ends of reinforcement steel.
3. Saw cut the edges of existing pavement to remain in service.
4. Cut existing reinforcement flush with saw cut edge.

D. Transport asphalt concrete millings to the City's Transportation Service Center or other stockpile location approved by the City.

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

F. Do not spread broken concrete on public property or easement without permission from the City.

G. Underground utilities: Cut water distribution and sanitary collection system service lines back to the main and cap or plug. Obtain inspection and approval from the Water Utilities Director after capping or plugging connections to City mains.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2106

RESTORATION

Part 1: General

A. Section Includes: restoration of surfaces and features, including turf, pavement, and fencing, and generally returning the project site to a condition equal to or better than prior to beginning the project.

Part 2: Products (not used)

Part 3: Execution

A. General:

1. Restore the project site to conditions equal to or better than those existing prior to beginning the project.
2. Any tree, shrub, or bush replaced shall be planted outside of City rights-of-way and easements.
3. Water and fertilize turf and plantings throughout the project.
4. Establish a viable stand of turf on all disturbed areas.

B. Turf:

1. Sod all disturbed areas as described below. Seeding may be acceptable with written permission from the City Manager.
    a) When existing turf is well maintained, replace with like sod.
    b) When weather and season are not suitable for establishment of required vegetation, stabilize seed bed, seed with perennial rye and then plant required vegetation when weather and season are suitable.
    c) When existing turf is poorly maintained, sparsely vegetated, or otherwise not equal or marginally equal to a high quality sod installation:
        1) In full sun, install bermuda sod or plant bermuda sprigs and mulch.
        2) Otherwise, seed with a bermuda and fescue mixture and mulch.
2. Where landscaping has been placed and maintained in a public right-of-way, restore completely.
3. Where landscaping has been placed and maintained in an easement as part of a residence's lawn: restore with sod.

4. Fertilize and water all restored turf until turf is well established. Provide temporary irrigation if necessary.

5. Sodding and Sprigging:

    a) Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 230 (Sodding and Sprigging). Exceptions: Method of Measurement, Basis of Payment.

    b) Additional requirements:

        1) 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.

        2) Place sod in rows perpendicular to the flow of water. Pin all corners and upstream/uphill edges 12 IN O.C. of sod panels in drainage channels and all corners and on slopes steeper than 5:1.

        3) Water sodded areas as often as necessary to maintain optimal soil moisture for establishment of a viable stand of grass.

6. Planting: perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 231 (Planting). Exceptions: Method of Measurement, Basis of Payment.

7. Seeding:

    a) Perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 232 (Seeding). Exceptions: Method of Measurement, Basis of Payment.

    b) Additional requirements:

        1) Provide only seed labeled in accordance with the Federal Seed Act.

        2) Water seeded areas as often as necessary to maintain optimal soil moisture for establishment of a viable stand.

8. Mulching: perform work in accordance with ODOT Standard Specifications for Highway Construction, Section 233 (Mulching). Exceptions: Method of Measurement, Basis of Payment.

9. 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) Additional requirements:

        1) Conduct soil testing to determine optimal fertilizer requirements.

2) If fertilizer containing phosphorous is provided for sodded areas, incorporate half of the fertilizer into the soil by disking. Apply the remaining part of the fertilizer after sod installation.

C. Pavement:

1. Restore all damaged pavement to remain, including road, sidewalk and other hard surface features.

2. Replace with pavement of like material unless otherwise allowed by the Transportation Director.

3. Fencing:

a) Reuse fencing material where possible. Replace gate hinges and other hardware with new hardware

b) Replaced damaged fence sections. Where replacement of individual panel boards is not practical or will not result in a visually pleasing end product, replace entire fence section.

4. Walls:

a) Replace earth retaining structures in accordance with Section 1300.

b) Reuse of removed material is only acceptable if the removed material meets all of the requirements of sections 1301 and 2301.

c) The restored structure shall be structurally and architecturally equal or better than to that which existed prior to construction.

END OF SECTION

CONSTRUCTION STANDARDS
SECTION 2107
BURIED PIPE CONSTRUCTION

Part 1: General

A. Section Includes: Installation of buried pipe, including drinking water, sanitary sewer, and storm sewer by open cut excavation, including excavation, jointing, embedment, backfill, and installation of associated accessories and appurtenances.

B. For installation by boring and drilling, reference Section 2108 – Bored Pipe Installation.

C. For installation by pipe bursting: install as required by the Water Resources Director.

Part 2: Materials

A. Mechanical Joint ends shall conform to AWWA C111.

B. Flanged ends: conform to ANSI B16.1, Class 125.

C. T-Bolts, flange bolts, and nuts:

1. Above grade: 304 stainless steel.

2. Below grade: Tyler Union Cor-Blue or approved equal.

D. Tracer wire:

1. Solid strand 12 AWG copper.

2. Direct bury rated.

3. Insulation: APWA color coded (ex: blue for water, green for sanitary sewer).

E. Tracer wire splice: 3M DBY or Approved Equal.

F. Warning Tape:

1. Non-detectable, polyethylene.

2. Minimum width: 3 inches.

3. Minimum thickness: 4 mils.

4. Insulation: APWA color coded (ex: blue for water, green for sanitary sewer).

5. Lettering: “CAUTION {WATER / SANITARY SEWER / STORM SEWER / (other)} LINE BURIED BELOW”.

G. Corrosion Protection:

1. Polyethylene encasement:

a) AWWA C105 compliant.

b) Minimum thickness: 8 mils (0.008 IN).

c) Minimum tensile strength 3,600 psi with elongation of 800 percent.

d) Tube type; sheets may be used for odd shaped appurtenances.

2. Tape used to seal or secure polyethylene wrap shall be plastic-backed adhesive tape: Polyken #900, Scotchrap #50, or Approved Equal.

H. Acceptable Restraint Devices:

1. Integral Bell and Spigot Restraint Systems:

a) ACIPCO Flex-Ring or Approved Equal.

b) US Pipe Anchor Gasket (grip type restraint) or Approved Equal.

c) Diamond Plastics Lok-21 (grip type restraint) or Approved Equal.

d) North American Pipe Certa-Lok or Approved Equal.

2. Mechanical Joint:

a) Swivel adapter.

1) EBAA Iron Megalug 1100 Series, 15MJ00, 19MJ00, 2000 Series (all grip type restraints), or Approved Equal.

2) "Duc lugs" and 304 stainless steel tie rods, nuts, and washers.

3. Push-On: EBAA Iron 1700, 1100HD, 1500(TD), 1600(TD), 1900 (all grip type restraints), or Approved Equal.

4. PE and FPVC plain ends:

a) Butt fusion.

b) Electrofusion coupling.

I. Pipe Embedment:

1. Granular Embedment:

a) All Pipe:

1) ASTM C33, Size Number 8 (3/8-IN) or 67 (3/4-IN).

2) ASTM D2321, Class I or II SPECIAL: 90% must pass ¾" sieve, no SW or SP.

2. Flowable fill:

    a) ODOT Controlled Low Strength Material.

    b) 28-day compressive strength: 800 PSI maximum, 500 PSI minimum.

3. Concrete embedment: ODOT Class C, 2,400 PSI, 28 day compressive strength.

J. Trench Backfill:

1. See Section 2104 - Earth work, paragraph 1.B.

2. Flowable Fill and Class A Aggregate Base (ODOT Section 703) are acceptable as trench backfill under pavement. In areas not under pavement, each is acceptable only with permission from the City Manager.

K. Pipe Supports: Anvil Figure 264 pipe saddle support with Figure 63 Type T pipe stanchion, all hot-dip galvanized or Approved Equal.

Part 3: Execution

A. General:

1. Install all materials in accordance with manufacturer recommendations.

B. Preparation:

1. If thrust block bearing areas, pipe restraint zones, pipe materials, or pipe thickness are not specified, contact the City immediately for clarification.

2. Prior to installing new pipe material, field-verify material and diameter of existing pipe material to be connected to.

3. Obtain all required permits and approval of all submittals, including plan for filling, flushing, disinfection, and testing.

4. Handle and store all materials in accordance with the manufacturer's recommendations. Store all pipe on palettes or racks to prevent damage. Cover pipe with an opaque material to protect the pipe from sunlight. Do not expose gaskets to direct sunlight, heat, oil, or grease.

5. Prior to installation, inspect all components, including working all moving parts through their full range of motion, to verify that all components are in like new condition and working order.

6. Use full pipe joints wherever possible.

7. Connection to structures: Pipe connecting to a structure shall be adequately protected against damage or misalignment due to movement or differential settlement. Measures shall include extra care to ensure proper compaction of embedment just outside structures and a flexible watertight seal at the pipe/wall penetration. When differential settlement is expected, such as when foundation conditions are poor or

new pipe is being connected to an existing structure, flexible joints or couplings external to the structure shall be provided.

C. Installation by Open Cut Trench:

1. Excavate in accordance with Section 2104 – Earth Work.

2. When pipe is installed in embankment fill, place embankment to an elevation equivalent to the top of embedment prior to trench excavation.

3. Excavate trenches with sufficient working room to properly place and consolidate embedment materials. Maintain adequate space between the pipe and trench wall to allow operation of consolidation equipment.

4. Do not open more trench in advance of pipe laying than necessary. No more than 300 linear feet of open trench shall be allowed per individual pipe laying operation in progress.

5. Pothole existing utilities and obstacles in advance of pipe laying activities to ensure that design changes are not necessary to maintain required utility crossing clearance. It is not acceptable to meet clearance requirements by adding fittings, unless specifically allowed by the City Manager. If required clearance cannot be met because an obstacle was not potholed sufficiently in advance, removal of installed work may be required.

6. Utility Separation:

   a) When utilities are located in the field at a different location that is shown on the drawings, maintain the horizontal and vertical clearances from other utilities and obstacles shown on the drawings.

   b) If specific clearance is not noted on the drawings, maintain at least 2 FT OD to OD vertical clearance, at least 10 FT OD to OD horizontal clearance between a sewer line and water line, and at least 5 FT OD to OD horizontal clearance between all utilities.

7. Excavated material:

   a) Do not obstruct streets, walks or driveways with stockpiled material.

   b) Remove from the site and legally dispose of all excess excavated material.

8. Keep appropriate compaction equipment on site during all excavation and backfill activities.

9. Dewater excavations and keep dewatered in accordance with Section 2111 – Site and Excavation Dewatering.

10. Unstable subgrade: Replace unstable subgrade or other unsuitable materials in accordance with Section 2104 – Earth Work (references ODOT Section 202 – Earthwork).

11. Ensure that sufficient room is excavated to accommodate pipe bells and restraint adapters.

12. Compact the bottom of the trench. Ensure that no loose material remains on the bottom or sides of the excavation.

13. Place and consolidate a layer of embedment material on the trench bottom before placing pipe. Consolidate the embedment material with a vibrating plate compactor.

14. Lower pipe into trenches by hand or mechanical means. Do not drop pipe! Use slings to carry pipe by mechanical means. Use hooks, chains, or cables only if the manufacturer specifically recommends them as an acceptable means of transport on site. Take special care when handling PVC during cold weather.

15. Field cut pipe perpendicular to flow line. Bevel field cut pipe to remove any sharp or rough edges which might otherwise damage the gasket. Use a tool specifically designed for beveling; do not hand bevel. Mark field cut pipe with an insertion line.

16. Prior to backfill, use laser and other electronic equipment to verify that all pipe is installed to the proposed alignments and depths.

17. Jointing:

    a) Clear some embedment material for the bell to ensure that the pipe is not supported by the bell. Place the pipe on the embedment material. Ensure that the pipe is resting on embedment material and not the trench bottom.

    b) Inspect and clean gaskets, bells, spigots, and groove area to identify damage and remove any foreign material prior to assembling.

    c) Lubricate the gasket if recommended by the manufacturer.

    d) Align the spigot and bell and insert the spigot into the bell until it contacts the gasket uniformly. Apply steady pressure by hand, bar and block assembly or by mechanical assistance until the spigot easily slips into/through the gasket. Do not insert the pipe by swinging the spigot into the bell or hammering the pipe. Insert the spigot to the insertion line marked on the pipe.

    e) Keep the joint straight while pushing. When joint deflection is allowed, deflect pipe after insertion. Do not exceed 80% of the manufacturer's recommended maximum joint deflection.

    f) Hold pipe in place with additional piles of embedment material. Verify that pipe has been installed to the required lines and grades.

    g) Provide isolators between dissimilar metal pipe, fittings, valves, and appurtenances.

    h) Joint restraint:

        1) Install restrained joints in strict accordance with the pipe manufacturer's recommendations. Pull on the pipe to engage restraint prior to embedment.

2) If a fitting and adjacent piping are installed in the field differently from what is shown on the drawings, obtain guidance from the Engineer to update the size and location of thrust blocks, as well as extent of joint restraint.

3) Once Megalug-type restraint device has been tightened on iron pipe, do not install again in the same location. Rotate the ring as necessary to ensure that the teeth are engaging undamaged pipe material.

4) Do not bend tie rods.

5) Assume all existing pipe is not restrained. Provide thrust collars at transition to existing pipe or replace existing pipe with new pipe through the required restraint zone.

18. Trim interior HDPE and FPVC butt fused joint beads for all applications other than drinking water.

19. Polyethylene Encasement: Encase all buried iron pipe, fittings, valves, and other ferrous system components, including those with epoxy or other coatings, with polyethylene wrap.

20. Install tracer wire directly on top of the pipe. Terminate tracer wire at locations described in the specifications specific to each pipe service type.

21. Place and consolidate embedment material evenly on both sides of the pipe in maximum 12 IN lifts. Consolidate the embedment material with a vibrating plate compactor or concrete vibrator. Make a special effort to ensure that the pipe haunches are well consolidated. Take special care to prevent damage to pipe and polyethylene encasement when using consolidation equipment.

22. If embedding with concrete or CLSM, place pipe in its proper position on temporary supports of wood or brick blocks and wedges. Anchor pipe to prevent flotation when the concrete is placed.

23. Place warning tape and complete embedment.

24. Backfill with Earth Fill in accordance with Section 2104 – Earth Work.

25. Restore the site in accordance with Section 2106 – Restoration.

END OF SECTION

CONSTRUCTION STANDARDS
SECTION 2108
BORED OR ENCASED PIPE CONSTRUCTION

Part 1: General Requirements

A. Section Includes: construction of casing pipe and carrier pipe, including beneath streets, highways, and railroads, and install carrier pipe.

Part 2: Products

A. General:

1. Minimum casing inside diameter: Greater of outside diameter of pipe bell plus 2 IN, or outside diameter of joint restraint device plus 2 IN.

2. New, unused material only.

B. Casing:

1. General:

a) Provide engineered documentation that proposed wall thickness is sufficient to withstand rigors of installation and installed loads.

2. Steel:

a) Welded steel pipe, compliant with ASTM A-139 (Electric Fusion of Welded Steel Pipe), Grade B.

b) Minimum yield strength: 35,000 psi.

c) Minimum wall thickness:

1) Inside diameter less than or equal to 18 IN: 1/4 IN.

2) Inside diameter less than or equal to <= 24 IN: 3/8 IN.

3) Inside diameter greater than 24 IN: as approved by the Water Resources Director.

3. PE:

a) Meet the material requirements for PE Pipe in Section 1410 – Drinking Water Distribution Systems.

b) Minimum wall thickness: DR 9.

c) Provide 2 IN additional casing inside diameter beyond general requirement, above.

4. PVC and FPVC:

a) Meet the material requirements for PVC and FPVC Pipe in Section 1400 – Drinking Water Distribution Systems.

b) Minimum wall thickness: DR 18.

c) Provide 2 IN additional casing inside diameter beyond general requirement, above.

5. DI:

a) Meet the material requirements for DI Pipe in section 1410 – Drinking Water Distribution Systems.

b) Minimum wall thickness:

1) DI nominal diameter less than or equal to 12 IN: pressure class 350.

2) DI nominal diameter less than or equal to 24 IN: pressure class 250.

3) DI nominal diameter greater than 24 IN: as approved by the Water Resources Director.

6. RCP: acceptable only with permission from the Water Resources Director.

C. Casing Spacers:

1. Allowable manufacturers and models: Cascade Waterworks Manufacturing Phoenix Gold, GPT Model PE, or Approved Equal.

2. Size spacers to match casing inside diameter, less 1 IN of clearance ("restrained"). Ex: For a casing with inside diameter of 8 IN, the diameter of the casing spacer runners should be no more than 7 IN.

D. Casing End Seals: GPT Model S or Approved Equal.

Part 3: Execution

A. General:

1. Excavate bore pits in a manner to prevent interruption of roadway traffic and so that pavement structure is not compromised. Provide bore pits of sufficient length to install carrier pipe without stressing joints, pipe, or spacers.

2. Install carrier pipe within casing using casing spacers. Provide casing spacers on either side of each joint. Provide at least the minimum number of spacers recommended by the manufacturer. Use a safety factor of 1.25 when calculating the load to be supported by each spacer.

3. Restrain all joints within casing.

4. For encasement longer than 36 LF, measure the axial load on the carrier pipe during insertion and ensure that the manufacturer's recommended maximum insertion force is not exceeded.

5. Install casing end seals.

6. Install a fiberglass marker at each end of the casing.

7. Install casing vent pipes when required by the ROW owner.

8. Do not deflect pipe joints after tightening the teeth of restraint adapters.

9. Provide tracer wire.

B. Dry Boring:

1. Pressure grout annular space between bore hole and casing material if annular space is greater than 1 IN.

C. Directional Drilling:

1. Pressure grout annular space between bore hole and casing material if annular space is greater than 1 IN.

D. Impact Moling:

1. Acceptable beneath existing pavement only with approval by the Transportation Director.

2. Ensure carrier pipe is of sufficient depth below sidewalk or pavement that pavement will not be damaged.

E. Pipe Ramming: Reserved.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2110

CONSTRUCTION STORMWATER POLLUTION PREVENTION

Part 1: General Requirements

A. Section Includes:

Part 2: Products

A. General:

Part 3: Execution

A. General:

1. Employment of temporary and permanent Best Management Practices (BMPs) shall be required 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.

2. Employ temporary and permanent Best Management Practices (BMPs) to ensure compliance with the City's MS4 permit. shall be required 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. ODEQ Compliance: In compliance with the Oklahoma Department of Environmental Quality (ODEQ) General Permit for Stormwater Discharges from Construction Activities, 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. SWPPP: In compliance with ODEQ regulation, 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.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2200

CONCRETE

Part 1: General

A. Scope

1. This section shall govern the performance of all work necessary for construction of cast-in-place concrete structures for inlets, manholes, junction boxes, head walls, and incidental structures. Construction of concrete street pavements shall conform to Oklahoma Department of Transportation 2009 Standard Specifications and Associated American Concrete Institute Standards.

    a) The Contractor shall guarantee that concrete of the specified compressive strength is incorporated in the structures and that the responsibility for producing the required grades of concrete is assumed by the Contractor. Should the average strengths shown by test cylinders fall below the strengths required, the City of Stillwater may require any or all of the following changes: amount of cement; grading of aggregate, or ratio of the water to the cement used. If the tests disclose that the strength of the concrete is insufficient for the structure as built, the City of Stillwater may condemn the part of any structure in which concrete of insufficient strength has been placed and the Contractor shall replace all in-place concrete whose representative cylinder fails a strength test.

    b) Concrete shall conform to the applicable requirements of 2009 ODOT Standard Specifications - Section 700 Materials, or most current edition and appropriate ACI Standard Specifications, most current edition.

B. Quality Assurance:

1. Submittals:

    a) The Contractor shall furnish, to the City of Stillwater, the certificates and test results described below. The City of Stillwater may require additional tests and/or verifications to insure the quality of concrete produced is as specified.

    b) Concrete:

        1) Mix design: Provide mix design formula for the materials proposed for use in making concrete using the absolute volume method. The design shall include material sources, specific gravities and other pertinent data.

        2) Strength: Prior to placing any concrete, the compressive strength shall be verified by making three test cylinders using the proposed mix designs. The cylinders shall be tested and the results provided with the mix design submittal.

c) Reinforcing steel:

1) Comply with requirements of the latest edition of the following codes and standards, except as herein modified:

A. American Welding Society, AWS D1.4-1979, "Standard Welding Code - Reinforcing Steel."

B. Concrete Reinforcing Steel Institute, "Recommended Practice for Placing Reinforcing Bars."

C. Concrete Reinforcing Steel Institute, "Manual of Standard Practice for Reinforced Concrete Construction."

D. American Concrete Institute, ACI 318, "Building Code Requirements for Reinforced Concrete."

E. ASTM A615: "Specifications for Deformed and Plain Billet-Steel Bars for concrete Reinforcement."

F. ACI 315: "Manual of Standard Practice for Detailing Reinforced Concrete Structures."

G. ASTM A185: "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement".

d) Formwork: Unless otherwise shown or specified, design, construct, erect, maintain, and remove forms and related structures for cast-in-place concrete work in compliance with the following:

1) ACI 347: Recommended Practice for Concrete Form work.

2) USPS PSI: Product Standard for Softwood Plywood Construction and Industrial.

e) Allowable tolerances:

1) Construct form work to provide completed cast-in-place concrete surfaces complying with the tolerances specified in ACI 374.

2) Before concrete placement, check the lines and levels of erected formwork. Make corrections and adjustments to ensure proper size and location of concrete members and stability of forming systems.

3) During concrete placement, check formwork and related supports to ensure that forms are not displaced and that completed work will be within specified tolerances.

Part 2: Materials

A. Cement

1. All cement used in the work shall be a standard brand of portland cement and shall comply with the cement ASTM C150 Standard Specifications for "Air-Entraining Portland Cement". The cement shall be Type I.

2. All cement hauled to the job shall be in original unopened containers, bags or sacks showing the brand name of the manufacturer. Only one brand of cement shall be used in any individual structure. Cement reclaimed by cleaning bags or cement that has leaked from containers shall not be used. Cement shall be used in the sequence of shipments received, unless otherwise directed.

3. Different brands, grades or types of cement shall be stored separately. All cement shall be stored in such a manner as to permit easy access for proper inspection and identification of each shipment, in a suitable weather tight building that will protect it from dampness and deterioration. Packages of cement which have become partially set, or contain any lumps or caked cement shall be rejected; and, in no instance will any portion of a bag of damaged or faulty cement be used.

B. Aggregates

1. All aggregates used shall conform to the requirements of ASTM C33 Specifications for "Concrete Aggregate", unless otherwise indicated on the drawings or directed by the City of Stillwater.

2. Sampling and testing: Sampling and testing shall be in accordance with the latest revision of the AASHTO Methods.

Sampling.....T-2

Sieve Analysis T-27

Material Passing No. 200 ..... T-11

Organic Impurities..... T-21

Clay Lumps and Friable Particles..... T-112 modified

Coal and Lignite..... T-113

Mortar and Tensile Strength T-35

3. Storage: Aggregate shall be stored in a manner that will allow good drainage and will insure that the aggregate is kept free of foreign matter. Sites for stock piles shall be graded and cleaned prior to storing materials. Aggregate from different sources shall be stored in separate stock piles. Care shall be taken to prevent segregation; material which becomes segregated to the extent that it no longer satisfies the grading requirements shall be combined to satisfy such requirements before being used in concrete.

C. Water

1. Water used in mixing concrete shall be clean, clear, and free from deleterious amounts of acids, alkalis, oil, salt, organic materials or any other substances injurious to the finished concrete. Water from City water system may be accepted without being tested. Water from other sourses shall not be used until tested and approved. Testing of water shall be in accordance with AASHTO Method T-26.

D. Admixtures

1. Air-entraining admixtures shall conform to ASTM Specifications C-260.

2. Set-control admixture: Set controlling agents shall conform to ASTM C 494, as follows:

   a) Type A, Water Reducing

   b) Type B, Retarding.

   c) Type C, Accelerating.

   d) Type D, Water-Reducing and Retarding.

   e) Type E, Water-Reducing and Accelerating.

3. Other admixtures: Other admixtures, unless specifically called for, shall be used only with the written approval of the City of Stillwater and shall be used in accordance with the manufacturer's instructions and recommendations.

E. Fly Ash: Use of fly ash or other cement substitutes shall conform to ODOT Standard Specification Section 702 Supplementary Cementitious Materials.

F. Reinforcing Steel

1. Reinforcing bars (rebar): All reinforcing bars shall be rolled from new billets and shall conform to the ASTM A615 Specifications for Billet-Steel Bars for Concrete Reinforcement, and shall be of the Grade 60 unless otherwise specified. Unless otherwise shown, all reinforcing bars shall be deformed and shall conform to the requirements of the ASTM A615 specifications for minimum reinforcement. The deformed bars used shall have a net sectional area at all points equivalent to that of plain bars of equal nominal size. Twisted steel bars shall not be used.

2. Supports for reinforcement: Reinforcement supports shall be bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcements in place.

   a) Wire bar type supports shall comply with CRSI recommendations, unless otherwise indicated. Do not use wood, brick, or concrete block.

b) Sand plates or horizontal runners shall be used where base material will not support chair legs for slabs on grade.

c) Either hot-dip galvanized, plastic protected or stainless steel protected legs shall be used for exposed-to-view concrete surfaces, where legs of supports are in contact with forms.

d) Tie wire: Tire wire sixteen (16) gauge minimum and in sufficient quantity to hold reinforcement accurately in place during concrete placement operations.

e) Welded steel wire fabric: Fabric shall conform to the requirements of ASTM A185 and shall be of the size and space opening as designated on the plans.

3. Fabrication:

a) General: Reinforcing bars shall be fabricated conforming to required shapes and dimensions, with fabrication tolerances complying with CRSI "Manual of Standard Practice." In case of fabricating errors, the Contractor shall not re-bend or straighten reinforcement in a manner that will injure or weaken the material.

b) Unacceptable materials: Reinforcement with any of the following defects will not be permitted in the work:

1) Bar lengths, depths and bends exceeding specified fabrication tolerances.

2) Bend or kinds not indicated on drawings or final shop drawings.

3) Bars with reduced cross-section due to excessive rusting or other cause.

c) Identification: Reinforcing bars shall be tied in bundles and tag with weatherproof tags showing shop drawing numbers.

4. Splicing: Provide a minimum of 35 bar diameters of lap length.

G. Forms

1. Forms for exposed concrete: Form work for exposed concrete surfaces shall be high-density overlay plyform Class I or II. Panels shall be APA grade-trade-marked and meet requirements of the latest edition of U.S. Product Standard PSI. Overlay shall not stain the surface of the architectural concrete. Full sheet sizes shall be used to minimize number of joints and to conform to joint system shown on drawings. Form material shall be of sufficient thickness to withstand pressure of newly placed concrete without bow or deflection (minimum 3/4 inch).

2. Forms for unexposed concrete: Concrete surfaces, which will be unexposed in the finished structure, shall be formed with plywood, lumber, metal, or other acceptable material. Lumber shall be dressed on at

least 2 edges and 1 side for tight fit, tongue and grooved, free from loose knots and of such moisture content as to prevent free absorption of moisture.

3. Form coatings: Commercial formulation form coating compounds shall be provided will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatment of concrete surfaces requiring bond or adhesion, nor impede the wetting of surfaces to be cured with water or curing compounds. Release agent shall be used in strict accordance with manufacturer's recommendations.

4. Vinyl foam tape: Vinyl foam tape shall be 3/4" x 1/8" adhesive backed closed cell tape.

5. Form accessories: Only form ties, anchors, and hangers of sufficient strength to completely resist displacement of forms due to construction loads and the depositing of concrete shall be used. Tie-and-spreader type form ties designed so that no metal will be within one inch of any surface when forms are removed shall be used. Where concrete surfaces are exposed to view, the Contractor shall not use form ties which, when removed, will leave a depression larger than one (1) inch in diameter. The Contractor shall use water seal ties in concrete exposed to hydrostatic pressure which conform to ACI 301 and 347.

    a) Metal inserts shall be used for anchorages of materials or equipment to concrete construction, not supplied by other trades and as required for the work. Threaded inserts of malleable cast iron, furnished complete with full-depth bolts to the proper size shall be used unless otherwise noted.

    b) Adjustable wedge inserts of malleable cast iron, complete with bolts, nuts and washers, and bolt size, shall be used.

6. Screen chairs: Metal or wood screen chairs shall not be used.

7. Corner chamfer: Chamfers shall be mill run white pine solid material or preformed PVC at all exposed corners of columns, walls and beams.

H. Concrete Curing Compounds

1. Absorptive cover: Burlap cloth shall be made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 3.

2. Moisture-retaining cover: Moisture retaining covers shall be one of the following, complying with ASTM C 171.

    a) Waterproof paper.

    b) Polyethylene film.

    c) Polyethylene-coated burlap.

3. Membrane-forming curing compound: Membrane forming curing compounds shall conform to ASTM C 309, Type I with white fugitive dye unless other type acceptable to the City of Stillwater.

4. Liquid curing, sealing, hardening compound: The following list of materials is not intended to be a complete list of materials and work required but a guide to the type, quality, and finish required for various surfaces. The list of products below is intended only to set a standard of quality.

Product	**Manufacturer**
Eucocure	Euclid Chemical Co.
Masterseal	Master Builders
Polyclear	Upco Chemical/USM Corp.
Dress & Seal	L & M Construction Chemicals
Triple Seal	Protex Industries
Clear Bond	Guardian Chemical Co.
Cure & Seal	Symons Corporation
Kure-N-Seal	Sonneborn Building Products

Special notes:

- Curing compounds containing oil or wax shall not be used.
- Allow concrete to thoroughly dry following rain.
- Use form release agents which will not transfer to the concrete.

I. Water Stops: Provide 3-1/4 IN polyvinyl chloride (PVC) water stops at construction joints and other joints of type shown on drawings.

J. Preformed Expansion Joint Fillers: Preformed expansion joint fillers shall conform ASTM D-1751, and be non-extruding and resilient type.

K. Radius Former: Radius former shall be PVC.

L. Flowable Fill:

1. Specify strength limitations to allow for diggable flowable concrete.

2. Flowable Fill admixture shall be provided with manufacturers' instructions regarding installation requirements and strength limitations.

Part 3: Installation

A. Concrete mixing:

1. Experimental concrete mixes:

a) The Contractor shall make experimental mixes prior to the placing of the concrete and at any time during the progress of the work when necessary to demonstrate that the concrete will meet these specifications. Materials for making experimental mixes shall be furnished by the Contractor and these materials shall be identical with those intended for use in the work. The cost of the materials, as well as the costs of crushing test specimens made from the experimental mix, shall be borne by the Contractor and shall be included in the price bid for concrete.

2. On-site mixing:

a) General: The Contractor shall mix concrete in a batch mixer conforming to requirements of the mixer manufacturer's Bureau of the Associated General Contractors of America. Mixer shall bear the manufacturer's rating plate indicating rated capacity and recommended revolutions per minute; operate mixer in accordance with these recommendations; and use only mixers that are equipped with a suitable charging hopper, water storage tank, water measuring device and are capable of thoroughly mixing the concrete into a uniform mass within the specified mixing time and of discharging the mix without segregation.

b) Admixtures: After approved for use, the Contractor shall dispense liquid admixtures by means of an automatic dispenser or similar metering device; weigh or measure by volume powdered admixtures, as recommended by the manufacturer; accurately measure all admixtures to within plus or minus 5 percent; and shall provide suitable agitating equipment to insure uniform distribution of ingredients.

c) Mixing: The Contractor shall charge batch into the mixer so that some water will enter in advance of the cement and aggregates; allow water to flow into the mixer until the end of the first 25 percent of the specified mixing time; provide controls to insure that the batch cannot be discharged until the specified mixing time has elapsed; provide controls to insure that no additional water may be added during mixing; and discharge the entire batch before recharging.

d) Mixing time: The Contractor shall mix each batch of 2 cubic yards or less for not less than 1-1/2 minutes, and not more than 5 minutes after all ingredients are in the mixer before any part of the batch is released; increase mixing time by 15 seconds for each additional cubic yard or fraction

thereof; and not exceed 30 minutes total elapsed time between intermingling of damp aggregates and cement to the discharge of the completed mix into the forms.

e) Maintenance: The Contractor shall keep mixer clean and replace mixer pick-up and throw over blades when they have lost 10 percent of their original depth.

f) Identification: The Contractor shall provide a batch ticket for each batch discharged and used in the work, indicating the project identification name and number, date, mix type, mix time, quantity and amount of water introduced.

g) Retempering: The Contractor shall mix concrete only in quantities for immediate use. Discard concrete which has set; do not retemper. Adding water to the mix at the job site shall not be permitted.

3. Ready-mix concrete: The Contractor shall comply with the requirements of ASTM C94, and as herein specified, provided quantity and rate of delivery will permit unrestricted progress of the work in accordance with the placement schedule. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required. Proposed changes in mixing procedures shall be accepted by the City of Stillwater before implementation. All mixer trucks shall be equipped with water meters. Plant equipment and facilities should conform to National Ready-Mix Concrete Association "Check-list for Certification of Ready-Mixed Concrete Production Facilities".

a) Consistency:

1) All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that:

A. All aggregates will float uniformly throughout the mass without settling or segregating.

B. When dropped directly from the discharge chute of the mixer, the concrete will flatten out at the center of the pile but will stand up at the edges, the piling spreading from internal expansion and not by flowing.

C. The concrete will flow sluggishly when tamped or spaded.

D. The concrete can be readily puddled into corners and angles of forms and around reinforcing steel,

E. The concrete can be readily spaded to the bottom of the placement or to a depth of several feet at any time within thirty (30) minutes after placing.

2) A desirable consistency is one which results in a very slight accumulation of water at the top of a layer several feet in thickness, but without segregation or accumulation of laitance. If, through

accident, intention or error in mixing, any concrete shall vary materially from the consistency specified, such concrete shall not be incorporated in the work but shall be discharged as waste material.

B. Cast-in-place concrete:

1. Form work design:

a) The Contractor shall design, erect, support, brace and maintain form work so that it will safely support vertical and lateral loads that might be applied, until such loads can be supported by the concrete structure. The Contractor shall carry vertical and lateral loads to ground by a form work system and in-place construction that has attained adequate strength for that purpose. The Contractor shall construct form work so that concrete members and structures are of correct size, shape, alignment, elevation, and position.

b) The Contractor shall design forms and falsework to include assumed values of live load, dead load, weight of moving equipment operated on Form work, concrete mix, height of concrete drop, vibrator frequency, ambient temperature, foundation pressures, stresses, lateral stability, and other factors pertinent to safety of structure during construction.

c) The Contractor shall provide shores and struts with positive means of adjustment capable of taking up form work settlement during concrete placing operations, using wedges or jacks or a combination thereof and provide trussed supports when adequate foundations for shores and struts cannot be secured.

d) The Contractor shall support form facing materials by structural members spaced sufficiently close to prevent deflection; fit forms placed in successive units for continuous surfaces to accurate alignment, free from irregularities and within allowable tolerances; and provide camber in form work as required for anticipated deflections due to weight and pressures of fresh concrete and construction loads for long-span members without intermediate supports.

e) The Contractor shall provide temporary openings in wall forms, column forms and at other locations necessary to permit inspection and clean-out.

f) The Contractor shall design form work to be readily removable without impact, shock or damage to cast-in-place concrete surfaces and adjacent materials.

g) The Contractor shall provide form work sufficiently tight to prevent leakage of cement paste during concrete placement; solidly butt joints and provide backup material at joints as required to prevent leakage and fins; seal form joints with foam tape or other demonstrated effective means; and provide a means to seal the bottom of forms at construction joints such as foam tape or other gasket devices.

2. Placing forms:

   a) Concrete forming shall conform to ACI Code 347, to the exact sizes, shapes, lines and dimensions shown, and as required to obtain accurate alignment, location, grades, level and plumb work in finished structures; provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking screeds, bulkheads, anchorages and inserts, and other features required; and use select materials to obtain required finishes.

   b) Forms shall be installed so removal without hammering or prying against concrete surfaces. Crush plates or wrecking plates shall be installed where stripping may damage cast concrete surfaces. Top forms for inclined surfaces shall be installed where the slope is too steep or place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like to prevent swelling and assure ease of removal.

   c) The Contractor shall provide temporary openings where interior area of form work is inaccessible for clean out, for inspection before concrete placement, and for placement of concrete. The Contractor shall brace temporary closures and set tightly to forms to prevent loss of concrete mortar and locate temporary openings on forms in as inconspicuous location as possible, consistent with project requirements.

   d) The Contractor shall form intersecting planes to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.

   e) The Contractor shall provide openings in forms to accommodate other work, including mechanical and electrical work; and accurately place and securely support items required to be built into the form.

   f) The material to be used in the forms for exposed surfaces shall be sized and dressed lumber or metal in which all bolt and rivet heads are countersunk. In either case, a plain, smooth surface of the desired contour shall be obtained.

   g) Undressed lumber may be used for backing or other unexposed surfaces, except inside faces of conduits.

   h) Dimensions affecting the construction of subsequent portions of the work shall be carefully checked after the forms are erected and before any concrete is placed.

   i) Temporary openings where interior area of form work is inaccessible shall be used for clean out, for inspection before concrete placement, and for placement of concrete. Temporary closures shall be braced and set tightly to forms to prevent loss of concrete mortar. Temporary openings shall be located on forms in as inconspicuous location as possible, consistent with project requirements.

j) Intersecting planes shall be formed to provide true, clean-cut corners, with edge grain of plywood not exposed as form for concrete.

k) Provide openings in forms to accommodate other work, including mechanical and electrical work. Accurately place and securely support items required to be built into the form.

3. Falsework:

a) The Contractor shall erect falsework and support, brace, and maintain it to safely support vertical, lateral and asymmetrical loads applied until such loads can be supported by in-place concrete structures; and construct falsework so that adjustments can be made for take-up and settlement.

b) The Contractor shall provide wedges, jacks, or camber strips to facilitate vertical adjustments; carefully inspect falsework and form work during and after concrete placement operations to determine abnormal deflection or signs of failure; and make necessary adjustments to produce work of required dimensions.

4. Forms for exposed concrete:

A. The Contractor shall drill forms to suit ties used and to prevent leakage of concrete mortar around tie holes and not splinter forms by driving ties through improperly prepared holes.

b) The Contractor shall not use metal cover plates for patching holes or defects in forms.

c) The Contractor shall provide sharp, clean corners at intersecting planes, without visible edges or offsets; and back joints with extra studs or girts to maintain true, square intersections.

d) The Contractor shall use extra studs, walers, and bracing to prevent bowing of forms between studs and to avoid bowed appearance in concrete. The Contractor shall not use narrow strips of form material which will produce a bow.

e) The Contractor shall assemble forms to be readily removed without damage to exposed concrete surfaces.

f) The Contractor shall form molding shapes, recesses and projections with smooth-finish materials, and install forms with sealed joints to prevent displacement.

5. Corner treatment:

a) The Contractor shall form exposed corners to produce square, smooth, solid, unbroken lines, except as otherwise shown.

b) The Contractor shall form chamfers with ¾ IN x ¾ IN strips, unless otherwise shown, accurately formed and surfaced to produce uniformly straight lines and tight edge joints. The Contractor shall extend terminal edges to required limit and miter chamfer strips at changes in direction.

c) Unexposed corners may be formed either square or chamfered.

6. Control joints:

a) Concrete shall be placed continuously so that the unit will be monolithic in construction. Fresh concrete may be placed against adjoining units provided the set concrete is sufficiently hard not to be injured thereby. Joints not indicated shall be made and located to least impair strength and appearance of the structure. Concrete for walls shall be in place at least 2 hours before concreting beams, girders, or slabs thereon. Beams, brackets, and haunches shall be considered as part of the floor system and shall be placed monolithically therewith. 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. Girders, beams, and slabs shall be placed in one operation. In walls having door and window openings, individual lifts shall terminate at top and bottom of opening. Other lifts shall terminate at such levels as are indicated or as to conform to structural requirements or architectural details, or both, as directed.

7. Water stops: The Contractor shall provide water stops in construction joints as shown on the drawings. Install water stops to form a continuous diaphragm in each joint; make provisions to support and protect water stops during the progress of the work; fabricate field joints in water stops in accordance with manufacturer's print instructions; and protect water stop material from damage where it protrudes from any point. No wood device of any kind used to separate forms shall be permitted to remain in the finished work.

8. Provision for other trades: The Contractor shall provide openings in concrete form work to accommodate work of other trades, including those under separate prime contracts (if any). Size and location of openings, recesses and chases are the responsibility of the trade requiring such items. The Contractor shall accurately place and securely support items to be built into forms.

9. Cleaning and tightening: The Contractor shall thoroughly clean forms and adjacent surfaces to receive concrete; remove chips, wood, sawdust, dirt or other debris just before concrete is to be placed; and retighten forms immediately after concrete placement as required to eliminate mortar leaks.

10. Form coatings:

a) The Contractor shall coat form contact surfaces with form-coating compound before reinforcement is placed; keep excess form coating from accumulating in forms or to come into contact with surface which will be bonded to fresh concrete; and apply in compliance with manufacturer's instructions.

b) The Contractor shall coat steel forms with a non-staining, rust-preventive form oil or otherwise protect against rusting. Rust-stained steel form work is not acceptable.

11. Installation of embedded items:

a) General: The Contractor shall set and build into the wood anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete and use setting drawings, diagrams, instructions and directions provided by suppliers of the items to be attached thereto.

b) Edge forms and screen strips for slabs: The Contractor shall set edge forms or bulkheads and intermediate screen strips for slabs to obtain required elevations and contours in the finished slab surface and provide and secure units to support types of screen required.

12. Shores and supports:

a) The Contractor shall comply with ACI 347 for shoring and reshoring, and as herein specified.

b) Remove shores and re-shore in a planned sequence to avoid damage to partially cured concrete.

c) Locate and provide adequate reshoring to safely support the work without excessive stress or deflection.

13. Placing reinforcement:

a) All reinforcement, when placed, shall be free from mill scale, loose or thick rust, dirt, paint, oil or grease, and shall present a clean surface. Storage of material shall be on pallets with tarpaulin coverings to prevent rust and scale.

b) Bends and splices shall be accurately and neatly performed, and shall conform to the ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures and the CRSI Handbook.

c) All reinforcing shall be placed in the exact position shown on the plans and shall be held firmly in position by means of metal chairs, bolsters, spacers, hangers or other accepted supports, such as wiring the bars together at intersections with accepted wire ties in order that the reinforcement will not be displaced during the depositing and compacting of the concrete. Tie wires ends shall be turned away from the exposed surfaces.

d) When the concrete surface will be exposed to the weather in the finished structure or where rust would impair the appearance, the portions of all accessories in contact with the form work shall be galvanized steel or plastic.

e) The placing and fastening of reinforcement in each section of the work shall be accepted by the City of Stillwater before any concrete is deposited in the section.

f) Care shall be taken not to disturb the reinforcement after the concrete has taken its initial set.

g) Reinforcing steel shall be overlapped to fully develop the reinforcing.

h) Splicing bars shall be performed in accordance with ACI Code 318 for minimum lap. Splice locations shall be at mid-span on all top bars and at the supports for all bottom bars.

i) The minimum coverages for reinforcement shall be maintained as stated in ACI Code 318.

14. Anchors and inserts:

a) Anchor bolts, castings, steel shapes, conduit, sleeves, masonry anchorage, and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored.

b) Unless installed in pipe sleeves, anchor bolts shall have sufficient threads to permit a nut to be installed on the concrete side of the form or template. A second nut shall be installed on the other side of the form or template and the two nuts shall be adjusted so that the bolt will be held rigidly in proper position.

c) Inserts shall be clean when installed. After installation, surfaces not in contact with concrete shall be cleaned of concrete spatter and other foreign substances.

d) The Contractor shall coordinate the installation of all anchors and inserts during forming operations. Prior to actual placement of concrete, all insert and anchor locations shall be rechecked to assure proper vertical and horizontal alignment.

e) Care shall be taken during placement operations so as not to alter the location of any anchors or inserts.

f) After screening operations are complete, the vertical and horizontal alignment shall be rechecked to assure the proper location of anchors and inserts.

g) In the event the alignment is improper, the Contractor shall revise, repair, modify, or replace any anchor or insert which is improperly embedded. The cost of such work shall be borne by the Contractor.

15. Pre-placement inspection:

a) Before placing concrete, inspect and complete the form work installation, reinforcing steel, preformed joint fillers, vapor barriers, water stops and items to be embedded or cast-in. Notify other crafts involved in ample time to permit the installation of their work; cooperate with other trades in setting such work, as required.

b) Thoroughly wet the forms immediately before placing concrete, as required where form coatings are not used. Where coating is used, the Contractor shall with a brush or spray coating, covering the form evenly without excess drip. Form oil which causes softening or permanent staining of the concrete shall not be used.

c) Soil at bottom of foundation systems is subject to testing for soil bearing value by the testing laboratory. Place concrete immediately after approval of foundation excavations. Excavate and backfill as necessary to complete the concrete work. Place concrete on subgrades that are well compacted to level and true grade. Before concrete is placed in areas between slabs on grade previously placed, recheck compaction of subgrade and if necessary, re-compact to avoid settlement of slabs at joints. Seal extremely porous subgrades in a manner approved by the City of Stillwater. Remove all ice, debris, and excess water from subgrades.

d) Coordinate the installation of joint materials and moisture barriers with placement of forms and reinforcing steel.

e) The installation of anchors, inserts, and sleeves for electrical, mechanical plumbing, heating, ventilating and air-conditioning work is subject to the inspection and approval of the supervisors of the particular trades involved. Finish voids in sleeves and inserts temporarily with readily removable material.

f) Notify the City of Stillwater 24 hours before placing concrete.

16. Concrete conveying:

a) General: Handle concrete from the mixer to the place of final deposit as rapidly as practicable and in a manner which will assure that the specified quality of the concrete is obtained.

b) Equipment: Provide conveying equipment of proper size and design to insure a continuous flow of concrete to a delivery end. Conveying equipment will be subject to the City of Stillwater's approval.

c) Truck mixers, agitators and non-agitating units and their manner of operation shall conform to the applicable requirements of ASTM C 94.

d) Belt conveyors: Provide conveyors and discharge apparatus of a type which will not cause segregation. Discharge long runs into a hopper.

e) Chutes: Provide metal or metal lined chutes and install to a slope not exceeding 1 vertical to 3 horizontal and not less than 1 vertical to 20 horizontal. Chutes more than 20 FT long and chutes not meeting the slope requirements may be used provided they discharge into a proper hopper.

f) Runways: Provide runways or other means for wheeled equipment to convey concrete to placement points. Do not support runways on reinforcement, or wheel equipment over reinforcement.

g) Pumps: Do not pump concrete without the City of Stillwater's approval. Any change in concrete mix necessitated by pumping must be approved by the City of Stillwater prior to placing concrete by this method.

17. Placing concrete:

a) Place concrete in compliance with the practices and recommendations of ACI 304, and as specified herein. Do not place any concrete until the City of Stillwater has reviewed the results of the design mix 28-day test breaks and approval is given to proceed.

b) Concrete shall be deposited so that the aggregates are not segregated. Conveying concrete shall occur to prevent segregation of the aggregate. Conveying shall be by belt conveyor, tremmie, chutes or pumps. Vertical drops in excess 5 FT shall be conveyed using one of these techniques. Chutes shall not be used if the slopes are greater than 3:1.

c) Deposit concrete in forms in horizontal layers not deeper than 24 IN and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.

d) Remove temporary spreaders in forms when concrete placing has reached the elevation of such spreaders.

e) The concrete shall be deposited in continuous horizontal layers so that no concrete will be allowed to harden and cause the formation of seams or planes of weaknesses. Concrete placement shall occur at a rate to keep the placed concrete integral with the new concrete. Work shall be arranged in order that each part of the work shall be placed as a unit if this is possible. Where necessary to stop placing concrete, the work shall be brought up in level courses and against a vertical stop board.

f) Consolidate concrete placed in forms by mechanical vibrating equipment supplemented by hand-spading, rodding or tamping, so that the concrete is thoroughly worked around reinforcement and embedded item and into the corners of forms. Consolidate each layer of concrete with previously placed layers in a manner that will eliminate all air or stone pockets which may cause honeycombing, pitting, or planes of weakness. Where internal vibrators are used, provide mechanical vibrators with a minimum frequency of 7000 revolutions per minute. Do not use vibrators to transport concrete. Insert and withdraw vibrators at points from 18 to 30 IN apart for 5 to 15 seconds duration. Keep a spare vibrator on the job site during all concrete operations.

g) Reinforcing steel position shall be held continuously during concrete placement.

h) The placing of concrete under water, where permitted, must be done by special accepted methods.

i) Formed elements: Use internal vibrators, not form vibrators. When a surface mortar is to be the basis of the finish, work coarse aggregate back from the forms with a suitable tool to bring a full surface of mortar against the form.

j) Supported elements: Use internal vibrators in elevated beams, girders and brackets and along construction joints. Consolidate elevated slabs with vibrating bridge screeds, roller pipe screens or other means approved by the City of Stillwater. Tamp slabs to force aggregates away from surface and screen level to comply with ACI 347. After screening, do not manipulate concrete prior to commencing finishing operations.

k) Bring slab surfaces to the correct level with a straight edge and strike off. Use bull floats or darbies to smooth the surface, leaving it free of humps or hollows. Do not sprinkle water on the plastic surface. Do not disturb the slab surfaces prior to beginning finishing operations.

18. Cold weather placement:

a) Concrete placed during cold weather shall conform to ACI Code 306-1-90 Standard Specification for Cold Weather Concreting.

19. Hot weather placement:

a) Concrete placed during hot weather shall conform to ACI Standard 305.1-06. Specification for Hot Weather Concreting. The work shall be performed entirely at the Contractor's risk.

20. Bonding:

a) Roughen surface of set concrete at all joints, except where bonding is obtained by use of a concrete bonding agent, and clean surfaces of laitance, coatings, loose particles, and foreign matter. Roughen surfaces in a manner to expose boned aggregate uniformly and to not leave latence, loose particles of aggregate, or damaged concrete at the surface.

b) Prepare for bonding of fresh concrete to new concrete that has set but is not fully cured, as follows:

1) At joints between footings and walls and between walls and beams or slabs they support, and elsewhere unless otherwise specified herein, dampen but do not saturate, the roughened and cleaned surface of set concrete immediately before placing fresh concrete.

2) At joints in exposed work; at vertical joints in walls; at joints in girders, beams, supported slabs and other structural members; and at joints designed to contain liquids; dampen, but do not saturate, the roughened and cleaned surface of set concrete and apply a liberal coating of neat cement grout.

3) Use neat cement grout consisting of equal parts Portland cement and fine aggregate by weight and not more than 6 gallons of water per sack of cement. Apply with a stiff broom or brush to a

minimum thickness of 1/16 IN. Deposit fresh concrete before cement grout has attained its initial set.

4) In lieu of neat cement grout, bonding grout may be commercial bonding agent. Apply to cleaned concrete surfaces in accordance with the printed instructions of the bonding material manufacturer.

21. Construction joints: Construction joints shall be located as shown on the plans and at other points as may be necessary during construction provided that the location and nature of additional joints shall be accepted by the City of Stillwater. In general, joints shall be located at points of minimum shear, shall be perpendicular to the principal lines of stress, and shall have suitable keys having areas of approximately one-third (1/3) of the area of the joints. When placing against a construction joint, the surface of the concrete previously placed shall be thoroughly cleaned of dirt, scum, laitance or other soft material, and shall be roughened. The surface shall then be thoroughly washed with clean water and covered with at least 2 IN of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner that will not splatter forms and reinforcing steel.

22. 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. If for any reason this requirement is not met, or if there are any conspicuous honeycombs, the City of Stillwater may require a correction of the defects by rubbing with carborundum bricks and water until a satisfactory finish is obtained. Immediately after removing the forms, all wires or other exposed metal shall be cut back of the concrete surface and the depressions thus made and all honeycomb and other defects shall be painted with mortar and then rubbed smooth. If the City of Stillwater deems any honey comb or other defect to require such treatment, the 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.

23. Curing concrete:

a) Exposed surfaces of concrete shall be protected by accepted methods from premature drying for a period of at least seven (7) days. Curing compounds, when accepted by the City of Stillwater, shall be applied according to the manufacturer's recommendations and shall not be used on any surface against which additional concrete is to be bonded, nor on surfaces which will be painted. In dry, hot weather, forms shall be removed as early as practicable and curing started immediately. The City of Stillwater may require the frequent wetting of the concrete and the use of means to protect it from the direct rays of the sun.

1) The Contractor shall protect freshly placed concrete from premature drying and excessive cold or hot temperature, and maintain without drying at a relatively constant temperature for the period of time necessary for hydration of the cement and proper hardening of the concrete.

2) The Contractor shall start initial curing as soon as free moisture has disappeared from the concrete surface after placing and finishing and weather permitting, keep continuously moist for not less than 72 hours.

3) The Contractor shall begin final curing procedures immediately following initial curing and before the concrete has dried; continue final curing for at least 7 days and in accordance with ACI 301 procedures; and avoid rapid drying at the end of the final curing period.

b) Water curing: The Contractor shall moist cure the concrete using only water that is free of impurities which could etch or discolor exposed, natural concrete surface. The methods are as follows:

1) Keeping the surface of the concrete continuously wet by covering with water.

2) Continuous water-fog spray.

3) Covering the concrete surface with the specified absorptive cover, thoroughly saturating the cover with water, and keeping the absorptive cover continuously wet. Place absorptive cover so as to provide coverage of the concrete surfaces and edges, with a 4 IN lap over adjacent absorptive covers.

c) Moisture Retaining Cover: The Contractor shall provide moisture retaining cover curing as follows: Cover the concrete surfaces with the specified moisture-retaining cover for curing concrete, placed in the widest practicable width with sides and ends lapped at least 3 IN and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during the curing period using cover material and waterproof tape.

d) Liquid membrane cover: The Contractor shall provide liquid membrane curing as follows:

1) Apply the specified membrane-forming curing compound to damp concrete surfaces as soon as the water film has disappeared. Apply uniformly in a 2-coat continuous operation by power spray equipment in accordance with the manufacturer's directions. Re-coat areas which are subjected to heavy rainfall within 3 hours after initial application. Maintain the continuity of the coating and repair damage to the coat during the entire curing period.

2) Do not use membrane curing compounds on surfaces which are to be covered with a coating material applied directly to the concrete or with a covering material bonded to the concrete, such as other concrete, liquid floor hardener, waterproofing, damp proofing, membrane roofing, flooring, painting, and other coatings and finish materials, unless otherwise acceptable to the City of Stillwater.

e) Curing formed surfaces: The Contractor shall cure formed concrete surfaces, including the undersides of girders, beams, supported slabs and other similar surfaces by moist curing with the forms in place

for the full curing period or until forms are removed. If forms are removed prior to specified curing period, continue curing by one of the methods specified in "Curing Unformed Surfaces".

f) Curing unformed surfaces: The Contractor shall immediately after finishing operation is complete, commence curing unformed surfaces by one of the following methods:

1) Continuously sprinkle or pond surface with water. Use this method for footings only.

2) Cover surface with 2 IN of moist sand. Keep sand moist throughout the curing period. Use this method for footings only.

3) Cover surface with moist fabric. Keep fabric moist and in direct contact with surface so that a film of water remains on the surface throughout the curing period. This method may be used on all concrete surfaces.

4) Cover surface with curing paper. Lap sides and ends at least 3 inches and seal with tape. This method may be used on all concrete surfaces.

5) Apply a uniform coat of liquid curing compound in accordance with manufacturer's recommendations. This method may be used on all concrete surfaces except those scheduled to receive bonded materials. Do not use this method in hot weather.

g) Temperature of concrete during curing:

1) When the atmospheric temperature is 40° F and below, the Contractor shall maintain the concrete temperature between 50° F and 70° F continuously throughout the curing period. When necessary, make arrangements before concrete placing for heating, covering, insulating, or housing, as required to maintain the specified temperature and moisture conditions, continuously for the concrete curing period. Do not use combustion the first 24 hours of curing without taking precautions to prevent exposure of the concrete to exhaust gases. Provide cold weather protection complying with the requirements of ACI 306.

2) When the atmospheric temperature is 80° F, and above or during other climatic conditions which will cause too rapid drying of the concrete, the Contractor shall make arrangements before the start of concrete placing for the installation of wind breaks or shading, and for fog spraying, wet sprinkling, or moisture retaining covering. Protect the concrete continuously for the concrete curing period. Provide hot weather protection complying with the requirements of ACI 305. Maintain temperature as uniformly as possible, and protect from rapid atmospheric temperature changes. Avoid temperature changes in concrete which exceed 5° F. in any one hour and 50° F. in any 24 hour period.

h) Protection from mechanical injury:

1) During the curing period, protect concrete from damaging mechanical disturbances including load stresses, heavy shock, excessive vibration, and from damage caused by rain or flowing water. Protect all finished concrete surfaces from damage by subsequent construction operations. Do not allow any traffic (except for curing purposes) on the concrete surfaces until the concrete has attained 60% of its 28-day strength.

2) Removal of forms: Forms shall be removed in such manner as to ensure the complete safety of the structure. No forms shall be removed except with the express permission of the City of Stillwater. In general, acceptance will be based on the following:

   A. Forms on ornamental work, railings, parapets and vertical surfaces which do not carry loads and which will be exposed in the finished work shall be removed within twenty-four (24) hours to forty-eight (48) hours after placing, as long as the temperature has been above 50° F the entire duration and the concrete hardness is such that the form removal will not damage the surface.

   B. Form work supporting weight of concrete, such as beam soffits, joists, and slabs and other structural elements shall not be removed in less than fourteen (14) days and not until concrete has attained the design minimum twenty-eight (28) day compressive strength. Determine potential compressive strength of in-place concrete location or members under the least favorable conditions prevailing for any portion of the concrete.

   C. Girder, beam and joint soffit forms shall remain in place with adequate shoring underneath, and no construction load shall be supported upon nor any shoring removed from any part of the structure under construction until that portion of the structure has attained sufficient strength to support safely its weight and the loads placed thereon.

   D. Form facing material may be removed four (4) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

i) Re-use of forms:

1) The Contractor shall form lumber which is to be used a second time shall be free from bulge or warp and shall be thoroughly cleaned and repaired. Split, frayed, delaminated or otherwise damaged form facing material will not be acceptable. The Contractor shall apply new form coating compound material to concrete contact surfaces as specified for new form work.

2) When forms are extended for successive concrete placement, the Contractor shall thoroughly clean surfaces, remove fins and latence, and tighten forms to close all joints. Align and secure joints to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to the Owner's Representative.

j) Concrete surface repairs:

1) Patching defective areas

A. The Contractor shall repair and patch all defective areas with cement mortar immediately after removal of forms, but only when directed by the City of Stillwater.

B. The Contractor shall cut out honeycomb and rock pockets, down to concrete but, in no case, to a depth of less than 1 inch. In no case shall reinforcing metal be cut into. Make edges of cuts perpendicular to the concrete surface. Before placing the cement mortar, thoroughly clean, dampen with water, and brush-coat the area to be patched with neat cement grout. Proprietary patching compounds may be used when acceptable to the City of Stillwater.

C. For exposed-to-view surfaces, the Contractor shall blend white portland cement and standard portland cement so that, when dry, the patching mortar will match the color of the surrounding concrete. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with the patching. Compact mortar in place and strike off slightly higher than the surrounding surface.

D. The Contractor shall fill holes extending through concrete by means of a plunger-type gun or other suitable device from the least exposed face, using a flush stop held at the exposed face to insure complete filling.

2) Repair of formed surfaces

A. The Contractor shall repair of exposed-to-view formed concrete surfaces where possible, that contain defects which adversely affect the appearance of the finish. Remove and replace the concrete having defective surfaces if the defects cannot be repaired to the satisfaction of the City of Stillwater. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets, and holes left by the rods and bolts; fins and other projections on the surface; and stain and other discoloration that cannot be removed by cleaning.

B. The Contractor shall repair concealed formed concrete surfaces, where possible, that contain defects that adversely affect the durability of the concrete. If defects cannot be repaired, remove and replace the concrete having defective surfaces. Surface defects, as such, include cracks in excess of 0.01 inch wide, cracks of any width and other surface deficiencies which penetrate to the reinforcement or completely through non-reinforced sections, honeycomb, rock pockets, holes left by tie rods and bolts and spalls except minor breakage at the corner.

3) Repair of unformed surfaces:

A. *The Contractor shall test unformed surfaces, such as monolithic slabs, for smoothness and to verify surface plane to the tolerances specified for each surface and finish. The Contractor shall correct low and high areas as herein specified.*

B. *Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness, using a template having the required slope, Correct high and low areas as herein specified.*

C. *Repair finished unformed surfaces that contain defects which adversely affect the durability of the concrete. Surface defects as such, include cracking, (cracks in excess of 0.01" wide or which penetrate to the reinforcement or completely through non-reinforced sections regardless of width) spalling, popouts, honeycomb, rock pockets, and other objectionable conditions.*

D. *Correct high areas in unformed surfaces by grinding, after the concrete has cured sufficiently so that repairs can be made without damage to adjacent areas.*

E. *Correct low areas in formed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete.*

F. *Repair defective areas, except random cracks and single holes not exceeding 1 IN diameter, but cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts, and expose reinforcing steel with at least ¾ IN clearance all around. Dampen all concrete surfaces in contact with patching concrete and brush with a neat cement grout coating, or use concrete bonding agent. Place patching concrete before grout takes its initial set. Mix patching concrete of the same materials to provide compact and finish as required to blend with adjacent finished concrete. Cure in the same manner as adjacent concrete.*

G. *Repair isolated random cracks and single holes not over 1 IN in diameter by the dry-pack method. Groove the top of cracks, and cut out holes to sound concrete and clean of dust, dirt and loose particles. Dampen all cleaned concrete surfaces and brush with a neat cement grout coating. Place drypack before the cement grout takes its initial set. Mix drypack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Compact drypack mixture in place and finish to match adjacent concrete. Keep patch areas continuously moist for not less than 72 hours.*

H. *Repair methods not specified above may be used, subject to the acceptance of the City of Stillwater.*

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2301

EARTH RETAINING STRUCTURES

Part 1: General

A. Construction Plans. Construction plans shall provide adequate detail and instruction for construction of earth retaining structure(s).

B. Site Stability. Construction techniques shall be used to ensure that earth cuts and embankments are maintained in a stable condition. Use of sheet piling and other temporary methods to support a cut in an embankment shall be done under the guidance of a professional engineer who has special knowledge of sheet piling requirement and in keeping with the design.

C. Best Management Practices. Best Management Practices shall be followed to ensure that excavated and removed materials or materials stockpiled for future use are controlled in such a manner as to control loss of material during a rainstorm.

D. Site Restoration. Site shall be restored to ensure against deterioration during rainstorms.

Part 2: Materials

A. Material Verification. Materials to be used in earth retaining structures shall be verified on site for use and to ensure that they meet the requirements of the city accepted construction drawings and the supporting specifications. Materials to be used for construction of specialty walls shall be the manufacturer's requirements. Materials used to construct the earth retaining system, such as concrete and reinforcing steel shall meet the material requirements of the design. Materials used for backfilling shall meet the gradation requirements of the construction drawings and associated specifications or the requirements of the Geotechnical Report, if that document's instructions are made a part of the construction requirements.

B. Material Storage. Materials shall be stored in such a manner as to avoid interruption of active drainage ways.

Part 3: Construction Requirements

A. Site preparation. Site shall be prepared using quality construction techniques, in such a manner as to disturb the smallest amount of space.

B. Site Drainage Control. Establish perimeter drainage control and local drainage systems to ensure against stormwater runoff containing sediment or other pollutants leaving the site.

C. OKIE Locates. Locate all buried lines within the proximity of any excavation activities.

D. Site Stability. Excavation of the area to receive the earth retaining structure shall be performed in a manner as to ensure that laid back excavations of the embankment are done in such a manner as to ensure a stable

excavation. The Engineer shall be consulted for all excavations of greater than 4 feet depth. Set backs and step back techniques shall be used where directed by the Engineer.

E. General Dewatering. Follow the requirements of the design and special precautions and instructions.

F. Shoring. Follow the requirements of the design and installation requirements.

G. Proximity to Structures. Structures adjacent to construction of an earth retaining system shall be examined before construction starts. For publically funded projects, depending on the proximity of the structure or structures to the proposed excavation and construction, the City may order a full examination of the structure, including visual inspection, photographs, and video filming of the structure walls, foundations, and surroundings to record pre-construction conditions and pre-construction damage. Survey monitoring to determine if there is building movement may also be determined to be appropriate. This process may also be made a requirement for privately funded projects, if in the determination of the City and the professional engineer this is found to be appropriate.

H. Terracing. Where terracing methods are used, terrace setbacks shall be a minimum of three (3) feet wide and shall be angled to the back of the embankment a minimum of 2 percent (2%). Terracing shall be drained to the side of the temporary or completed excavation. Drainage shall be collected in such a manner as to restrict erosion due concentrations of flow and shall be dissipated to accepted outlets or detention facilities. Terraces shall be sloped laterally to drain no greater than two percent (2%) to limit surface erosion of the terrace surfaces.

I. Side seeps and drainage ways. Side seeps encountered in an excavation or drainage ways shall be addressed as encountered by the Engineer in such a manner as to leave the excavation in a stable manner.

J. Site Bearing Surface Preparation. Preparation of site bearing surfaces for an earth retaining structure shall follow the recommendations of the professional engineer.

K. Construction of Earth Retaining Systems. Various earth retaining systems require specialty installation techniques and methods, which shall be addressed as part of the accepted Construction Plans. Such requirements as bin wall assembly, installation of tiebacks and anchoring systems, etc. shall require the placement and installation monitoring of the Engineer. More conventional systems, such a masonry block or concrete retaining walls shall also follow the design details and instructions contained in the accepted construction drawings.

L. Certified Installers. Construction of patented specialty wall systems shall be installed using certified, trained installers, using City accepted, detailed installation plans and shop drawings, developed by a Professional Engineer registered in the State of Oklahoma.

M. Backfilling Procedures. Backfill of wall systems, whether conventional gravity or cantilever wall systems, bin-type wall systems, stack-wall systems, Gabion type, or another system shall be performed under the direction of the professional engineer using properly graded and accepted materials, in lifts not to exceed 8 inches or

that thickness allowed by the geotechnical engineering report, or in the case of walls filled with rock materials, in accordance with the manufacturers recommendations. Compaction of soil materials within, behind, or in front of wall systems shall be to the percent and optimum moisture content specified by the professional engineer.

N. Wall Drainage System. The earth retaining structure shall include a complete behind-the-wall, designed drainage system, including drain rock or gravel, filter fabric, and drain pipe to relieve hydrostatic pressures, except where the system has been designed to deliberately be porous, such as for Gabion systems.

Part 4: Special Inspection

A. Earth retaining structure construction shall be monitored by the Engineer or by a Professional Engineer and, where appropriately directed by the Engineer, by a specialist in Geotechnical Engineering, to ensure quality construction is met and that the special considerations of the geotechnical report (where provided) and geotechnical, structural, and civil designs requirements are fully met. Where structural observation is required, the structural engineer or designee shall monitor the construction to ensure a quality product.

B. 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 Engineer.

END OF SECTION

CONSTRUCTION STANDARDS
SECTION 2400
DRINKING WATER DISTRIBUTION SYSTEM CONSTRUCTION

Part 1: General

A. Summary:

1. This section includes requirements for installation of water distribution systems, including main lines, valves, meters, hydrants, and other accessories and appurtenances., and other services necessary to construct water mains and appurtenances, including extensions and relocations.

B. Referenced Standards:

1. American National Standards Institute (ANSI):

a) B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

2. American Water Works Association (AWWA):

a) Standards:

1) C105: Polyethylene Encasement for Ductile-Iron Pipe Systems.

2) C110: Ductile-Iron and Gray-Iron Fittings

3) C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings (also ANSI A21.11).

4) C116: Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

5) C151: Ductile-Iron Pipe, Centrifugally Cast.

6) C153: Ductile-Iron Compact Fittings for Water Service (also ANSI A21.53).

7) C219: Bolted, Sleeve-Type Couplings for Plain-End Pipe.

8) C508: Swing-Check Valves for Waterworks Service, 2 IN through 24 IN (50-mm through 600-mm) NPS.

9) C509: Resilient-Seated Gate Valves for Water Supply Service.

10) C512: Air-Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.

11) C515: Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

12) C550: Protective Epoxy Interior Coatings for Valves and Hydrants.

13) C651: Disinfecting Water Mains.

14) C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN through 60 IN (100 mm through 1,500 mm).

15) C901: Polyethylene (PE) Pressure Pipe and Tubing, ½ IN (13 mm) through 3 IN (76 mm), for Water Service.

16) C906: Polyethylene (PE) Pressure Pipe and Fittings, 4 IN (100 mm) through 63 IN (1,600 mm), for Water Distribution and Transmission.

b) Manuals of Water Supply Practices:

1) M23: PVC Pipe – Design and Installation.

2) M41: Ductile-Iron Pipe and Fittings.

3) M51: Air-Release Air/Vacuum, and Combination Air Valves.

4) M55: PE Pipe – Design and Installation.

3. ASTM International:

a) A240/A240M: Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

b) B88: Standard Specification for Seamless Copper Water Tube.

c) C33: Standard Specification for Concrete Aggregates.

d) C478: Standard Specification for Precast Reinforced Concrete Manhole Sections.

e) D2000: Standard Classification System for Rubber Products in Automotive Applications

4. NSF International:

a) NSF/ANSI Standard 61.

5. Oklahoma Administrative Code:

a) Title 252. Oklahoma Administrative Code, Chapter 626, Public Water Supply Construction Standards, ODEQ.

6. Foundation for Cross-Connection Control and Hydraulic Research at the University of Southern California:

a) Manual of Cross Connection Control.

C. Submittals:

1. Plan for filling, flushing, disinfection, and pressure testing the installed pipeline.

Part 2: Materials

A. General;

1. Provide equipment and materials meeting AWWA specifications.

2. All materials touching drinking water shall conform to NSF Standard 61.

3. Gaskets: conform to AWWA C111 and NSF-61.

4. All components shall be rated for 150 psi working pressure.

B. Pipe:

1. Polyvinyl Chloride (PVC), including Fusible PVC (FPVC):

a) Compliant with AWWA C900.

b) Acceptable manufacturers: JM Eagle, Diamond Plastics, North American Pipe, or Approved Equal.

2. Ductile iron (DI):

a) Compliant with AWWA C151.

b) Acceptable manufacturers: U.S. Pipe, American Cast Iron Pipe Company (ACIPCO), or Approved Equal.

c) Allowable joints (AWWA C111 compliant):

1) Push-on.

2) Mechanical joint.

3) Flanged:

A. Exposed installation: allowed.

B. Buried installation: allowable only with Water Resources Director approval. For approval, demonstrate advantages of flanged connections over other types. Typical advantages include restraint and ease of pre-assembly for rapid field installation.

d) Linings and coatings:

1) Interior:

A. Hydraulic cement mortar, AWWA C104 compliant.

B. Other: NSF 61 compliant; with approval of Water Resources Director only.

2) Exterior, buried:

A. Asphaltic, AWWA C151 compliant.

B. Other: with approval of Water Resources Director only.

3) Exterior, exposed: with approval of the Water Resources Director. For approval, propose coating, insulation, and cladding system (if necessary) for a 50 year service life with minimal maintenance.

e) Fittings: ductile iron, compliant with AWWA C110 or C153.

3. High Density Polyethylene (PE):

a) AWWA C901 or C906 compliant.

b) Allowable joints:

1) Butt fused.

2) Butt fused MJ adapter: acceptable for transition from PE to fittings and other pipe materials.

C. Fittings:

1. Ductile iron fittings:

a) AWWA C110 or C153.

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.

2. PVC fittings are not acceptable.

3. PE and FPVC fittings:

a) Acceptable only when butt fused to the same pipe material.

b) Manufacture to serve same test and operating conditions as connected pipe.

c) Only molded fittings are acceptable. Fabricated fittings are only acceptable with permission from the Water Resources Director. If segmented construction, no more than 30 degrees per segment.

D. Couplings and Adapters:

1. Meet or exceed pressure ratings of piping system.

2. Nuts, bolts, and hardware: 304 stainless steel.

3. Sleeve couplings:

a) AWWA C219 compliant.

b) Acceptable manufacturers and models: Krausz Hymax, Romac Macro, or Approved Equal.

1) End Rings: Ductile Iron.

2) Center Ring: ASTM A283 Grade A steel or Ductile Iron.

3) Bridge: 304 stainless steel.

c) Interior and exterior: fusion bonded epoxy, minimum 10 mil DFT, AWWA C116 or C213 compliant.

d) Nuts, bolts, and hardware: 304 stainless steel with anti-galling protection for threads.

E. Gate Valves:

1. AWWA C509 or C515 compliant.

2. Acceptable manufacturers: American Flow Control, Mueller, or Approved Equal.

3. Features:

a) Body: ductile iron.

b) Stem: bronze.

c) Resilient wedge style.

d) Nuts and bolts for bonnet, stuffing box, wrench nut cap, other miscellaneous fasteners: Type 304 stainless steel.

e) Exterior coating: fusion bonded epoxy, minimum 10 mil DFT.

f) Interior coating: fusion bonded epoxy, minimum 10 mil DFT, AWWA C550 compliant.

4. 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.

F. Valve boxes for buried AWWA nut valves:

1. Risers: single continuous length of 6-IN C-900 PVC DR 18 or Schedule 40 PVC.

2. Valve box frame and cover:

a) Cast iron or ductile iron.

b) East Jordan Iron Works Type 70 or Approved Equal.

c) The word “WATER” shall be cast in each cover.

3. Ball valves for air valve isolation, test ports, sample ports, gauge isolation valves, and other small diameter exposed piping:

a) Body: brass, less than 15% zinc.

b) Ball: stainless steel or brass.

c) Seal: Buna-N (nitrile) rubber.

d) Handle: stainless steel.

e) Full port.

4. Check valves:

a) For mains and other large diameter pipe:

1) AWWA C508 compliant.

2) Single disc,

3) Swing type, Horizontal shaft.

4) Fill diameter passage.

5) Provide outside lever and weight or spring.

6) Provide anti-slam trim.

7) Disc face: bronze.

5. Backflow preventer assemblies: compliant with the Plumbing Code.

6. Air valve assemblies:

a) Air valve:

1) AWWA C512 compliant.

2) Air / vacuum valves are not acceptable. Use combination air valves instead.

3) Body and cover: cast iron.

4) Interior coating: fusion bonded epoxy, 10 mil DFT.

5) Exterior coating: fusion bonded epoxy, 10 mil DFT.

6) Linkage and float: 304 stainless steel.

b) Vent:

1) Piping: ductile iron or cast iron, flanged outlet.

2) Screen: 316 stainless steel.

c) Vault:

1) Walls and top: precast concrete

2) Access frame and cover:

A. Same model as wastewater collection system manhole frame and cover.

B. ""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.

7. Tapping Sleeves and Valves:

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.

3) Nuts, bolts, and hardware: 304 stainless steel with anti-galling protection for threads.

4) AWWA C110 compliant.

b) Tapping sleeves greater than 12 IN nominal diameter: as approved by the Water Resources Director.

c) Tapping valves:

1) Provide valve designed to match tapping sleeve.

2) See isolation valves, this section. Exception: provide one end flanged, to match tapping sleeve.

G. Fire Hydrants:

1. Acceptable models:

a) American Darling 5¼ IN B-84-B with 6 IN main valve.

b) Mueller Super Centurion 250.

c) Clow Medallion.

d) Only the above listed models are acceptable.

2. Conforming to AWWA C502.

3. Post type, dry barrel.

4. Riser, hydrant body, and valve body: ductile iron.

5. Nuts, bolts, and hardware: 304 stainless steel.

6. Main valve:

a) Valve opening: not less than 5 ¼ IN.

b) Connection diameter: 6 IN nominal.

7. Nozzles:

a) 2 x 2.5 IN hose nozzles.

b) 1 x 4.5 IN pumper nozzle.

c) Hydrant nozzles and caps shall meet National Standard thread requirements.

d) Provide long life rubber gaskets meeting ASTM D2000 requirements for each nozzle.

8. Hydrants shall be equipped with two drain holes and an automatic and positively operating non-corrodible drain or dip valve. The drain holes and valve shall ensure that the hydrant drains completely when the main valve is shut.

9. Color:

a) City of Stillwater: Federal Standard 595A 31105 Red.

b) Private: silver.

10. Operating Nut: AWWA standard, pentagonal, 1-1/2 IN from point to flat at the base of the nut.

11. Breakaway design.

H. Flush Hydrants:

1. Kupferle #2 Eclipse Post Hydrant or Approved Equal.

a) 2-1/2 IN nozzle.

b) MJ inlet.

c) Operating Nut: AWWA standard, pentagonal, 1-1/2 IN from point to flat at the base of the nut.

I. Automatic Flushing System:

1. Mueller Hydro-Guard Permanent Flushing System HG3 Cold Climate Model or Approved Equal.

J. Low profile green enclosure. Valve Vaults

1. Air release and pressure-reducing valve vaults shall be precast concrete conforming to ASTM C478.

K. Service Connections:

1. Meters:

a) Use only meters provided by the Stillwater Utilities Authority.

b) Other: as approved by the Water Resources Director.

2. Tapping Saddle:

a) Allowable tapping saddle model:

1) All water main materials except PE: Ford 202B or Approved Equal.

2) PE: Electrofusion, as approved by the Water Resources Director.

b) Tap thread: AWWA taper thread.

3. Tapping Sleeves: see tapping sleeve and valves.

4. Service Brass:

a) General:

1) Acceptable manufacturers: Ford, Mueller (no Equals accepted).

2) Connections to service line pipe: Grip Joint (with stainless steel insert stiffener when connecting to PE pipe).

3) No lead alloy required, must be fully compliant with current federal and state requirements.

b) Corporation Stops:

1) Ford FB series or Mueller 300 series ball corporation valves (no Equals accepted).

2) AWWA taper thread x Ford Grip Joint or Mueller equivalent.

c) Coppersetters (3/4 IN through 2 IN):

1) Ford 70 series or Mueller equivalent (no equals accepted).

2) Inlet valve: angle ball meter valve with padlock wing.

3) Outlet valve: none.

4) Bypass: none.

5) Setter height: 12 IN.

6) Inlet and outlet orientation: horizontal.

d) Meter Valves:

1) ¾ IN through 2 IN: Ford or Mueller Angle Ball Meter Valve (no Equals accepted) with padlock wing.

2) greater than 2 IN: as approved by the Water Resources Director.

e) Customer Shut-Off Valves:

1) Ford B-Series Ball Valve Curb Stop or Mueller 300 series (no equals accepted).

2) Stop and waste feature strictly prohibited.

5. Service Line Pipe:

    a) PE:

        1) AWWA C901, DR 9.

        2) Match tap diameter.

        3) Provide stainless steel pipe stiffeners for pack joints and other compression type joints.

        4) Maximum 1 joint per 100 LF.

    b) Copper:

        1) Conform to ASTM B-88 and ANSI/NSF Standard 61.

        2) Type K, SDR-9.

        3) Maximum 1 joint per 100 LF.

    c) Not Acceptable: PVC, Iron.

6. Meter Enclosures:

    a) General: Requirements for meter enclosure are based upon meter size, pavement condition, and traffic condition. If meter size, pavement condition, or traffic condition are not shown on the drawings, request guidance from the Water Resources Director.

    b) Meter Size less than or equal to 1 IN:

        1) Non-Paved Areas, No Traffic (ex: front yards, grassy areas between parking lots and sidewalks. Front yards in areas where yard parking has been observed are considered traffic areas.):

            A. Walls: PW Eagle Ultra-Rib or Ultra-Corr:

                1. For ¾ IN meters: 18 IN nominal diameter.

                2. For 1 IN meters: 24 IN nominal diameter.

            3. Frame:

                a) ¾ IN meter: Sigma MB141 or Approved Equal.

                b) 1 IN meter: Sigma MB164 or Approved Equal.

            4. Lid:

                a) DFW Plastics 18AMR-40 / 24AMR-40 or Approved Equal

                b) Antenna pocket.

c) Locking pin, compatible with standard meter lid key.

d) Lettering:

Top (7/8" letters): "CITY OF STILLWATER".
Middle (7/8" letters): "WATER METER".
Middle (3/4" letters): "DO NOT TAMPER".
Middle (1/2" letters): "FOR HELP:".
Middle (1/2" letters): "405-372-3292".

2) Paved and Non-Paved Areas, Occasional Traffic (ex: driveways, alleys, and parking lots):

A. Armorcast A6001545 Fiberglass round FRP vault or Approved Equal.

B. ANSI Tier 15.

c) Meter Size greater than 1-IN through 2-IN, Paved or Non-Paved, Occasional Traffic (ex: single family residential driveways, alleys, and parking lots):

1) Armorcast A6001509TAX36 24"x 36" FRP box and cover assembly or Approved Equal.

2) ANSI Tier 15.

d) Meter Size greater than 2-IN, Paved or Non-Paved, Occasional Traffic (ex: single family residential driveways, alleys, and parking lots):

1) Precast concrete vault with hatch.

2) ANSI Tier 15, designed for 20K loading.

e) Any Size, Paved or Non-Paved, Continuous Traffic (ex: streets and parking lots): as approved by the Water Resources Director. Although location of a meter in traffic areas is not allowed and may inhibit the safe operation of meters and safe access, it may be necessary in certain situations. Suitable meter enclosure construction must typically be concrete and cast iron, designed for H20-44 loading, including repeated traffic. Concrete and iron materials severely reduce the range of the City's AMR radio network. In place testing may be required to verify that the provided materials are compatible with the City's AMR network at the meter location.

7. Customer Pressure Reducing Valves: Watts N45B or Approved Equal.

8. Customer Shut-Off Valve: see Service Brass, above.

9. Customer Shut-Off Valve Box:

a) Non-Paved, No Traffic:

1) Box and Lid: Rainbird PVB6RND 6-IN Round Valve Box or Approved Equal.

2) Riser: 8-IN Schedule 40 PVC.

b) Pavement or Any Traffic: Construct as public main meter box, without concrete apron.

L. Tracer Wire: see Section 2107 – Buried Pipe Installation.

M. Warning Tape: see Section 2107 – Buried Pipe Installation.

N. Pipe Embedment: see Section 2107 – Buried Pipe Installation.

O. Pressure Gauges:

1. Acceptable manufacturers: Ashcroft or Approved Equal.

2. Range: 0-160 psi.

3. Case: weatherproof, stainless steel.

4. Glycerin filled.

Part 3: Execution

A. General:

1. Reference Section 2107 – Buried Pipe Installation.

2. Only the City may operate isolation valves on public mains.

3. Service Interruptions:

a) When necessary to facilitate construction, the City will interrupt service to its customers or isolate sections of the distribution system, following the procedure listed on the City's web site.

b) The Water Resources Director may require that service interruptions be rescheduled based on customer response to shutdown notices.

c) The Water Resources Director may require that service interruptions take place at night or on weekends to minimize the impact of the interruptions.

4. Non-functioning valves and other issues may prevent complete isolation of a requested shutdown area.. City staff will assist in reducing the flow water as much as possible, but a dry working environment is not guaranteed and should not be expected.

B. Field Quality Control:

1. Supervision:

a) Perform all water distribution system work under qualified direct supervision.

b) Supervisor minimum qualifications:

1) Hold a current ODEQ Class D Water Works Operator certification.

2) Experience with materials and procedures required to complete the work, including protection of existing facilities such as transportation and other utility infrastructure.

C. Pipe Installation:

1. Install by the open cut method (trenching) in accordance with Section 2109 – Buried Pipe Installation, except where trenchless installation has been approved by the Water Resources Director.

2. Minimum cover: 3.25 FT. Exceptions may be made for driveway cuts, small swales, and other local features, provided that cover is not reduced to less than 3' with permission from the Water Resources Director. Thoroughly clean each joint of pipe and fitting before installing and keep clean for the duration of the project.

3. Plug open pipe ends of installed pipe whenever pipe laying operations are not in progress, including at the end of each day, meals, and breaks, to prevent animals, sediment, and other contaminants from entering. Provide a means of allowing the line to vent when the plugs are in place.

4. 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.

D. Connection to Existing Mains

1. Do not connect to existing mains without an SUA inspector on site.

2. Furnish and install all fittings necessary to join existing and new water mains.

3. 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.

4. Have all manpower, materials, and equipment ready to connect to the existing main to minimize water service interruptions.

E. Isolation Valves:

1. 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.

2. 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.

3. Set gate valves with shaft in the vertical position, plumb.

4. Valve boxes:

a) Install a valve box and lid for each valve.

b) Install the box centered and plumb over the operating nut of the valve.

c) Install valve box covers flush with the surface of finished grade.

d) Provide a reinforced concrete collar.

F. Tapping Sleeves and Valves:

1. Test the installed tapping sleeve body with water or nitrogen.

2. Size-on-size taps are only acceptable with permission from the Water Resources Director.

3. Tap hole may be no smaller than 90% of the inside diameter of the tapping tee branch.

4. Retrieve the coupon and make it available to the Water Resources Director for examination.

G. Fire Hydrant Assemblies:

1. Location and Position:

a) Connect hydrant isolation valve directly to service tee, using a swivel joint connection. Restrain hydrant to isolation valve using tie rod system (see Acceptable Restraint Devices, this section). Other methods of restraint and location of the isolation valve may be allowed with permission from the Water Resources Director.

b) Set hydrants and risers plumb. Deviate from vertical no more than ¼ bubble.

c) Orient pump nozzle toward the street or fire lane in accordance with NFPA code.

d) Set hydrant so that lowest nozzle no less than 18 IN above surrounding grade.

e) Set hydrant so that the operating nut is no more than 4 FT above surrounding grade.

f) Set hydrant so that surrounding grade meets the hydrant at the bury line. Deflect the hydrant connection line joints or provide fittings as necessary. Measure depth at the proposed hydrant location and identify the need for fittings, deflection, or other measures before installing new hydrant, service tees, valves, or connection piping.

g) Set the center of the hydrant 6 FT-4 IN from the face of curb of the street or fire lane.

2. Keep weep holes clear and free to drain. Surround weep holes with washed rock as shown in the standard details.

3. Compact the area supporting the hydrant and provide thrust blocking in accordance with the standard details.

H. Service Connections:

1. General:

a) Flush service line prior to connecting meter (meter set by City only).

b) Provide a pressure reducing valve when normal operating pressure of the main is expected to exceed 85 psi. Set the customer side of the pressure reducing valve to no more than 85 psi.

2. Service saddle installation:

   a) Thoroughly clean pipe exterior prior to installing service saddle.

   b) Protect locator wire from damage.

   c) Install service saddle and corporation stop no lower than horizontally from the center of the water main.

   d) Tighten bolts uniformly and to manufacturer's recommended torque.

   e) Do not cover service saddle and main until a SUA inspector has approved the saddle installation.

   f) Leave line uncovered and provide opportunity for a SUA inspector to approve the service saddle installation.

3. Service line installation:

   a) 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.

   b) Install service line, fittings, valves, tracer wire, embedment material, and warning tape.

      1) Only the City may set a meter.

      2) It is not required that tracer wire continues past the meter and run with the private portion of a water service line. If the tracer wire is continued past the meter, provide a splice within the meter enclosure.

   c) Pressure test service line from main through customer shutoff valve. Use a spacer in place of meter.

   d) Flush service line through customer shutoff valve.

   e) Re-embed main, repair main locator wire, and (re)place warning tape.

4. Meter enclosure installation:

   a) Prepare and level meter enclosure base with embedment material.

   b) Set meter enclosure and customer shutoff valve box flush with finished grade. Ensure that valve box does not bear on pipe or curb stop. If finished grade is not established when meter box is set, it is acceptable to set the top of the box above existing and finished grade, then cut the box to match finished grade after finished grade has been established.

c) Backfill with Earth Fill in accordance with Section 2105 – Earth Work. Backfill around meter enclosure and customer shutoff valve with embedment material and hand tamp to consolidate. Maintain meter enclosure and valve box position during consolidation.

I. Polyethylene Encasement:

a) Encase all iron pipes, fittings, valves, and other ferrous system components with polyethylene wrap.

b) Install and repair polyethylene wrap in accordance with AWWA Manual of Practice M41 and AWWA C105.

c) Use tubing for pipe and fittings. Use sheets for valves and other irregular components.

J. Tracer Wire and Warning Tape:

1. Install tracer wire and warning tape for all water mains and service lines.

2. Tracer Wire:

a) Ensure that insulation is sounds and free from cuts, nicks, or other paths to ground.

b) Splice new tracer wire to existing tracer wire, unless otherwise approved by the Water Resources Director. If the end of a tracer wire is buried, seal the end with a splice kit, two layers of liquid electrical tape, or other solution approved by the Water Resources Director. Do not use wire nuts to splice or terminate.

3. Warning Tape:

a) Install warning tape directly above the top of the pipe, as shown in the Details.

b) Ensure that warning tape is continuous. Overlap minimum 2 FT with existing tape and at breaks in tape.

K. Air Valves:

1. Valve vault top minimum 6 IN above highest finish grade.

2. Completely support valve assembly. Do not use connecting pipe to support valve.

3. Vent to outside of vault with down facing vent and screen, minimum 12 IN above vault top.

L. Blow-Off Assemblies: not allowed.

M. Filling, Flushing, Disinfection, and Testing:

1. Sequence:

a) Clean.

b) Fill.

c) Flush.

d) Disinfect and Test.

e) Pressure Test.

2. Filling:

a) Notify SUA staff 48 hours prior to filling the line.

b) Ensure that the pressure in the new main remains lower than the connected, adjacent system at all times until the main has passed disinfection testing.

c) Ensure that hydrants and air valves are open prior to filling.

d) Do not fill the line. SUA operations 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 (only 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 corporations stops on the as recorded drawings.

3. Flushing: Flush the pipeline in accordance with AWWA C-651.

4. 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. Provide all necessary equipment, materials, manpower, and expertise.

c) Dispose of chlorinated water in accordance with applicable law and AWWA C651. Do not discharge chlorinated water to the storm sewer, creeks, or other water bodies without dechlorination.

5. Testing:

a) General:

1) 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.

2) Provide all necessary equipment, materials, manpower, and expertise.

3) Notify the Water Resources Director 48 hours prior to pressure testing and schedule the testing so that a representative of the Stillwater Utilities Authority can be on site during testing.

b) Disinfection Testing:

1) Gather samples and conduct bacteriological testing to verify the sanitary condition of the installed pipeline, in accordance with AWWA C-651 and ODEQ regulations.(to be performed by City staff)

2) If the tested section fails the test, take corrective measures, and repeat testing.

3) If any tested section fails two disinfection tests, take corrective measures, perform disinfection again, and repeat testing.

c) Hydrostatic Testing:

1) Hydrostatic testing may be conducted prior to disinfection testing only with the approval of the Water Resources Director and if backflow prevention methods are in place to protect the existing system from contamination from the new main.

2) Test in accordance with the AWWA standards and manuals of practice applicable to the pipe material(s) installed.

3) Test medium: drinking water. Air testing is not acceptable.

4) Minimum test period: 2 hours.

5) Test pressure: 150 psi. Engineer may specify a higher test 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. Use two gauges to verify accuracy.

8) Measure make-up water with a domestic water meter or other accurate measuring device.

9) If any visible leaks are observed or if the volume of make-up water required exceeds the limits described by the AWWA standard applicable to the pipe material, the system will have failed the test. Correct the leakage and repeat the test until the system passes the test.

N. Abandonment of Existing Infrastructure:

1. Valves:

a) Remove valve box and backfill.

b) Under pavement, it is acceptable to remove only the lid and fill the valve box with concrete.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2500

WASTEWATER COLLECTION SYSTEM CONSTRUCTION

Part 1: General

A. Summary:

1. This section includes requirements for installation of wastewater collection systems, including main lines, manholes, service connections, and other accessories and appurtenances necessary to construct wastewater mains and appurtenances, including extensions and relocations.

B. Referenced Standards:

1. American National Standards Institute (ANSI):

a) B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.

2. American Water Works Association (AWWA):

a) Standards:

1) C105: Polyethylene Encasement for Ductile-Iron Pipe Systems.

2) C111: Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings (also ANSI A21.11).

3) C116: Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings.

4) C151: Ductile-Iron Pipe, Centrifugally Cast.

5) C900: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 4 IN through 12 IN (100 mm through 300 mm), for Water Transmission and Distribution.

6) C905: Polyvinyl Chloride (PVC) Pressure Pipe and Fabricated Fittings, 14 IN through 48 IN (350 mm Through 1,200 mm), for Water Transmission and Distribution.

3. ASTM International:

a) A240/A240M: Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

b) C33: Concrete Aggregates.

c) C478: Precast Reinforced Concrete Manhole Sections.

d) D1784: Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

e) D2000: Classification System for Rubber Products in Automotive Applications

f) D2241: Poly (Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series).

g) D3034: Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

h) F477: Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

i) F679: Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

4. Oklahoma Administrative Code:

a) Title 252, Chapter 656, Water Pollution Control Facility Construction, Oklahoma Department of Environmental Quality (ODEQ), current version.

C. Submittals:

1. Plan for mandrel and pressure testing the installed pipeline and vacuum testing the installed manholes.

Part 2: Materials

A. Manholes and Other Miscellaneous Concrete Structures:

1. General:

a) Seal all joints with rubber gaskets.

b) Provide core-drilled or formed openings with a smooth, uniform, cylindrical hole of the proper size to accommodate the pipe sealing element.

2. Precast Concrete:

a) Design and construct precast sections in accordance with ASTM C478.

b) Minimum base thickness: 8 IN.

3. Cast In Place Concrete:

a) Minimum 4000 PSI at 28 days.

b) Minimum base thickness: 12 IN.

4. Plastic Manholes (only with permission from the Water Resources Director): Pipelife Jet Stream Pro40 or Approved Equal.

5. Mortar: The materials for mortar shall conform to the following:

    a) Sand - ASTM C33, passing a No. 8 Sieve.

    b) Cement - ASTM C150, Type 1.

    c) Water - shall be potable.

    d) Aggregate - ASTM C144.

    e) Hydrated Lime - ASTM C207, Type S.

6. Rubber gaskets:

    a) Conforming to ASTM C443.

    b) The gasket shall be the sole element depended upon to make the joint flexible and watertight.

7. Pipe seals:

    a) Conforming to ASTM C923.

    b) Press Seal PSX, Press Wedge II, or Approved Equal.

8. Interior coating for concrete structures: Interior: Kop-Coat Bitumastic 300-M or Approved Equal, 12 mil DFT.

9. Frame and Cover:

        1) Cast iron, conforming to ASTM A48.

        2) Heavy duty.

        3) Machined bearing surfaces.

        4) Where manhole may be inundated by flooding, provide a watertight assembly, including neoprene gasket and gasket groove cast into lid.

        5) "Sanitary Sewer" cast into the lid.

        6) Lifting method: pick bar. Pick holes and vents are not acceptable.

        7) Acceptable Models:

            A. For precast manholes: East Jordan Iron Works 2100 (27 IN nominal) or Approved Equal.

            B. For plastic manholes: as approved by the Water Resources Director.

C. For replacement of existing frames and covers where 27 IN frame and cover will not fit or is not practical: east Jordan Iron Works 2132 (24 IN nominal) or Approved Equal.

10. Manhole ring seal: K.T. Snyder Ram Neck or Approved Equal.
11. Non-shrink grout:
    a) Master Builders Embeco;
    b) Sonneborn Berrolith G-DS;
    c) Or Approved Equal.

B. Pipe:

1. General;
2. Gravity Mains:
    a) 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.
    b) Ductile iron (DI) (when allowed by the Water Resources Director):
        1) Conforming to AWWA C151.
        2) Allowable joints: push-on, mechanical joint.
        3) Acceptable manufacturers: U.S. Pipe, American Cast Iron Pipe Company, or Approved Equal
        4) Linings and coatings:
            A. Interior: Protecto 401 or Approved Equal.
            B. Exterior, buried: Bituminous, conforming to AWWA C151.
        5) Gaskets: ASTM F477.
    c) High Density Polyethylene (PE):
        1) Conforming to AWWA C900/C906.
        2) Allowable joints: butt fused.

3. Pressure Mains:

a) Polyvinyl Chloride (PVC), including Fusible PVC (FPVC):

1) Conforming to AWWA C-900.

2) Allowable joints: push-on, butt fusedFPVC .

b) Ductile iron (DI) (when allowed by the Water Resources Director):

1) Conforming to AWWA C151.

2) Allowable joints:

A. Mechanical joint.

B. Proprietary integrally restrained: US Pipe TR Flex, ACIPCO Flex-Ring, Griffin Snap-Lok or Approved Equal.

C. Flanged: exposed installation only.

3) Acceptable manufacturers: U.S. Pipe, American Cast Iron Pipe Company or Approved Equal.

4) Linings and coatings:

A. Interior: Protecto 401 or Approved Equal.

B. Exterior, buried: Bituminous, conforming to AWWA C151.

5) Gaskets: ASTM F477.

c) High Density Polyethylene (PE):

1) Allowable joints: butt fused.

2) Fittings: HDPE, butt fused.

C. Fittings (pressure mains only):

1. Pressure:

a) Ductile iron:

1) Allowable joints:

A. Mechanical joint, conforming to AWWA C110 or C153.

B. Proprietary integrally restrained: US Pipe TR Flex, ACIPCO Flex-Ring, Griffin Snap-Lok or Approved Equal, only when compatible with pipe material.

b) PE and FPVC:

1) Acceptable only when butt fused to same pipe material.

2) Manufacture to serve same operating conditions as connected pipe.

3) Only molded fittings are acceptable. Fabricated fittings are only acceptable with permission from the Water Resources Director. If segmented construction, no more than 30 degrees per segment.

D. Couplings and Adapters:

1. Meet or exceed pressure ratings of piping system.

2. Nuts, bolts, and other threaded hardware: A36 steel.

3. Non-threaded hardware: Type 304 stainless steel.

4. Sleeve couplings:

a) Body and end rings: ductile iron (fabricated steel couplings are not acceptable).

b) Interior lining: fusion bonded epoxy, 4 mil DFT.

c) Exterior coating: fusion bonded epoxy, 4 mil DFT.

E. Valves

1. General:

a) Connections:

1) Exposed: flanged, conforming to ANSI B16.1, Class 125.

2) Buried: mechanical joint.

b) Nuts, bolts, and other threaded hardware: A36 steel.

c) Other hardware: Type 304 stainless steel.

d) The laying lengths of flanged valves shall conform to the dimensions of ANSI B16.10.

e) Exterior coating: fusion bonded epoxy, minimum 10 mil DFT.

f) Interior coating: fusion bonded epoxy, minimum 10 mil DFT.

g) Valve operation:

1) Operating nut opening direction: counterclockwise.

2) Buried: operating nut: 2-IN square.

3) Exposed: provide a hand wheel with the closing direction clearly indicated.

4) Maximum required input torque under any condition: 10 FT-LB.

5) Provide a gear box if necessary to achieve required input torque:

A. Provide gear box completely enclosed and lubricated with seals provided on all shafts to prevent entry of dirt and fluid into the actuator.

B. Provide shaft bearings with permanently lubricated bronze bearing bushings.

C. Provide valve position indicator on exposed gear boxes.

D. Provide adjustable stops designed to withstand 200% of the maximum required input torque.

2. Valve boxes

a) Risers: single continuous length of 6 IN DR 21 PVC.

b) Valve box frame and cover:

1) Cast iron or ductile iron.

2) Sigma Type 70 or Approved Equal.

3) The word “WASTEWATER” shall be cast in each cover.

4) Concrete collar: 6 IN thick by 2 FT x 2 FT square, steel reinforced, concrete collar.

3. Plug Valves:

a) 4 IN nominal diameter and larger:

1) Eccentric plug type only with resilient face.

2) Materials:

A. Body: ductile iron.

B. Stem: bronze.

3) Port area greater than or equal to 80% of full pipe area.

4) Corrosion and abrasion resistant, such that exposure over a period of five years to domestic wastewater, industrial wastewater, 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.

5) 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 cusion.

d) Materials:

1) Disc faces and seat rings: bronze.

F. Service Connections:

1. Tapping Saddle:

a) Allowable tapping saddle model: Romac CB sewer saddle.

2. Service Line Pipe and Fittings:

a) PE:

1) DR 9.

2) Match tap diameter.

3) Provide stainless steel pipe stiffeners for compression type joints.

b) PVC:

1) Schedule 40 PVC within the right-of-way.

Part 3: Execution

A. General:

1. Reference Section 2107 – Buried Pipe Installation.

2. Service Interruptions:

   a) Do not interrupt customers' service without 48 hour advance approval from the Water Resources Collection System Supervisor. The Water Resources Director may require that service interruptions take place at night or on weekends to minimize the impact of the interruptions.

   b) Provide door hangers in the affected area of any service interruption 48 hours in advance to advise residents and customers of work to be performed.

3. Field Quality Control:

   a) Supervision:

      1) Perform all work under qualified direct supervision.

      2) Supervisor minimum qualifications:

         A. Hold a current ODEQ Class D Collection System Operator certification.

         B. Experience with materials and procedures required to complete the work, including protection of existing facilities such as transportation and other utility infrastructure.

4. 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.

B. Manhole Installation:

   a) General:

      1) Excavation

         A. Side clearances: Side clearances outside the manhole and/or structures shall be no greater than to allow for forming, connection of piping, proper application of special coatings, if required, and to permit inspection. When concrete is to be placed directly against excavated faces, excavation shall be sufficiently outside of the manhole or structure to provide not less than 3 inches of concrete cover over the steel reinforcement.

B. Existing structure: Excavation shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services and for inspection.

2) Precast Manholes:

A. Do not deliver precast concrete components to the job until concrete has attained at least 80 percent of the specified minimum design strength. Mix design and casting documentation may be used to verify that this requirement has been met.

B. Clean precast sections of all dirt, grass, and other deleterious matter. Seal each joint (including adjustment rings and castings) with a double bead of pre-formed bitumastic joint sealant. Patch lift holes with non-shrink grout.

3) Do not provide cast-in-place manholes without permission from the Water Resources Director.

4) Precast Bases: install on a layer of embedment material.

5) Cast In Place Bases:

A. Pour invert monolithically with base.

B. Embed bottom wall sections minimum 3 IN into base.

C. Reinforce with 10 gauge welded wire fabric, supported on chairs.

D. Pour base with bottom wall section already in place, supported and leveled on solid concrete blocks.

E. If pipe stubs are used, cast in place and plug with a watertight removable stopper. Maximum stub length: 24 IN.

6) Clear inside diameter: 4 FT. Clear inside diameter is defined as a circle of a certain diameter into which nothing protrudes, including inside drop structures. A manhole featuring an inside drop that protrudes 12 IN from the manhole wall would be required to be 5 FT in diameter to maintain a 4 FT clear inside diameter.

7) Patch tie holes with non-shrink grout.

8) In flood prone or drainage ways, provide bolt-down lids with gaskets and waterproof inserts.

b) Bench and Invert:

1) Provide steel troweled inverts with a dense, smooth finish. Provide a channel u-shaped in cross section, at least one half of the pipe inside diameter in depth. Provide smooth transitions between pipes of different sizes and elevations, and through bends.

2) Slope the bench and invert to drain completely.

3) Smooth the transition between pipe and invert with grout. Ensure complete drainage.

c) Grade Adjustment:

1) Adjust all new manholes with reinforced concrete adjustment rings.

2) Seal with preformed bitumastic sealant.

3) Maximum height between top of cone and bottom of frame: 12 IN.

4) 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.

C. Pipe Installation:

1. Install by the open cut method (trenching) in accordance with Section 2107 – Buried Pipe Installation, except where trenchless installation has been approved by the Water Resources Director.

2. Minimum cover: 4 FT.

3. Plug open pipe ends of installed pipe whenever pipe laying operations are not in progress, including at the end of each day, meals, and breaks, to prevent animals, sediment, and other materials from entering. Provide a means of allowing the line to vent when the plugs are in place.

4. All butt-fused pipe, including HDPE and Fusible PVC: ream all internal fusion beads.

D. Connection to Existing Mains

1. Do not connect to existing mains without a City inspector on site.

2. Furnish and install all appurtenances and materials necessary to join existing and new mains.

3. 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.

4. Have all manpower, materials, and equipment ready to connect to the existing main to minimize service interruptions.

5. Provide at least seven (7) calendar days' notice prior to connecting to any mains.

E. Joint restraint: see Section 2107 – Buried Pipe Installation.

F. Service Connections:

1. Service saddle installation:

a) Ensure that at least 3 FT remains between new service line taps and existing taps, fittings, and pipe joints.

b) Protect locator wire from damage.

c) Install service saddle no lower than 45 degrees above horizontal from the center of the main.

d) Tighten bolts uniformly and to manufacturer's recommended torque.

e) Do not cover service saddle and main until a SUA inspector has approved the saddle installation.

f) Leave line uncovered and provide opportunity for a SUA inspector to approve the service saddle installation.

2. Service line installation:

a) Trench and excavate for service line.

b) Install service line and cap.

c) Re-embed main, repair locator wire, and (re)place warning tape.

d) Backfill service line trench in accordance with– these specifications.

e) Mark capped end of service line.

f) Provide at least 3 FT between service line taps.

G. Tracer Wire and Warning Tape:

1. Install tracer wire and warning tape for all mains and service lines.

2. Tracer Wire:

a) Install directly on top of the top of the water main or service line as shown in the Details.

b) Ensure that insulation is sounds and free from cuts, nicks, or other paths to ground.

c) Terminate as shown on the details.

d) Splice new tracer wire to existing tracer wire, unless otherwise approved by the Water Resources Director. If the end of a tracer wire is buried, seal the end with a splice kit, two layers of liquid electrical tape, or other solution approved by the Water Resources Director.

e) Do not use wire nuts to splice or terminate.

3. Warning Tape:

a) Install warning tape directly above the top of the pipe, as shown in the Details.

b) Ensure that warning tape is continuous. Overlap minimum 2 FT with existing tape and at breaks in tape.

H. Anchors for steep grades:

1. Construct pipe anchors as a concrete collar extending at least 12 IN into undisturbed earth below and to both sides of the installed sewer main. Attach the anchor to the pipe at a restrained joint or fitting. Reinforce the anchor with #4 deformed steel bars at 12 IN on center. Obtain permission from the Water Resources Director prior to implementing other anchor designs. Provide sealed design documentation to support any alternative anchor designs.

I. Testing:

1. Test all gravity sewer mains (regardless of pipe material) using the low pressure air method, in accordance with ASTM F 1417.

2. Pressure sewer mains:

a) Test all pressure sewer mains (regardless of pipe material) in accordance with AWWA C900 .

b) Test medium: drinking water. Air testing is not acceptable.

c) Minimum test period: 2 hours.

d) Test pressure: 150 psi. Engineer may specify a higher different pressure appropriate for the system design.

e) Measure test pressure relative to the lowest elevation of the test section.

f) Maximum allowable pressure gauge increment: 5 psi. Use two gauges to verify accuracy.

g) Measure make-up water with a domestic water meter or other accurate measuring device.

h) 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.

i) Deflection test all 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 a representative of the City.

j) Vacuum test all manholes in accordance with ASTM C1244.

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2700

STREETS AND APPURTENANCES

Part 1: GENERAL REQUIREMENTS

A. Scope: The latest edition of the Oklahoma Standard Specifications for Highway Construction, as published by the Oklahoma Department of Transportation (ODOT), are hereby adopted as the standard specifications for grading, street, road and drainage construction for the City, except as amended herein. Should a conflict between the provisions of the ODOT specifications and the specific provisions set forth herein, the specific provisions set forth herein shall control.

B. Abbreviations: Wherever the words, forms, or phrases herein defined or pronouns used in their stead occur in these specifications, in the contract or in the Advertisement of any document or instrument herein contemplated or to which these specifications apply, the intent and mean shall be interpreted as defined in the General Conditions of the Construction Contract.

C. Revisions, Amendments and Clarifications: Revisions, amendments, and clarifications to ODOT standard specifications (Standard Units) shall be included in any Special Conditions of the contract. The ODOT section shall be referenced by number and description, followed by the required information.

D. Submittals

1. Before construction, the Contractor shall submit to the City of Stillwater for review drawings showing construction and installation details.

2. All material furnished shall be in accordance with the drawings and these standards.

E. City Testing Requirements

1. Materials testing: Materials testing shall be as specified in the ODOT Standard Specifications.

2. Construction testing: Testing of completed construction shall be performed in accordance with the appropriate AASHTO or ASTM test method to ensure work meets the appropriate ODOT or City of Stillwater Standard Specification.

3. Tolerances: Shall conform to ODOT Standard Specifications except as modified herein.

4. Cost for testing: The cost for all material testing shall be borne by the contractor.

5. Test results: Test results shall be provided by the Contractor prior the acceptance by the City of any work performed.

Part 2: MATERIALS

A. General: This section shall govern the performance of all work necessary for construction of street bases and traffic courses, curbs and gutters, sidewalks and stormwater drainage piping and structures.

B. Concrete Mixes

1. Concrete shall conform to the requirements of ODOT Section 701.

C. Concrete Curing Compounds and Agents.

1. Curing agents shall conform to the requirements established in ODOT Specification 701.

D. Joint Fillers and Sealers.

1. Joint Fillers and sealers shall conform to ODOT Specification 701.

E. Mineral Aggregate

1. Mineral Aggregate shall conform to ODOT Specification 703 as described for the intended use of the aggregate.

F. Lime/Flyash for Soil Stabilization

1. When required hydrated lime or flyash shall be used for the stabilization of roadway subgrade.

2. Hydrated lime shall meet ODOT Specification 706.

3. Flyash shall conform to ODOT Specification 702.

G. Emulsified Asphalt

1. Prime and tack coats shall conform to ODOT Specification 708.

H. Asphaltic Concrete

1. Asphaltic concrete shall conform to ODOT Specification 708.

I. Traffic Striping

1. Permanent traffic striping shall consist of thermoplastic compounds conforming to ODOT Specification 711.

2. Temporary striping shall be removable marking tape conforming to ODOT Specification 711.

3. Striping paint shall be used only with special approval of the City of Stillwater.

J. Riprap and Filter Blanket

1. Riprap and aggregate filter blanket in accordance with ODOT Specification 713.

K. Signage

1. Signs shall be extruded sheet aluminum conforming to ODOT Specification 719.

2. All signs shall meet current retroreflectivity requirements of MUTCD.

L. Sign Posts

1. Sign posts shall be galvanized steel, conforming to ODOT Specification 721.

M. Reinforcing Steel

1. All reinforcing steel shall conform to ODOT Specification 723.

2. Supports for reinforcement: Reinforcement supports shall be bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcements in place.

3. Tie wire: Tie wire sixteen (16) gauge minimum and in sufficient quantity to hold reinforcement accurately in place during concrete placement operations is required.

N. Storm Sewer

1. The following pipe is allowed for storm drainage within public rights of way:

Description	**AASHTO**	**ASTM**
Reinforced concrete culvert, storm drain and sewer pipe	M170	C76
Reinforced concrete arch culvert, storm drain, and sewer pipe	M206	C506
Reinforced concrete elliptical culvert, storm drain	M207	C507
Reinforced concrete low-head pressure pipe	M242	C361
High Density Polyethylene (HDPE)	M252	D3350

Part 3: EXECUTION

A. General: Execution of the roadway construction shall conform to ODOT specifications, latest revision requirements

B. Concrete Paving: Portland Cement Concrete pavement shall conform to ODOT Section 414.

C. Joint Sealing

1. Preparation of joints:

a) New paving: Immediately before installation of the backer rod, the joints shall be thoroughly cleaned until all laitance, curing compound, fill and protrusion of hardened concrete are removed from the sides and upper edges of the joint space.

b) Existing paving:

1) Existing sealant shall be removed from the joint. After cutting the existing sealant free from both joint faces, the sealant shall be removed to a minimum depth equal to the width of the joint. Removal of sealant shall be to a depth required to accommodate the backer rod and to maintain the specific depth for the new sealant to be installed. Prior to refacing of the joint surfaces, all loose old sealant remaining in the joint opening shall be completely removed.

2) Refacing of joints shall be accomplished using a power-driven concrete-saw with diamond or abrasive blades to remove all residual old sealant and a minimum of concrete from the joint faces to provide exposure of newly clean concrete and, if required, to widen the joint space to the width and depth necessary to accommodate the backer rod and new sealant as indicated below. Immediately following the sawing operation, the joint faces shall be thoroughly cleaned. The joint specifications are the following:

Joint Width, (inches)	Joint Depth, Min. (inches)	Sealant Bead Thickness (inches)*	Backer Rod Depth (inches)
(¼)	1-½	¾	¾
3/8	1-5/8	¾	¾
½	1¾	¾	¾
5/8	1-¾	¾	¾
¾	2	¾	¾
7/8	2-1/8	1	1
1	2¼	1	1
1-1/8	2-3/8	1	1

* Top of sealant to be 1/4 inch below pavement surface

2. Backer rod installation: Backer rod shall be installed at the depth recommended by the manufacturer. The size of the backer rod for each joint shall be in accordance with those specified below.

Joint Width	**Rod Diameter**
inches	**inches**
3/16	1/4
1/4	3/8
3/8	1/2
1/2	5/8
5/8	5/8
3/4	7/8
7/8	7/8
1	1-1/8
1-1/8	1-1/4
1-5/8	2

3. Sealant preparation: Hot-poured sealing material shall not be heated in excess of the safe heating temperature recommended by the manufacturer as shown on sealant containers. Sealant that has been overheated or subjected to heating for over three hours or that has remained in the applicator at the end of the day's operation shall be removed and disposed.

4. Sealant installation:

   a) New paving: Joints shall be sealed immediately 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.

   b) Existing joints: Joints shall be sealed immediately following the cleaning of the joint walls and following placement of the backer rod. The walls of the joint shall be surface dry, and the atmospheric and pavement temperatures shall be above 40°F at the time of application of the sealant. Open joints ready for resealing which cannot be sealed under the conditions specified herein, or when rains interrupt sealing operations, shall be re-cleaned prior to installing sealant.

   c) Seal joints: Joint sealant shall not be installed until the cleaned joints have been inspected and accepted by the project inspector. Joints shall be completely filled from the backer rod up to the surface of the pavement. [NOTE: at constructor's option backer rod may be omitted and joint completely filled with sealant] Excess or spilled sealant shall be removed from the pavement and

discarded. In no cases shall the sealant extend above the surface. When a primer is supplied by the manufacturer, it shall be applied evenly to the joint faces in accordance with the manufacturer's recommendations. The joint shall be checked frequently to insure that the newly installed sealant is cured to a tack-free condition with 24 hours.

d) Final acceptance: In-place sealant which is not completely bonded to the concrete surfaces of the joint walls, or which develops cohesive failures within the sealant, or which contains voids or entrapped air, or which fails to cure to a tack-free condition within 24 hours will be rejected. Sealant may be rejected at any time prior to final acceptance of the project. Sealant, which is rejected, shall be removed from the joint, disposed of and replaced in a manner satisfactory to the City of Stillwater.

D. Asphaltic Concrete (Bituminous) Paving

1. Asphalt Pavements shall be installed per ODOT Specifications Section 411.

2. Asphaltic concrete paving courses shall not be placed until the curb and gutter sections are in place and have attained design strength.

E. 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.

b) Excavation for curbs s shall be compacted to a firm, even surface to not less than 95% of standard density as determined in accordance with AASHTO T-99.

c) Concrete for curbs shall be Class A, as specified previously for concrete pavement.

d) The curbs shall be constructed by the use of wood or metal forms; or if accepted by the City of Stillwater, the curb may be constructed using a curb slipform machine. Forms, if used, shall be straight, free from warped or bent sections, and shall extend for the entire depth of the curb and shall be securely held in place so that no deviation from alignment and grade will occur during placement of concrete. The concrete shall be consolidated by vibration or other acceptable methods. The top of the curb shall be floated smooth and the top outer corner rounded to a ¼-inch radius.

e) 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.

f) Concrete shall be cured with white curing compound, wet mats, or fog spray. If fog spray is used, the surface shall be kept moist for 36 hours following placement. Over spraying will not be allowed.

2. Transverse joints:

a) Transverse contraction joints shall be placed at intervals equaling the spacing used for concrete streets.

b) Transverse construction joints on curb and gutter shall match the type of joint required for the type of street being constructed.

3. Expansion joints:

a) Expansion joints shall align with concrete pavement expansion joints and be placed at all street intersection radius and at the last joint before a cul-de-sac. Joints for asphaltic concrete paving shall be spaced between 80' and 120' and shall be uniform ½-inch in width, full depth. The joint shall be a straight joint at right angles to the length of curb. Joints shall be filled with specified preformed bituminous joint filler material. Expansion joints shall be formed around all abutting structures such as inlets and shall be as specified previously.

b) Expansion joints shall have a tiebar when the street being constructed requires a tiebar or keyway for a construction joint.

4. Joint sealing:

a) The joints in the gutter up to 1 inch above the flow line will be sealed with low-modulus silicon sealant conforming to ODOT Specification 701.

b) Vertical face of curb joints shall be cleaned and sealed with silicone conforming to ODOT Specification 701 or polyurethane sealant conforming to ASTM C-920, Type M, Grade NS, Class 25.

F. Valley Gutters

1. Valley gutters shall be constructed with ODOT Class A Portland cement concrete. The minimum width shall be three feet. The valley gutter trough shall match the alignment and grade of the adjacent gutter lines.

G. Sidewalks:

1. Sidewalk construction shall conform to the following:

a) Sidewalks shall consist of 3 inches compacted base material and a minimum 4-inch thick concrete section. Concrete shall be ODOT Class "A concrete.

b) Compact subbase to not less than 95% of maximum dry density as determined in accordance with AASHTO T-99.

c) Sidewalks shall have a broom surface finish. Tool all outside edges of sidewalk and all joints with a 1/4-inch radius edging tool.

d) Expansion joints shall be placed around all abutting structures and appurtenances such as driveways, manhole, utility poles, hatches, and hydrants. Install 1/2-inch thick premolded expansion joint filler in the joints, full joint depth.

2. Finish and joints:

a) Sidewalks shall have a non-slip broomed surface, cured per concrete requirements.

b) Expansion joints shall be placed at all intersections with curbs.

c) Transverse cracking joints will normally be tooled or sawed into the finished sidewalk to a depth of 1 inch.

d) Transverse cracking joints shall be placed at intervals not to exceed every 5 feet and filled with low modulus silicon sealant.

H. Pavement, Curb and Gutter and Sidewalk Removal and Replacement

1. General: This section governs all work involved in the repair and replacement of existing streets, roads, highways, drives, parking areas, curbs, gutters, sidewalks, and other paved areas either damaged/destroyed during construction or scheduled for repair.

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: A subgrade of a minimum 8 inches thick shall be provided in locations where pavement is to be placed. All subgrades with plasticity indexes (PI) of 10 or greater shall be replaced with material with less than a PI of 10, replaced with compacted aggregate or modified to meet the requirements of ODOT Section 307 or Section 317.

4. Pavement replacement:

a) All pavements encountered with respect to base courses, surface courses, and thicknesses shall be replaced in conformance with current minimum requirements for new paving. Finish elevations, lines, and grades of replacement pavement shall be the same as elevations, lines, and grades of pavement removed, unless otherwise shown on the drawings.

b) Chip and seal pavement (bituminous surface treatment): Unless otherwise shown on the drawings, chip and seal pavements shall have 8 inches of compacted aggregate base and a processed bituminous coated aggregate pavement placed and rolled as specified in ODOT Specification 402.

5. Sidewalks:

a) Replacement shall conform to new construction and shall match lines and grades of existing features.

b) If existing sidewalk is to be removed and replaced with new sidewalk or new sidewalk extended from existing sidewalk, the existing sidewalk shall be removed to the nearest joint of suitable quality or as directed by the City of Stillwater. The new section shall meet the lines and grades of existing features.

6. Curbs and gutters:

a) Replacement shall conform to new construction standards and shall match the lines and grades where the replacement meets existing features.

b) If existing curb is to be removed and replaced with new curb or new curb extended from existing curb, the existing curb shall be removed to the nearest joint of suitable existing curb or as directed by the City of Stillwater.

7. Lane striping: Contractor shall stripe new paving with standard white or yellow removable marking tape for temporary makings and thermosetting plastic or other specified material for permanent markings. Stripe width and spacing to match that of paving restored or replaced.

I. Off-Street Driveway and Parking Areas:

1. Westwood Overlay District: Temporary Gravel Construction: Gravel parking surface construction authorized by Section 23.275.13 shall conform to the general requirements of the Stillwater City Code Sections 27-128 and 37-129, except as follows:

a) The approach shall be a minimum of ten feet (10 FT) in width, five feet (5 FT) in depth, and constructed of concrete.

b) Mirafi Fabric No. #RS380i or an equivalent liner shall be placed from the back of the concrete approach to the edge of any area covered by rock.

c) Large aggregate for ODOT Class A concrete, or larger, shall be used.

d) All fabric and rock shall be free of fines to allow the infiltration of water.

e) Rock shall be placed at a minimum depth of four inches (4 IN) and contained within firm edge protection.

J. Riprap

1. Riprap shall be installed in accordance with ODOT Section 601

END OF SECTION

CONSTRUCTION STANDARDS

SECTION 2800

STORMWATER COLLECTION SYSTEM

Part 1: General

A. Unless otherwise specified below, construct storm sewers as described by section 2500 – Wastewater Collection Systems.

Part 2: Materials

A. Manhole frames and covers:

1. All manhole frames and covers shall be cast iron.

2. Lids shall be cast to identify 'Storm Sewer'.

B. Storm sewer piping:

1. Acceptable materials, in addition to those listed in section 2500 – Wastewater Collection Systems:

a) Reinforced concrete.

b) Corrugated polyethylene pipe (CPP):

1) High density corrugated polyethylene.

2) Smooth interior pipe.

3) Manufactured in conformity with the latest AASHTO M 294, Type S specification.

4) Meet the requirements of ASTM D 3350 Cell Classification 324420C, or ASTM D 1248, Class C, Category 4, Grade P33.

C. Curb Openings (Hoods)

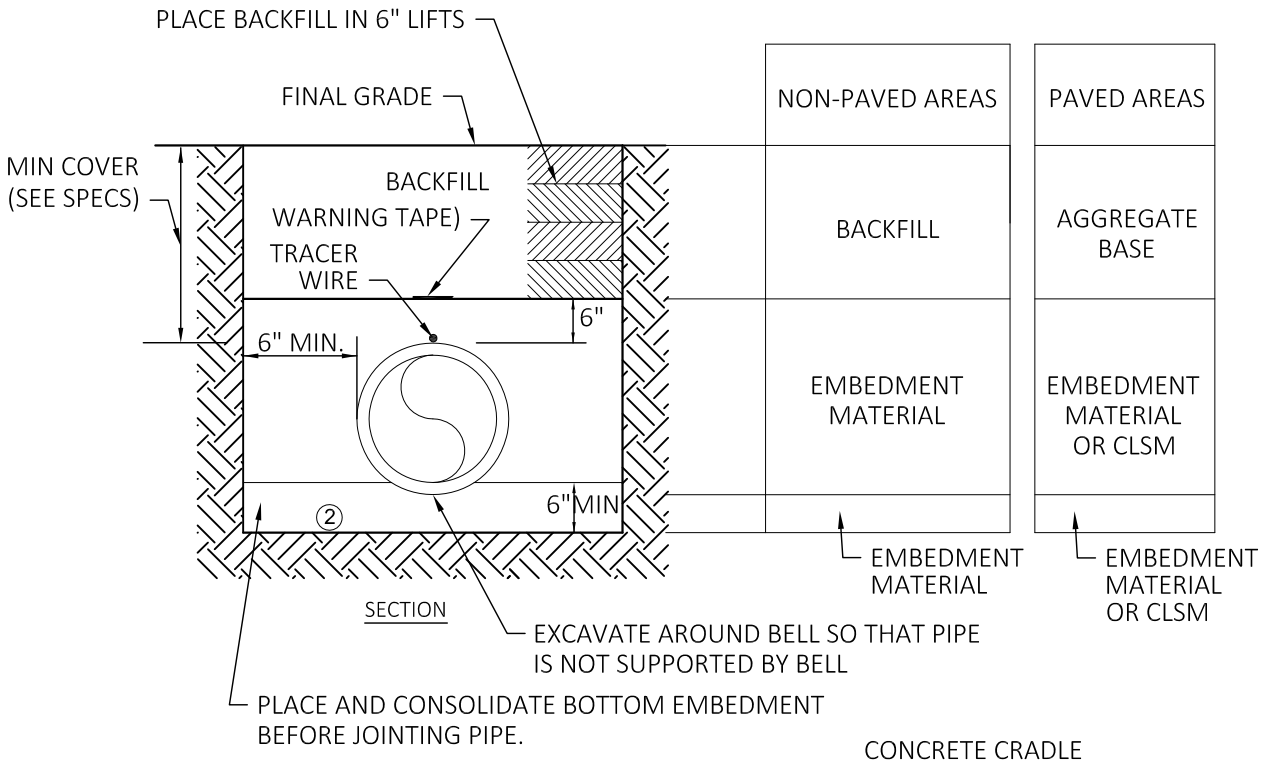
1. Curb openings (hoods) shall be manufactured of cast iron.

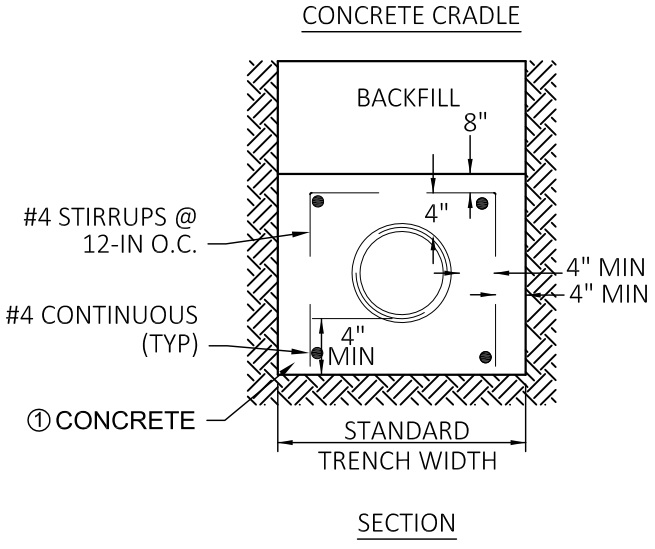
2. Cast iron curb openings will be cast with a 'No Dumping Drains to Creeks' message, or accepted equivalent, to support stormwater quality.

Part 3: Execution (reserved)

End of Section

REV	DATE	DESCRIPTION	BY





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.

Pipe Embedment

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 7/30/2012

Issued: 3/20/2017

Detail No. 3101

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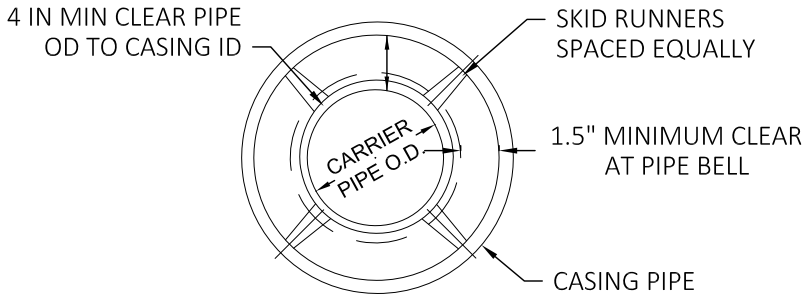
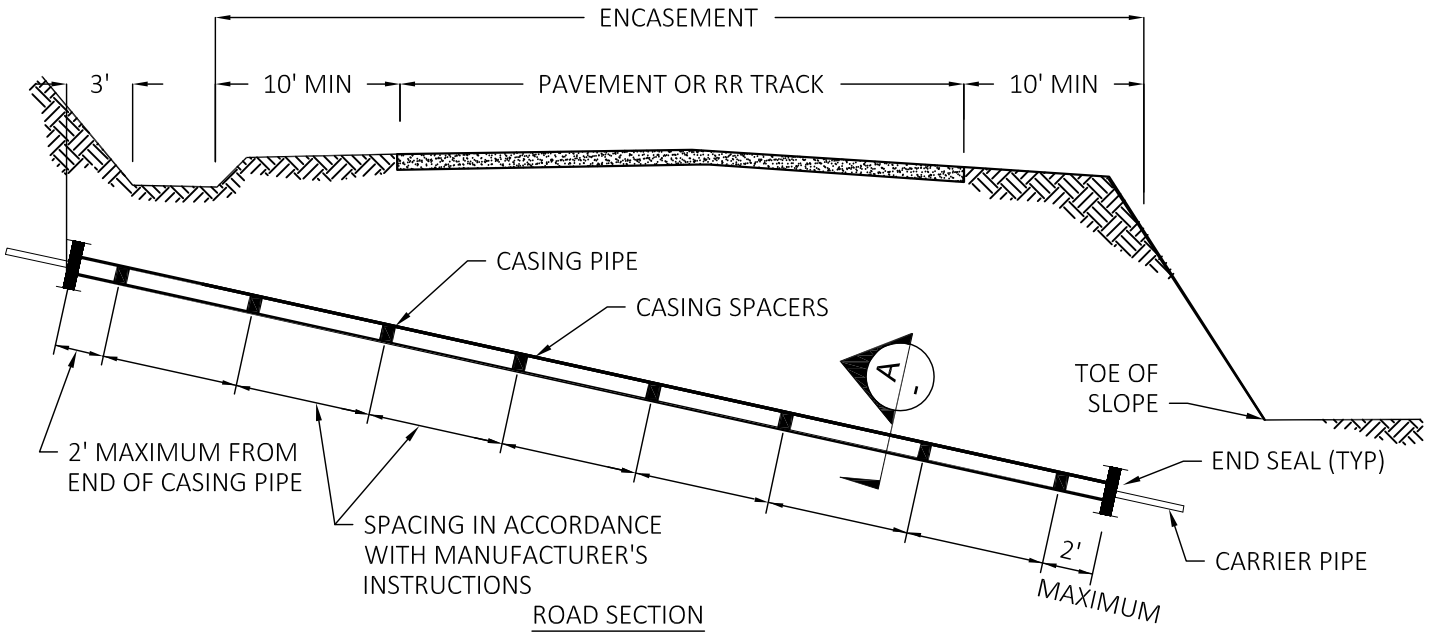


SECTION A-A



ROAD SECTION

Detail No.	Issued:	Adopted:
3103	3/20/2017	3/20/2017

The City of Stillwater OKLAHOMA

Pipe Encasement

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

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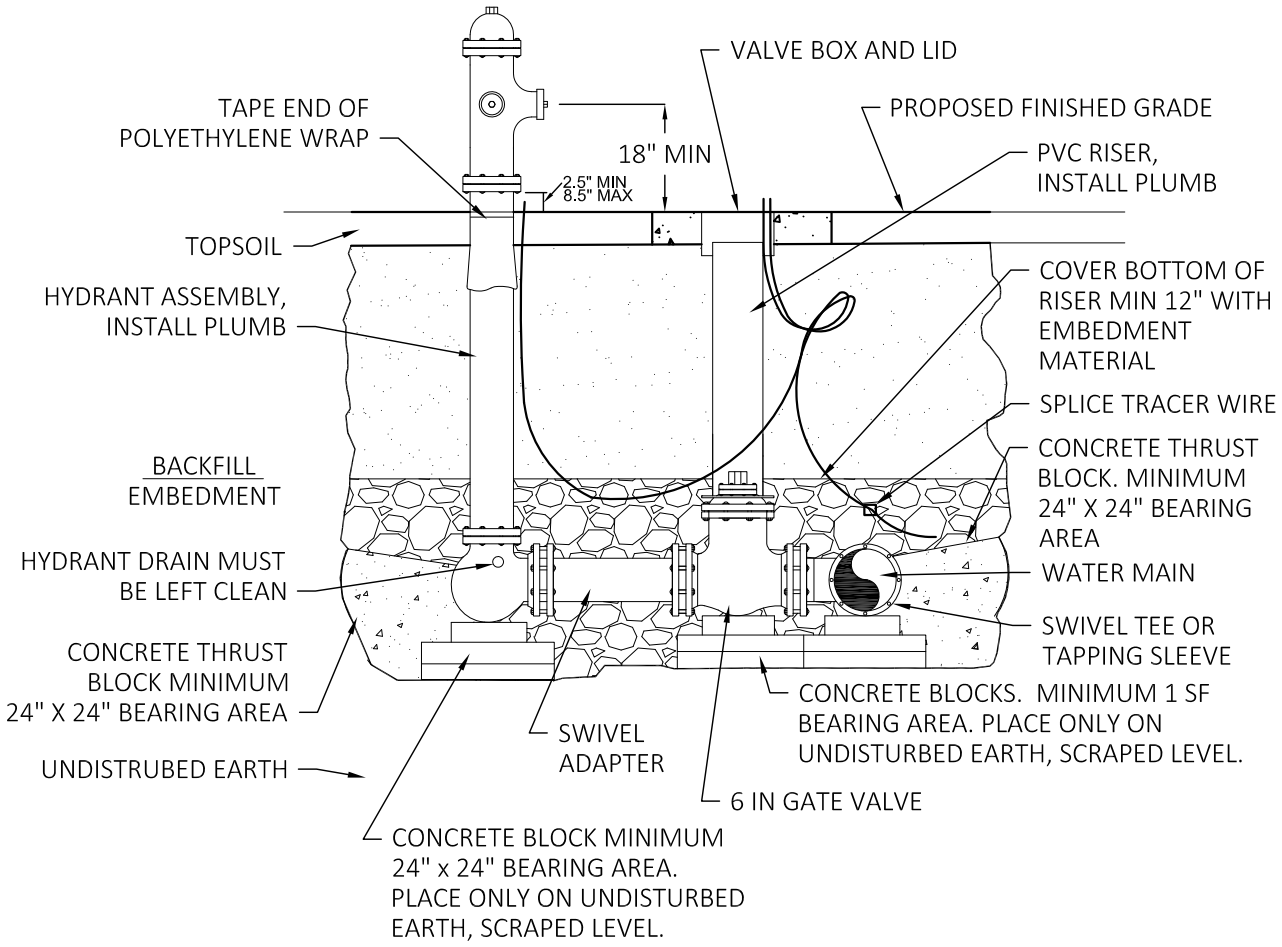


NOTES:

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.
5. HYDRANT/TEE THRUST BLOCKS NOT REQUIRED WHEN HYDRANT LEG EXCEEDS DEAD-END RESTRANT LENGTH.

REV	DATE	DESCRIPTION	BY

Hydrant Assembly

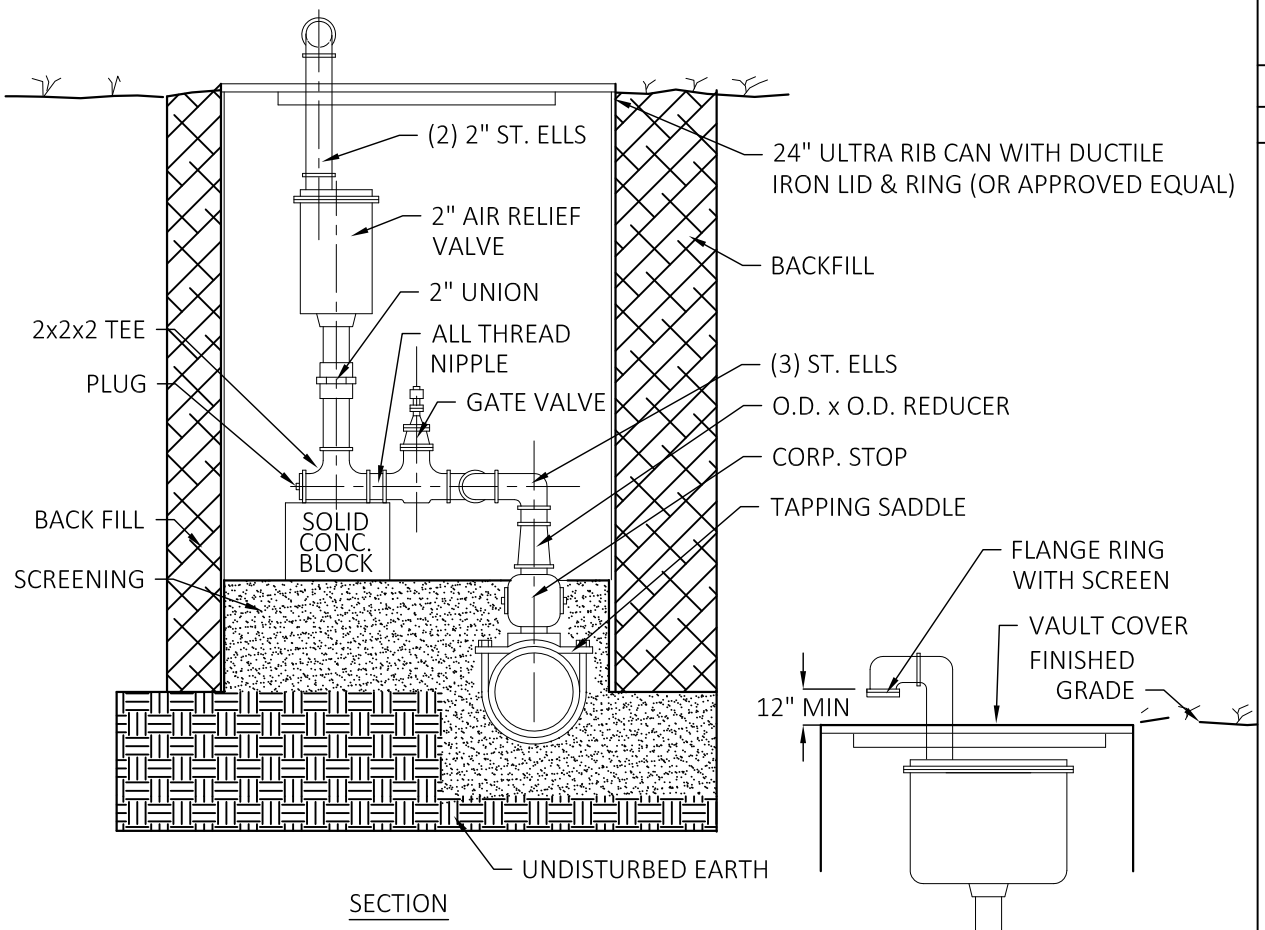
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

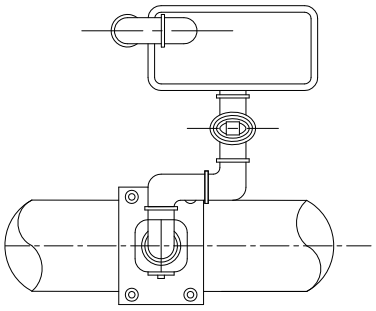
Adopted: 3/20/2017

Issued: 3/20/2017

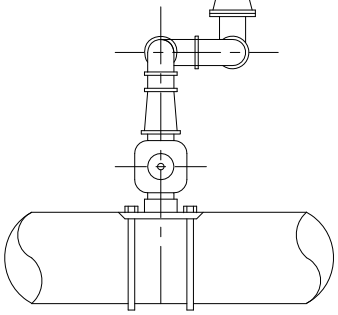
Detail No. 3402



SECTION



TOP VIEW



SIDE VIEW

NOTES:

1. ALL PIPING AND CONNECTORS SHALL BE BRONZE, EXCEPT 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 LARGER THAN 2" REQUIRES LARGER CAN. CONTACT WATER RESOURCES DEPARTMENT

REV	DATE	DESCRIPTION	BY

Air Relief Valve and Vault

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 4/29/2011

Issued: 3/20/2017

Detail No. 3404

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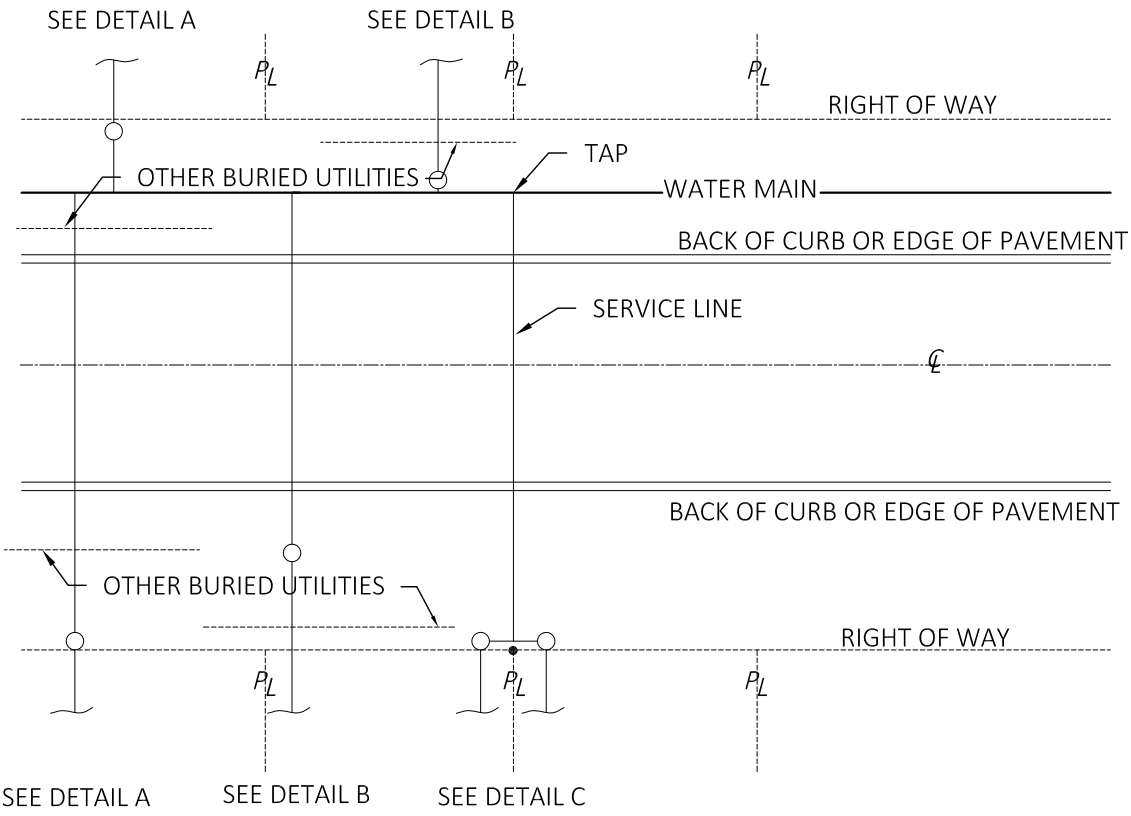
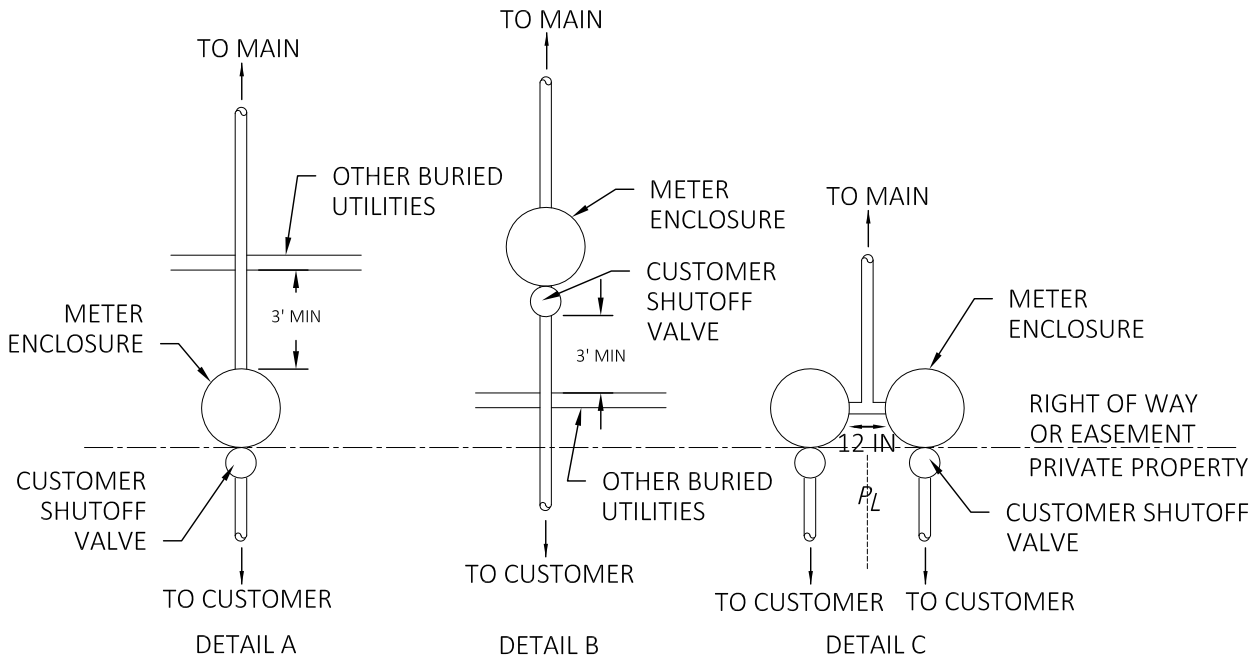




REV	DATE	DESCRIPTION	BY

Service Line and Meter Locations

CITY OF STILLWATER STANDARDS

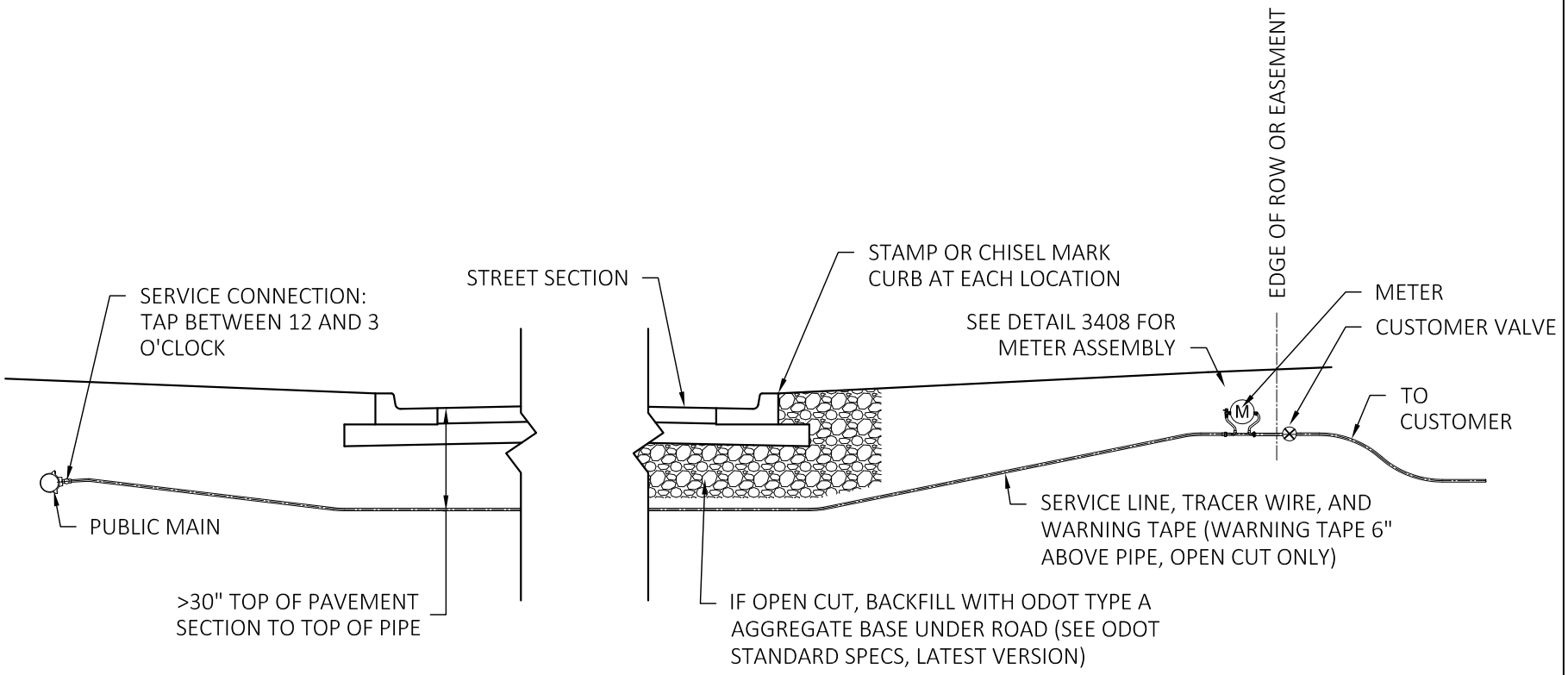
The City of Stillwater OKLAHOMA

Adopted: 3/20/2017

Issued: 3/20/2017

Detail No. 3406

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



Detail No. 3407

Issued: 3/20/2017

Adopted: 3/20/2017

The City of Stillwater OKLAHOMA

Service Line Street Crossing

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

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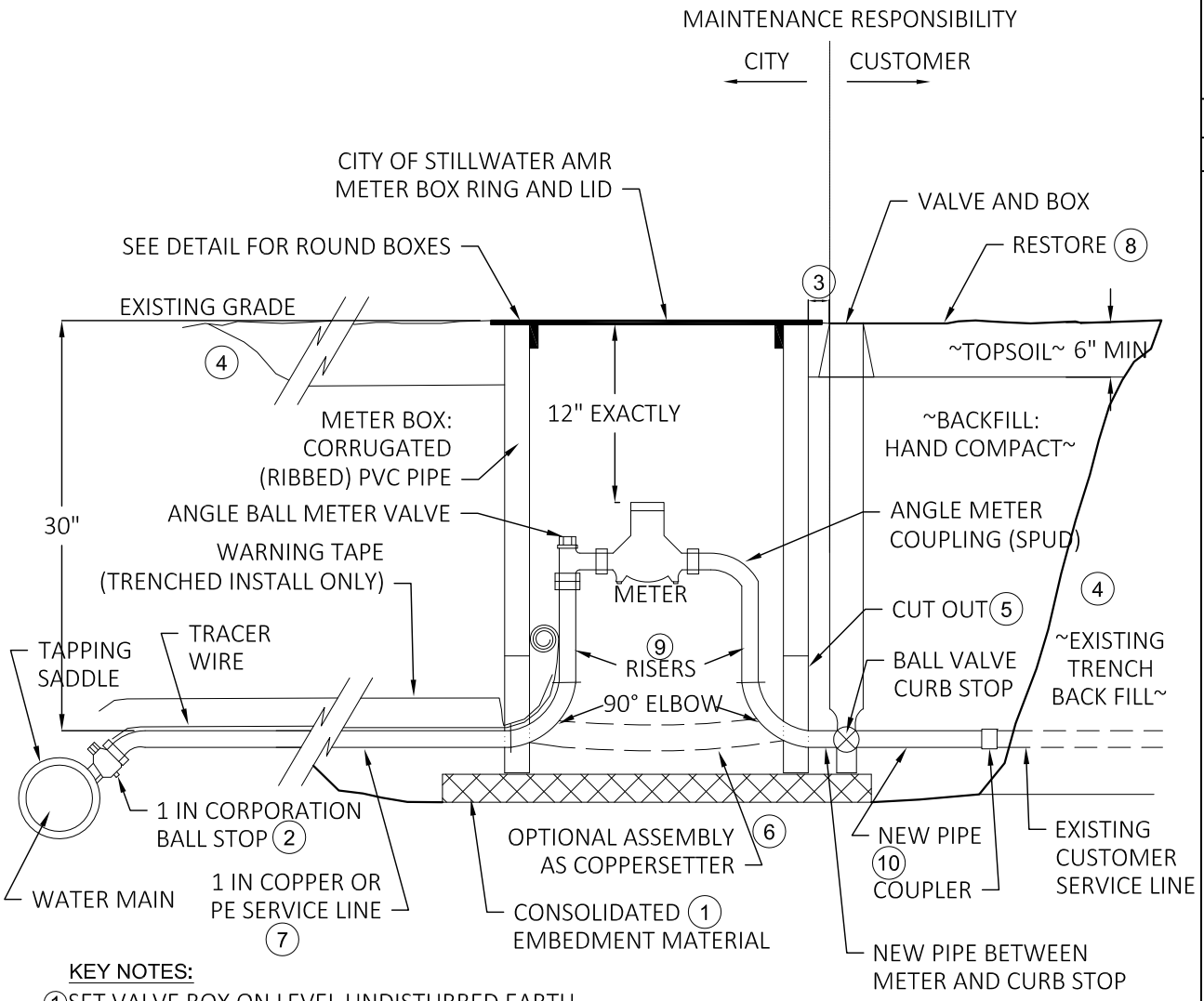

KEY NOTES:

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

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: 3/20/2017
Detail No. 3408

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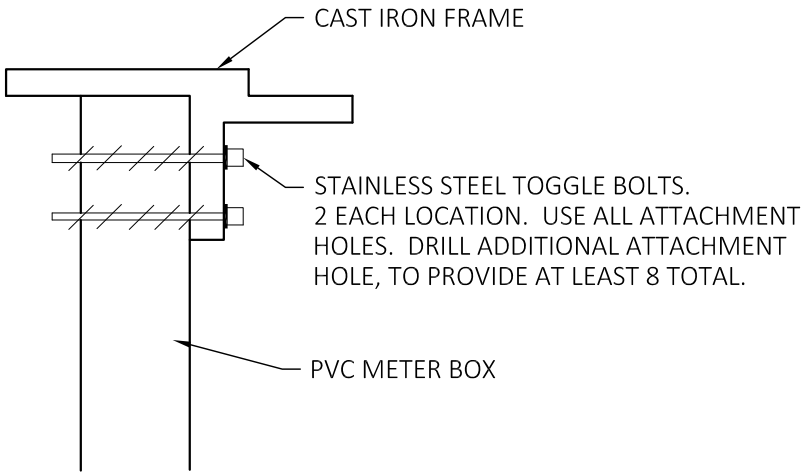

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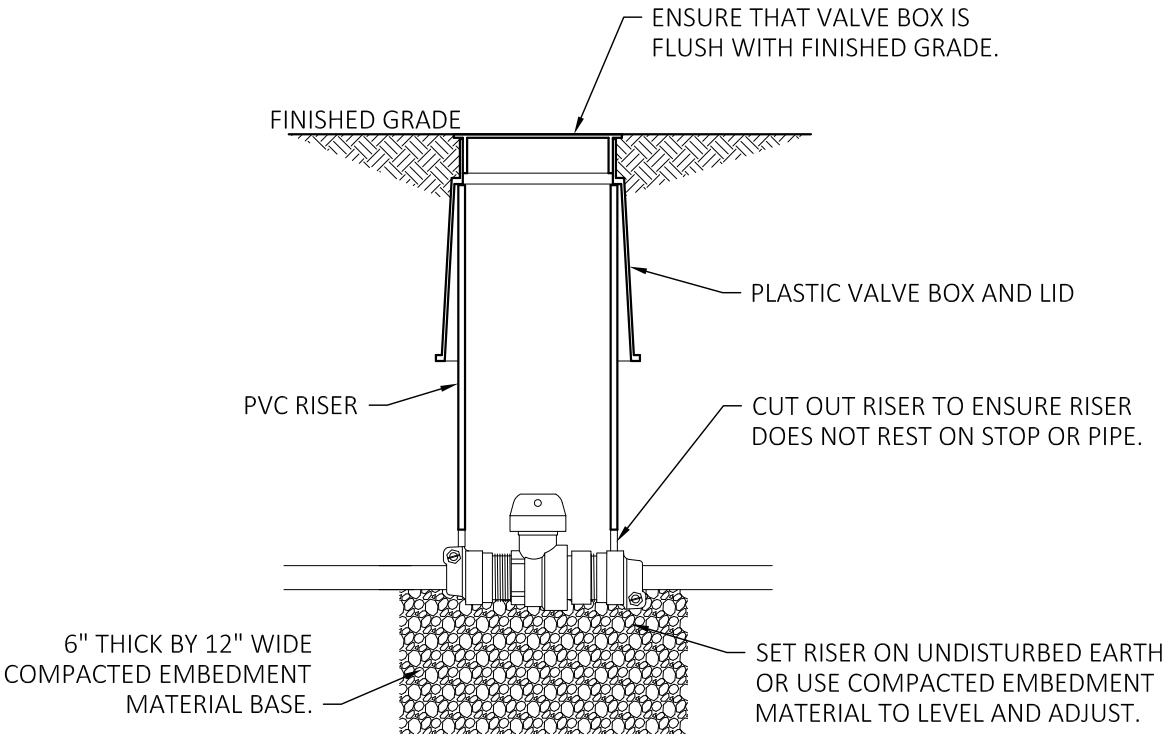


CUSTOMER VALVE BOX DETAIL

REV	DATE	DESCRIPTION	BY

Meter Box and Customer Valve Box

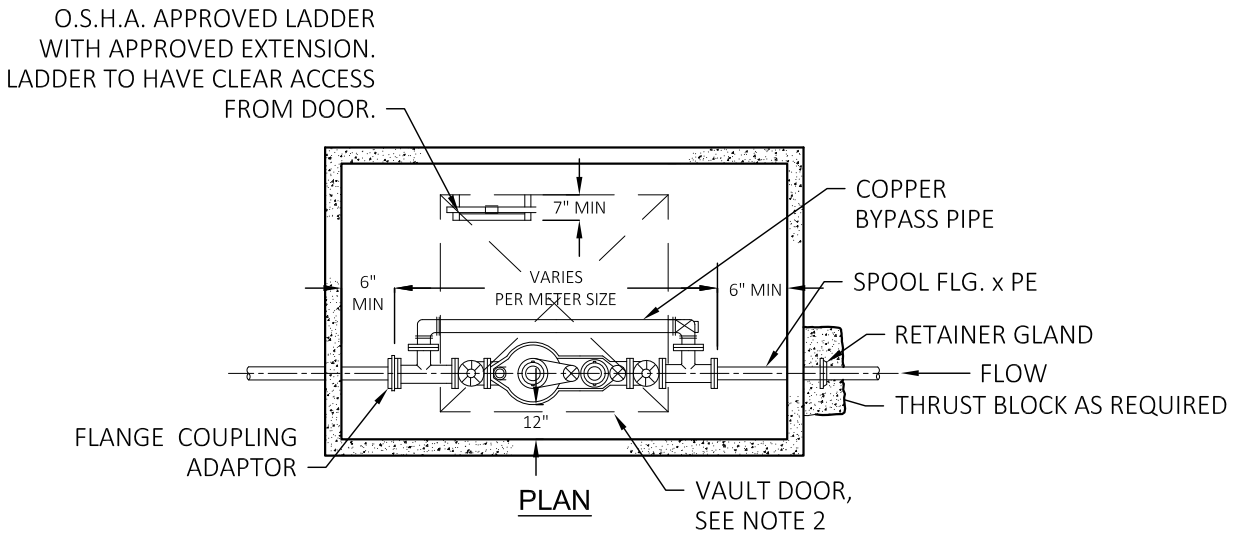
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

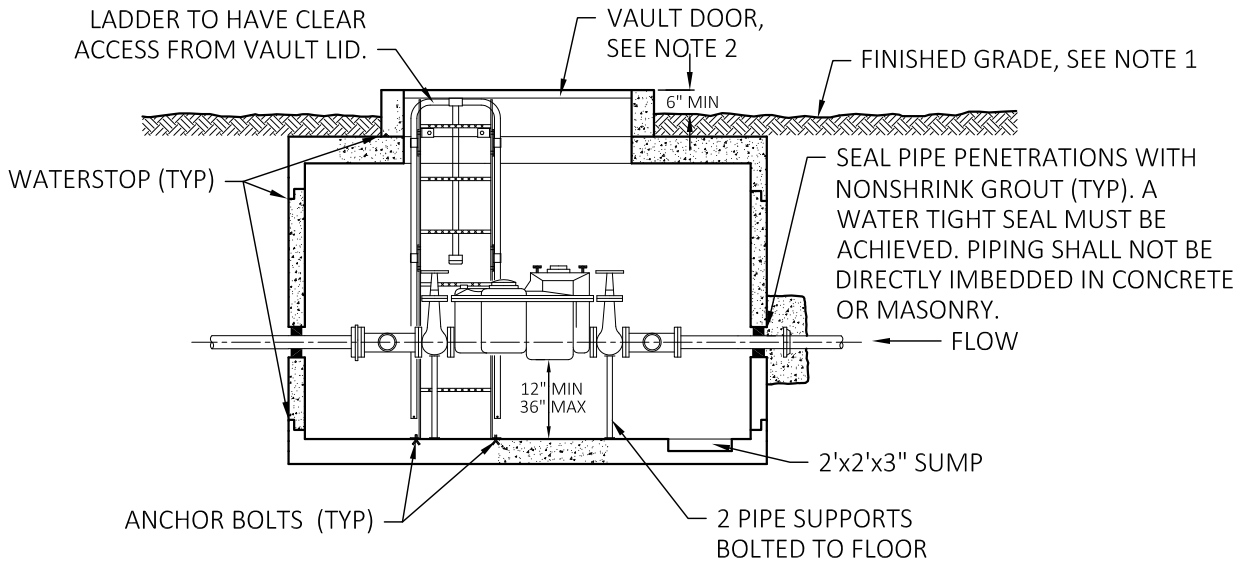
Adopted: 3/20/2017

Issued: 3/20/2017

Detail No. 3409



PLAN



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.

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

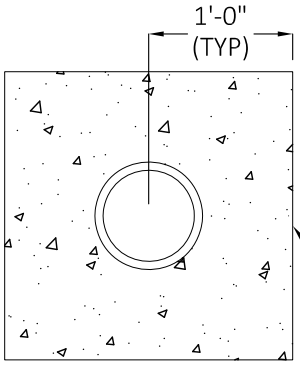
The City of Stillwater OKLAHOMA

Adopted: 4/29/2011

Issued: 3/20/2017

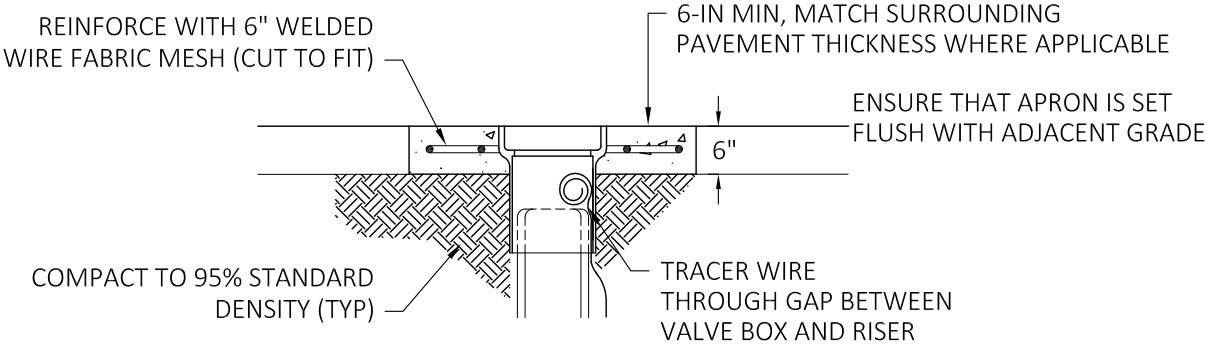
Detail No. 3411

NOTES:
1. PRECAST CONCRETE APRONS NOT ACCEPTABLE



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.



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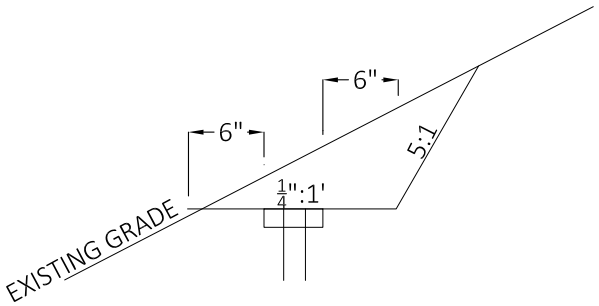

REV	DATE	DESCRIPTION	BY

Valve Box

CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 3/20/2017

Issued: 3/20/2017

Detail No. 3412

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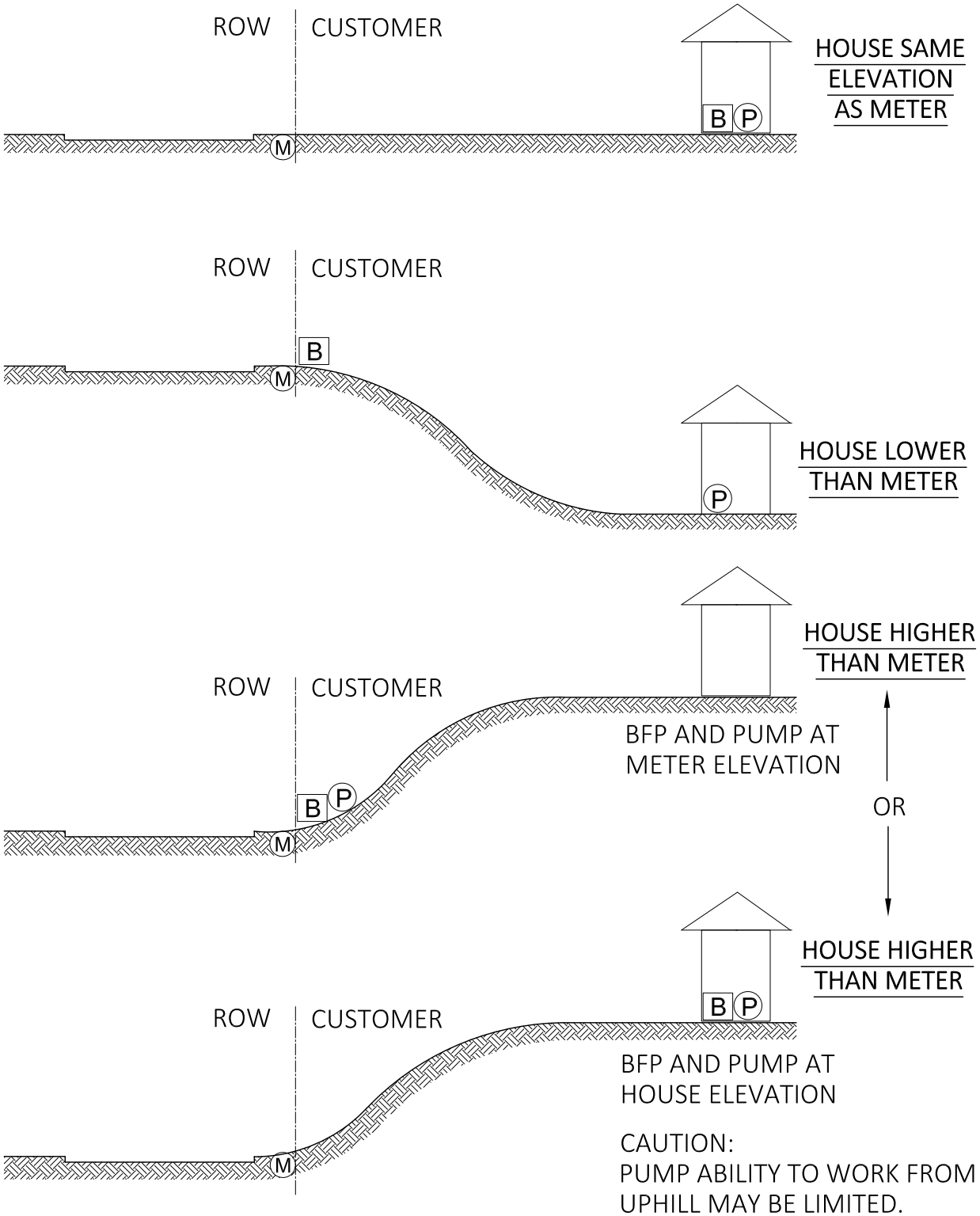


CAUTION:
PUMP ABILITY TO WORK FROM UPHILL MAY BE LIMITED.

(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.

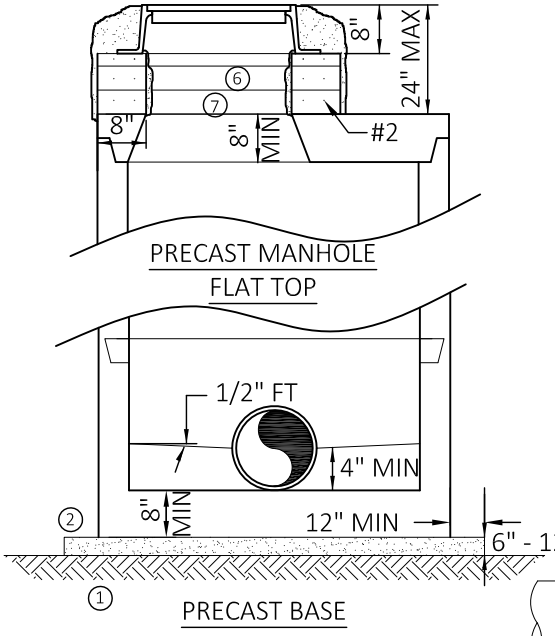
REV	DATE	DESCRIPTION	BY

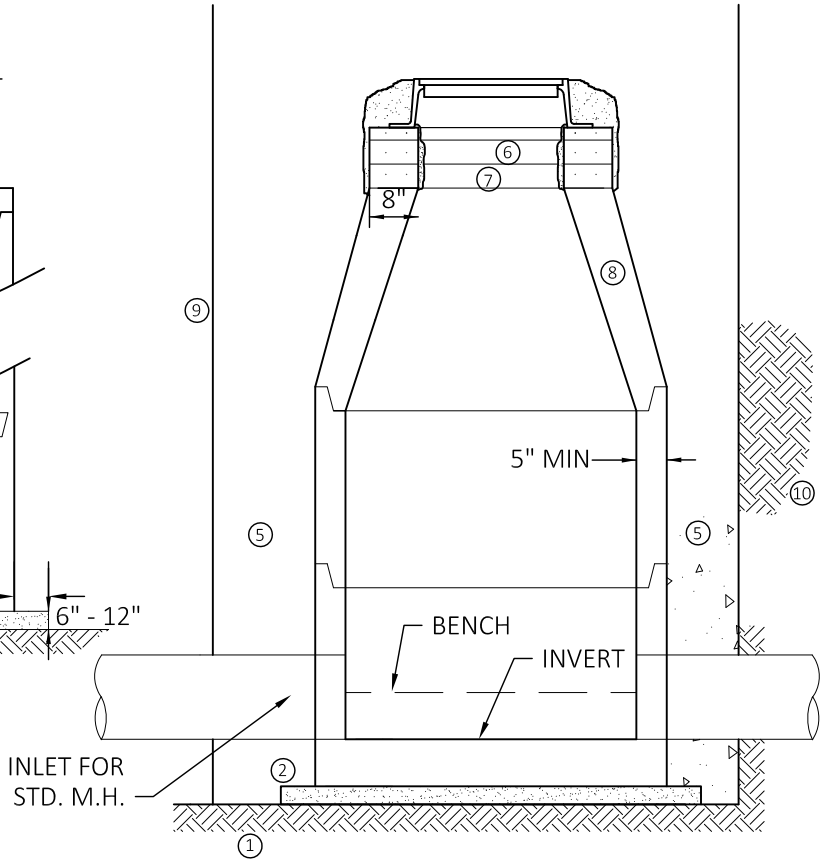
Private Booster Pump Station Locations

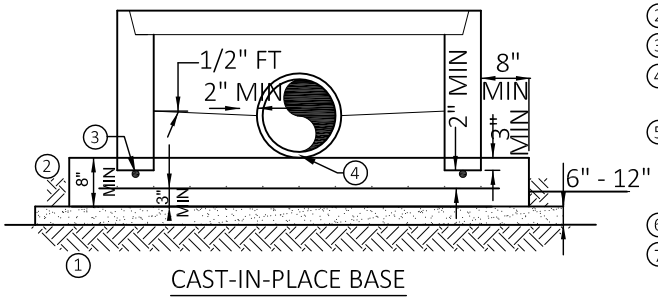
CITY OF STILLWATER STANDARDS

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 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

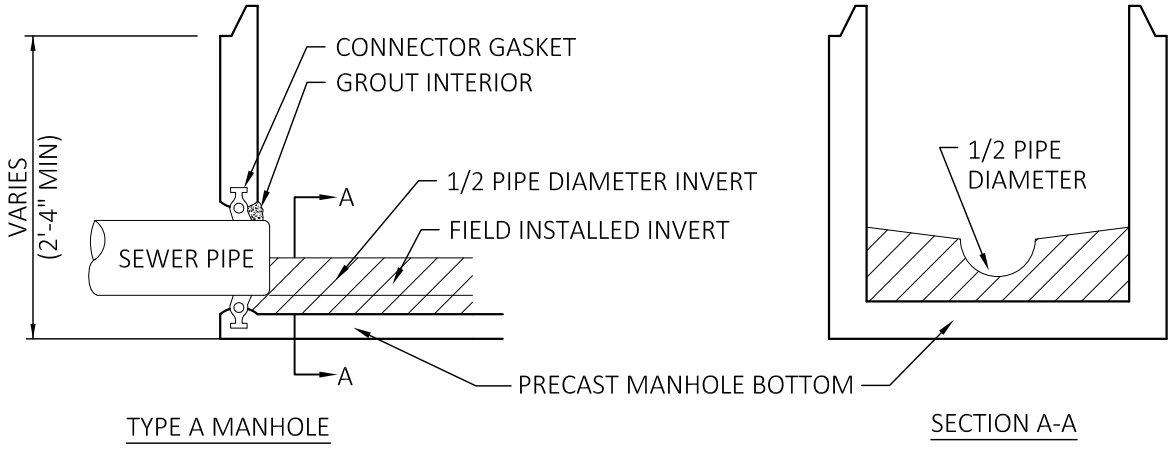
CITY OF STILLWATER STANDARDS

The City of Stillwater OKLAHOMA

Adopted: 3/20/2017

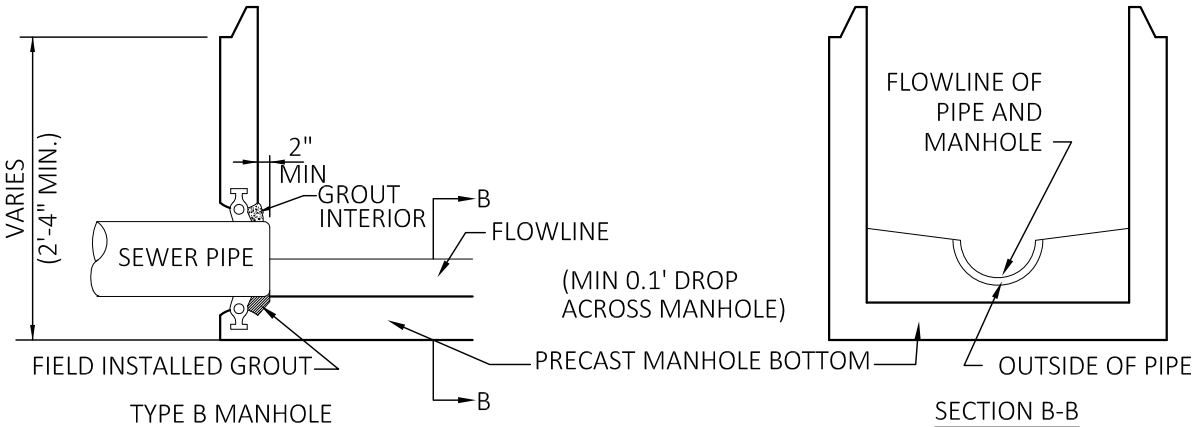
Issued: 3/20/2017

Detail No. 3501



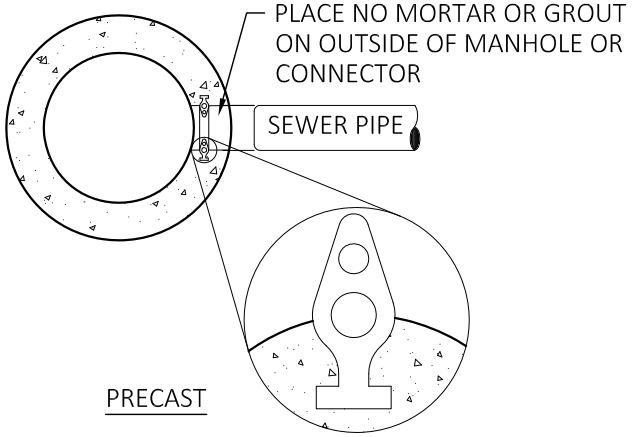
TYPE A MANHOLE

SECTION A-A



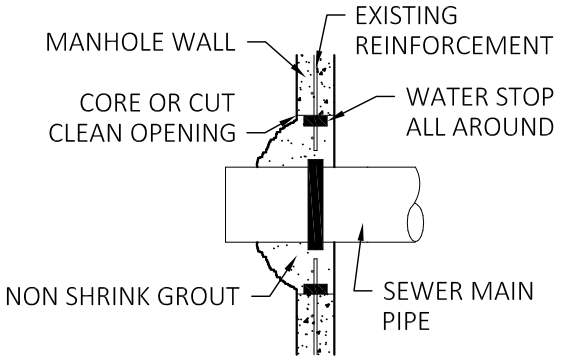
TYPE B MANHOLE

SECTION B-B



PRECAST

ENLARGED
VIEW



INSTALLED IN FIELD

REV	DATE	DESCRIPTION	BY

Manhole Pipe Connections

CITY OF STILLWATER STANDARDS

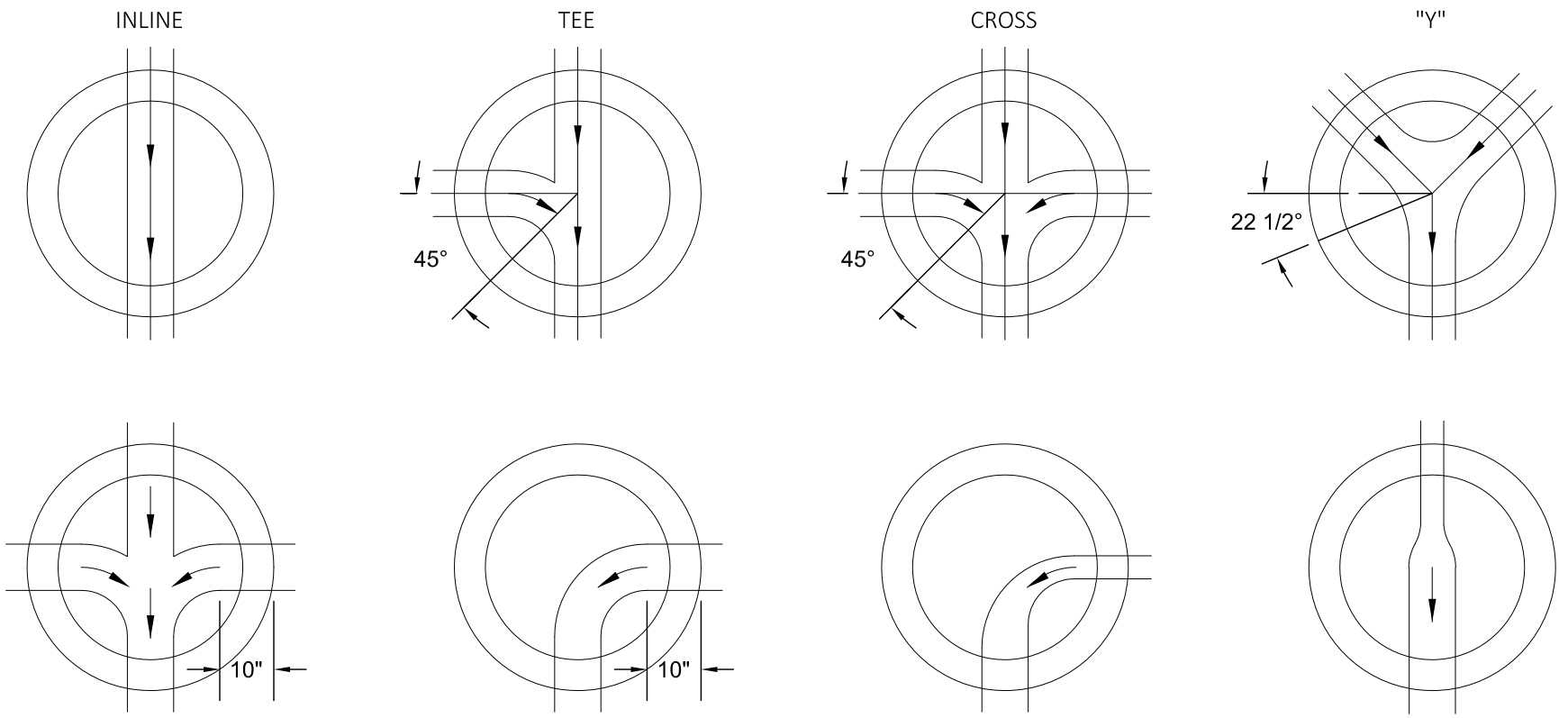
The City of Stillwater OKLAHOMA

Adopted: 2/21/2013

Issued: 3/20/2017

Detail No. 3502

w:\engineering\standards\details\01_adopted details\cad\3502 manhole pipe connections_20130221.dwg



TYPICAL MANHOLE INVERT DETAIL

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

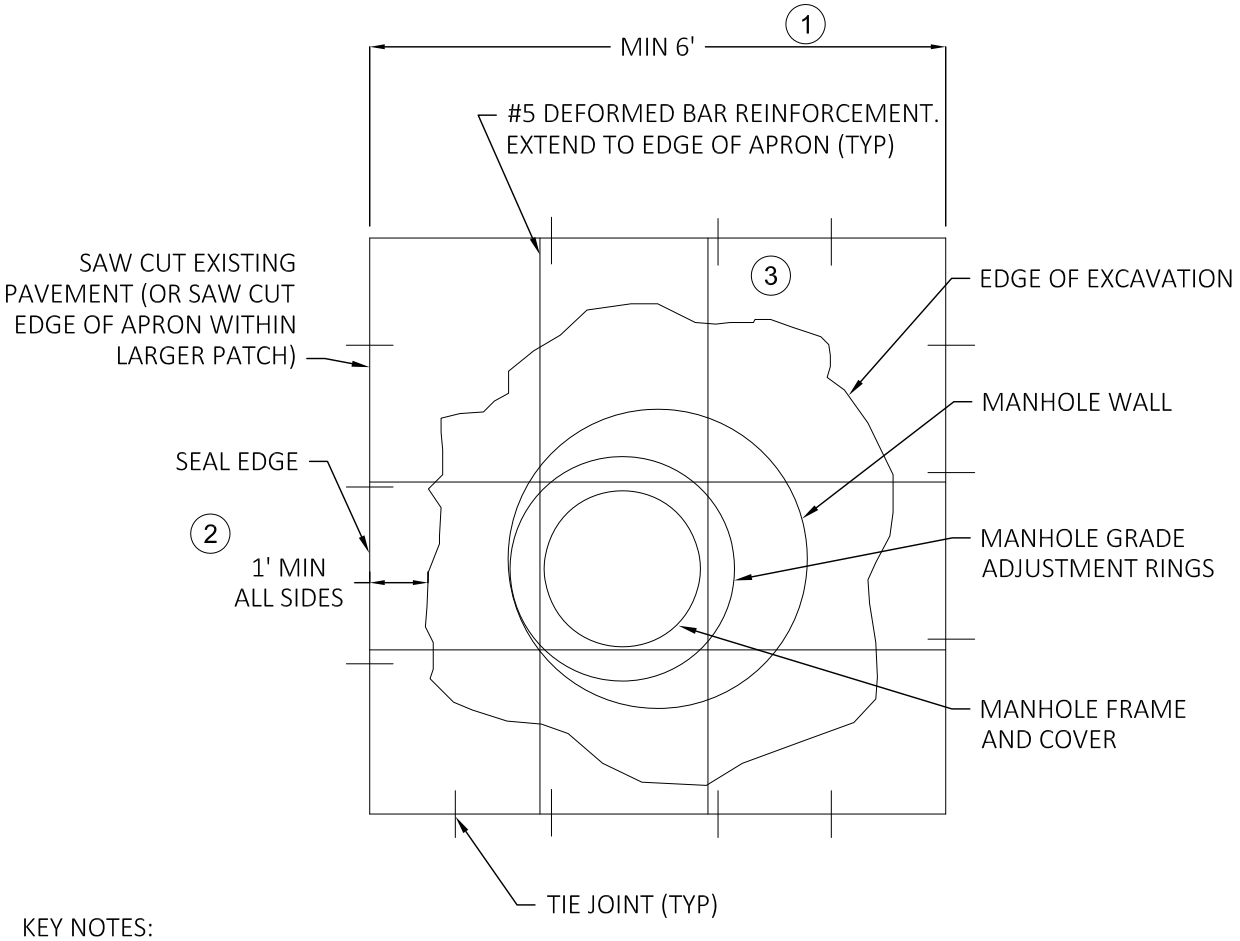
The City of Stillwater OKLAHOMA

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. EXTEND REINFORCEMENT TO 3 FEET TO MANHOLE FRAME. WHEN EDGE OF APRON IS < 5 FEET FROM MANHOLE FRAME, EXTEND REINFORCEMENT TO EXISTING PAVEMENT AND TIE TO EXISTING PAVEMENT.

REV	DATE	DESCRIPTION	BY

Manhole Concrete Apron

CITY OF STILLWATER STANDARDS

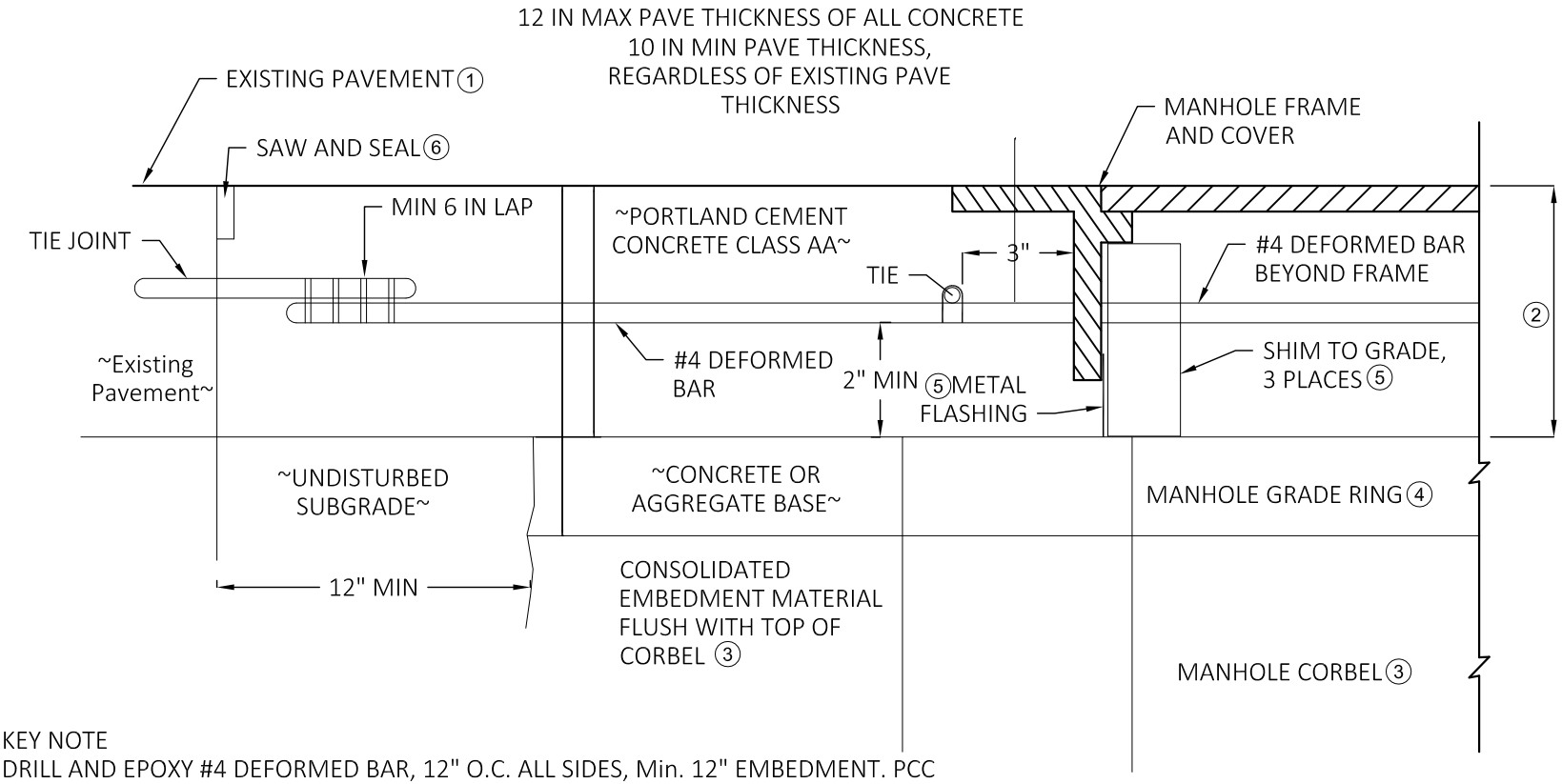
The City of Stillwater OKLAHOMA

Adopted: 2/21/2013

Issued: 3/20/2017

Detail No. 3504

w:\engineering\standards\details\01_adopted details\cad\3504 manhole concrete apron_20130221.dwg



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 MATCH PAVEMENT THICKNESS

③ TOP OF CORBEL AND TOP OF CONSOLIDATED EMBEDMENT MATERIAL TO MATCH BOTTOM OF EXCAVATION FOR GRADE RING.

④ MATCH THICKNESS OF AGGREGATE BASE.

⑤ REMOVE AFTER CONCRETE APRON INSTALLATION.

⑥ 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.	Issued:	Adopted:
3505	3/20/2017	2/21/2013

The City of Stillwater OKLAHOMA

Manhole Concrete Apron Section

CITY OF STILLWATER STANDARDS

REV	DATE	DESCRIPTION	BY

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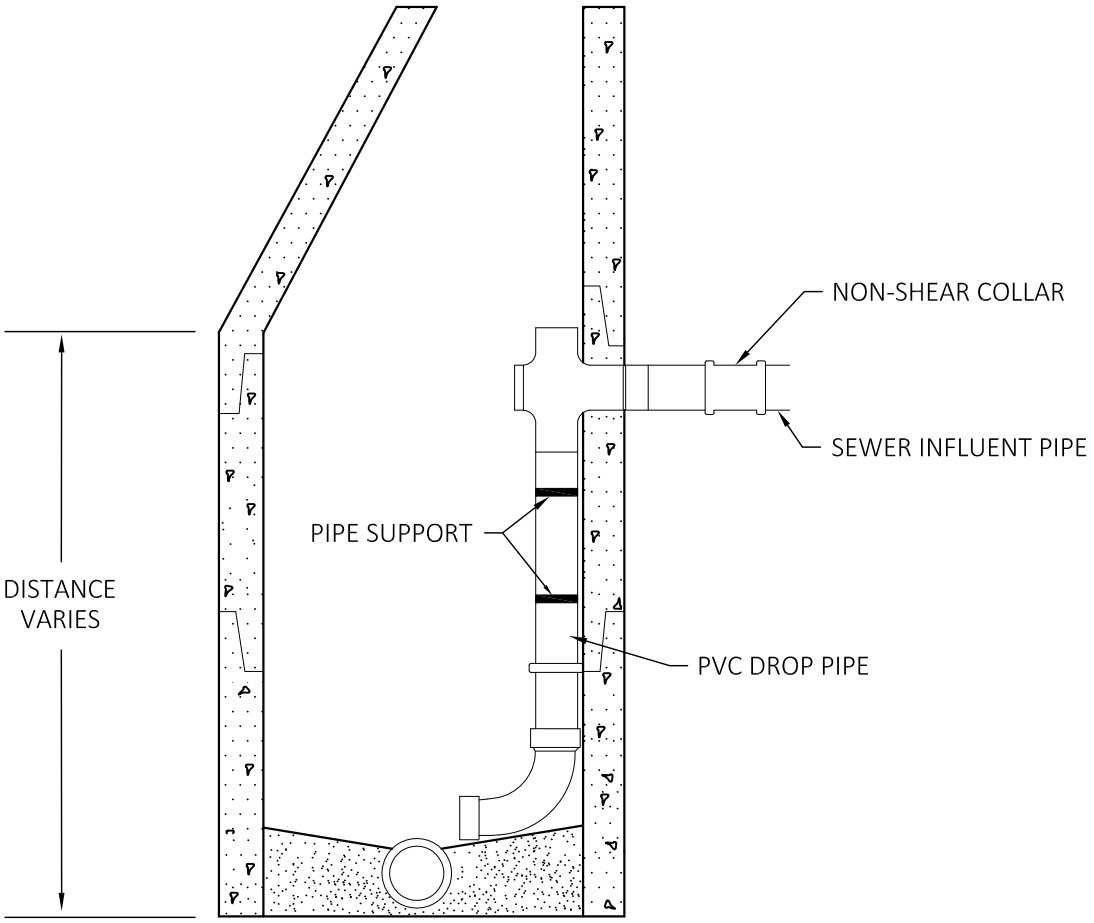


NOTES:

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

REV	DATE	DESCRIPTION	BY

Manhole Inside Drop

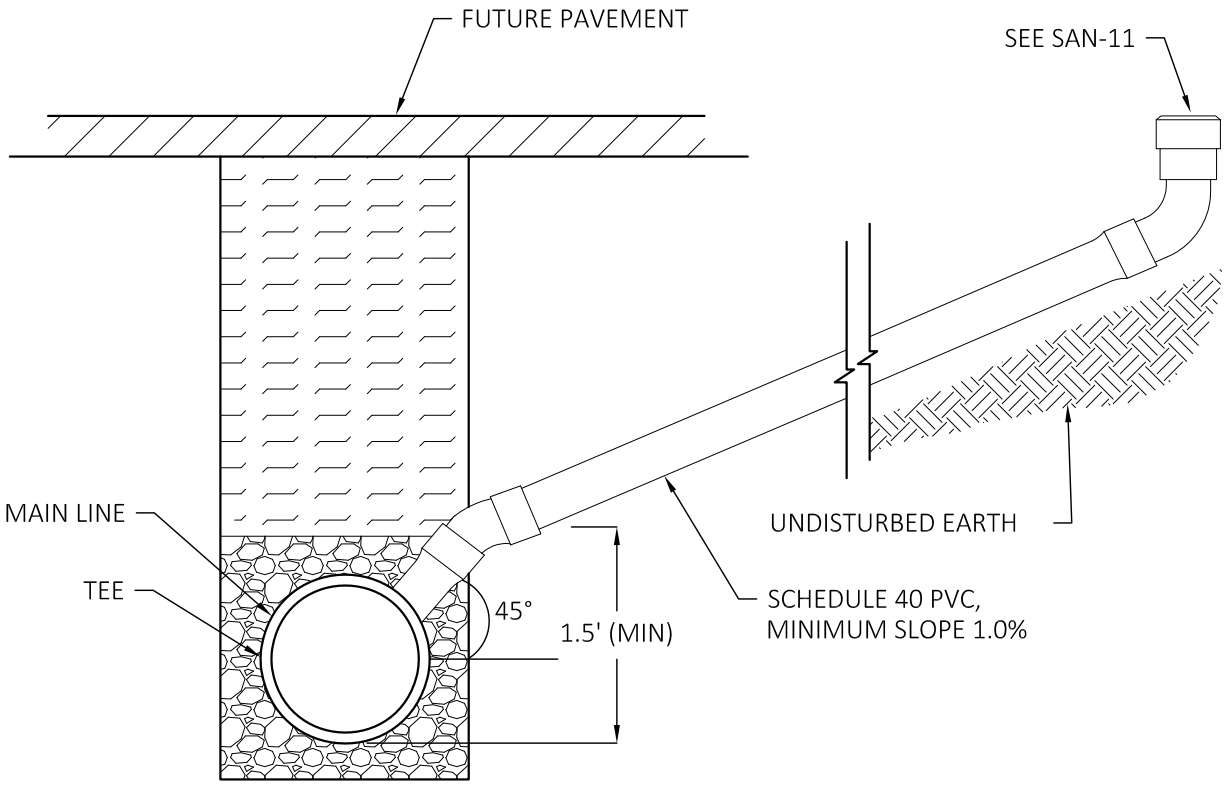
CITY OF STILLWATER STANDARDS

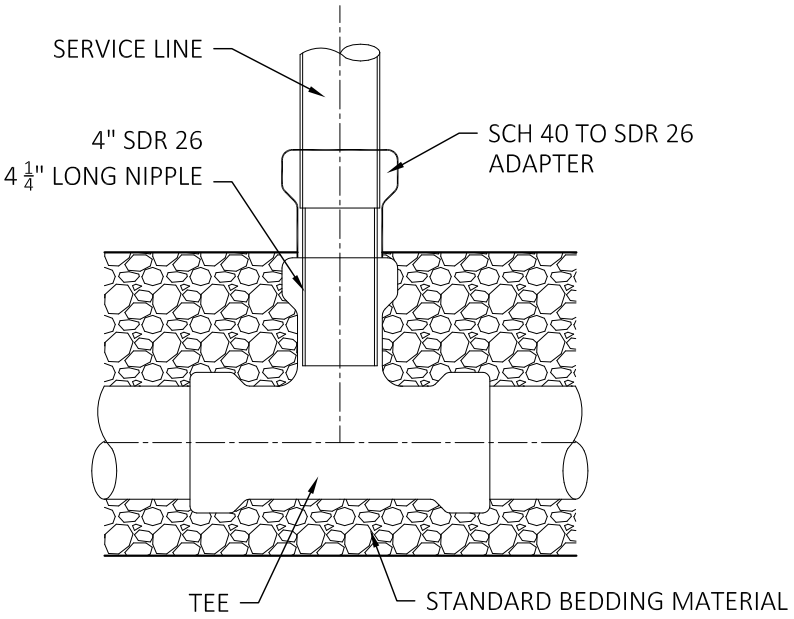
The City of Stillwater OKLAHOMA

Adopted: 4/29/2011

Issued: 3/20/2017

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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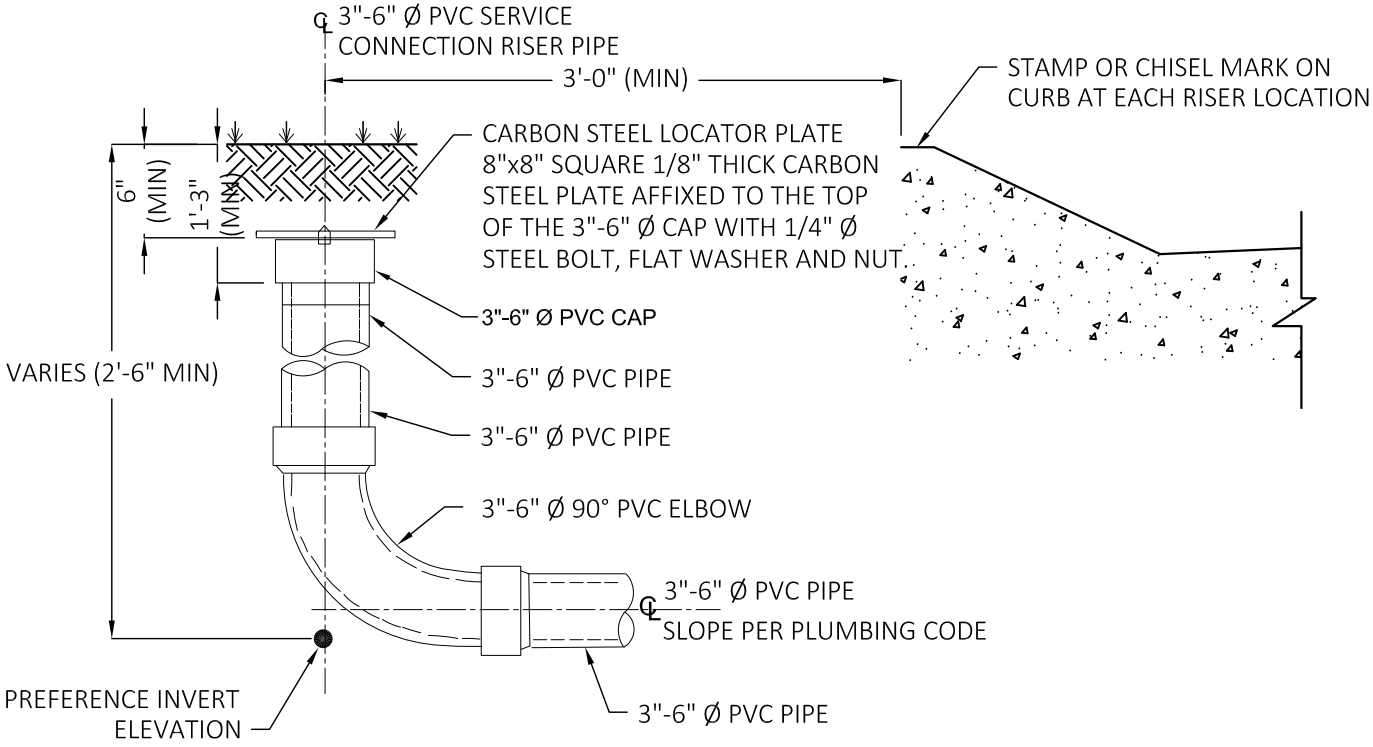

SECTION VIEW

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

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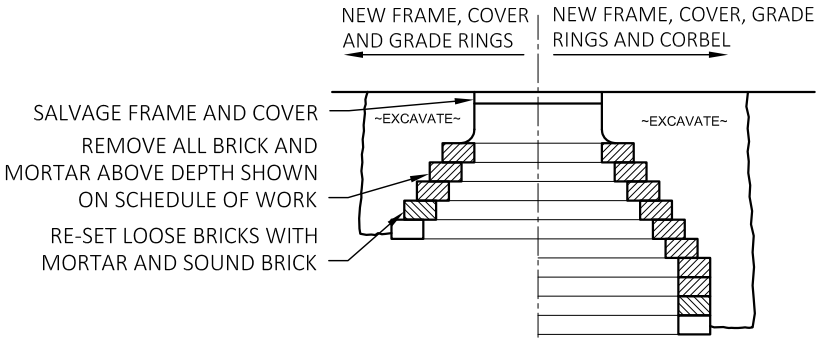
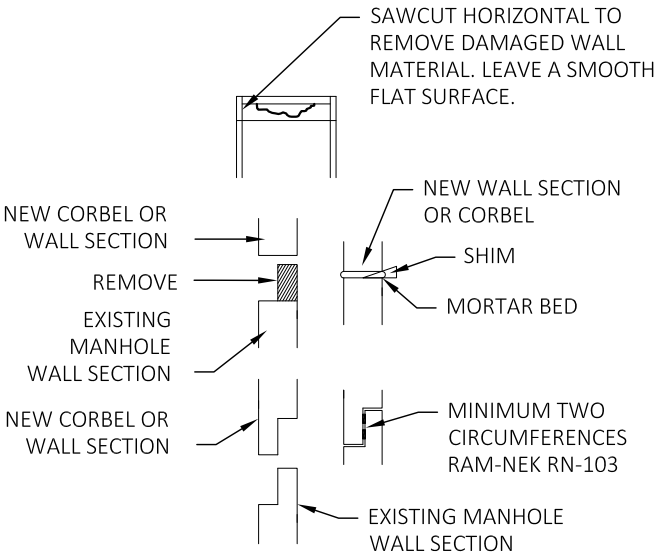
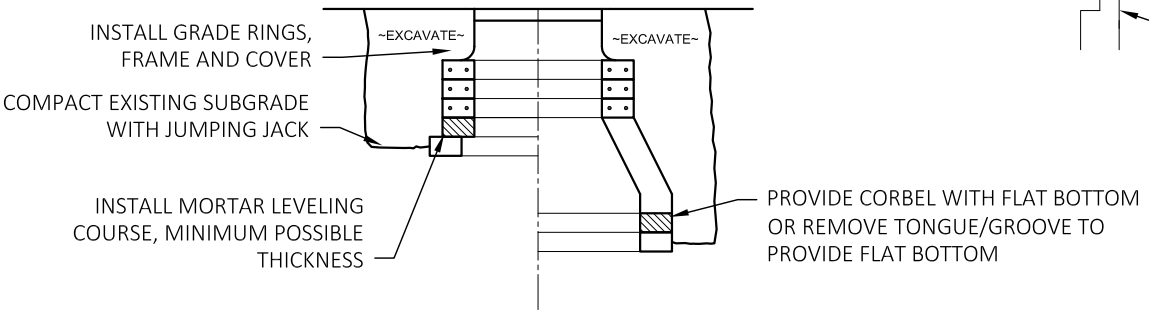


DEMOLITION





INSTALLATION

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

Detail No. 3509

Issued: 3/20/2017

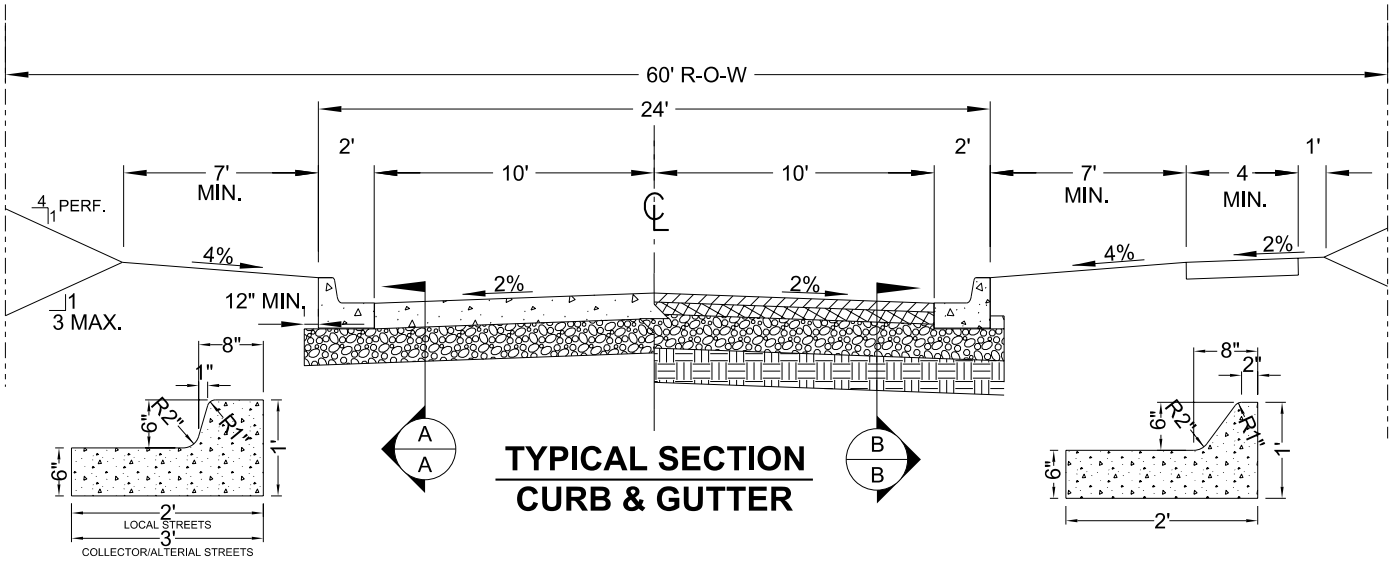
Adopted: 3/9/2012

The City of Stillwater OKLAHOMA

Brick MH Frame/Cover/Corbel Replacement

CITY OF STILLWATER STANDARDS

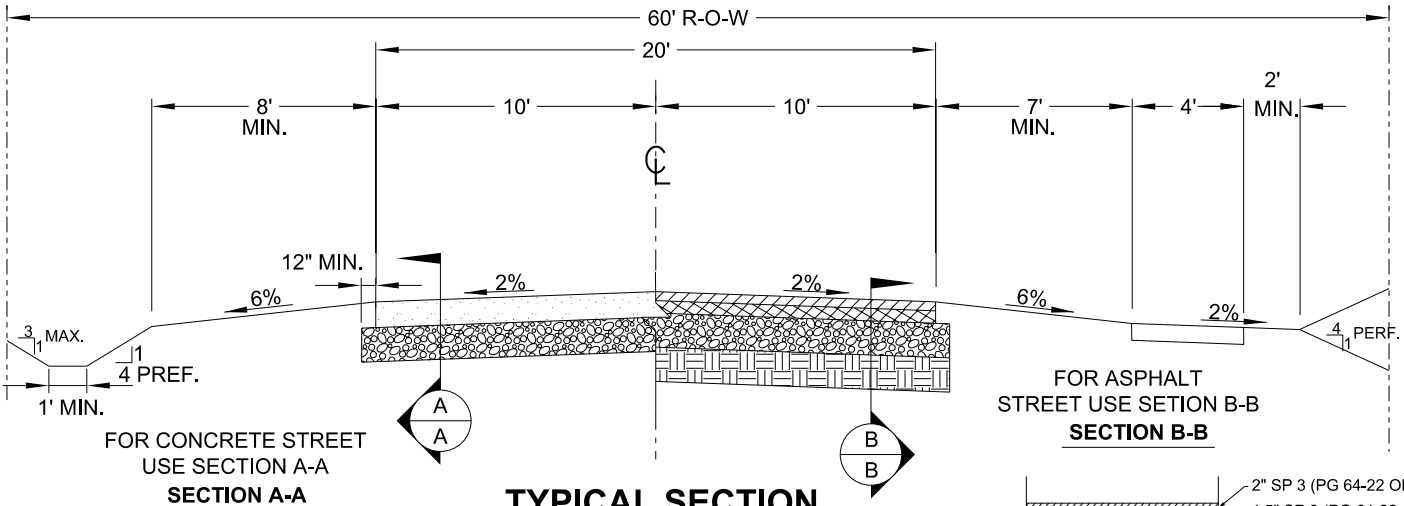
REV	DATE	DESCRIPTION	BY



TYPICAL SECTION
CURB & GUTTER

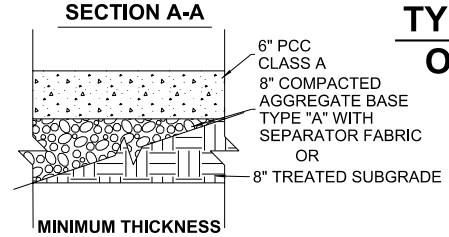
COMBINED CURB & GUTTER (6" BARRIER)
LOCAL, COLLECTOR, AND ARTERIAL STREETS

COMBINED CURB & GUTTER (6" MOUNTABLE)
LOCAL STREETS



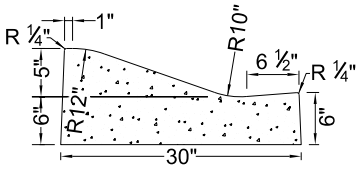
FOR CONCRETE STREET USE SECTION A-A

SECTION A-A



MINIMUM THICKNESS CONCRETE CONSTRUCTION
LOCAL STREETS

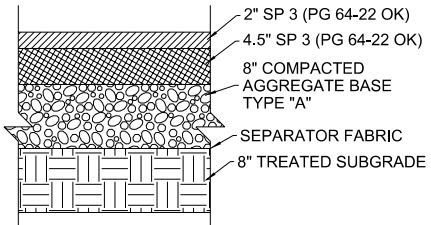
TYPICAL SECTION
OPEN GRADED



COMBINED CURB & GUTTER (5" MOUNTABLE)
LOCAL STREETS

FOR ASPHALT STREET USE SETION B-B

SECTION B-B



MINIMUM THICKNESS ASPHALT CONSTRUCTION
LOCAL STREETS

NOTES:

1. SECTIONS SHOWN ARE MINIMUM REQUIRED.
2. SUBGRADE MAY REQUIRE ADDITIONAL THICKNESS OF MODIFICATION OR A SUBBASE DRAINAGE SYSTEM WHERE SEVERE SOIL CONDITIONS EXIST.
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

REVISION	BY	DATE

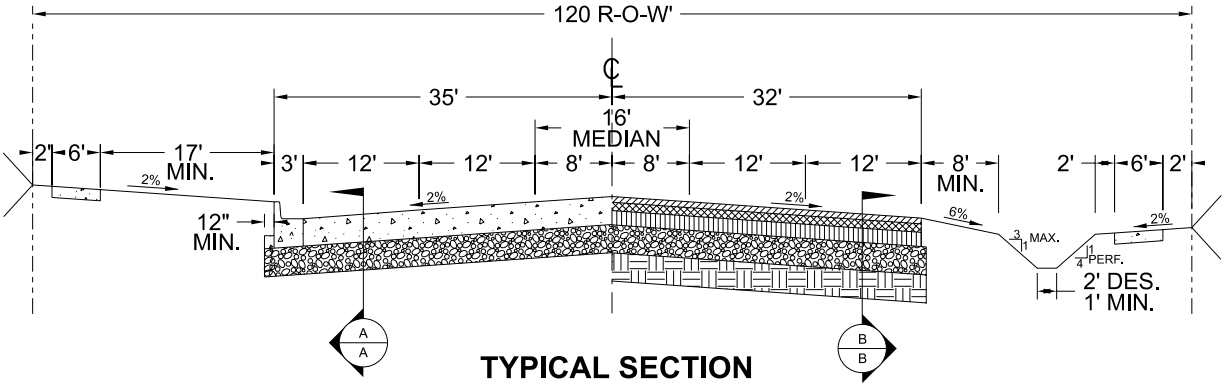
City of **stillwater**
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

LOCAL STREET
STANDARD DETAILS

DATE: JULY 18, 2011

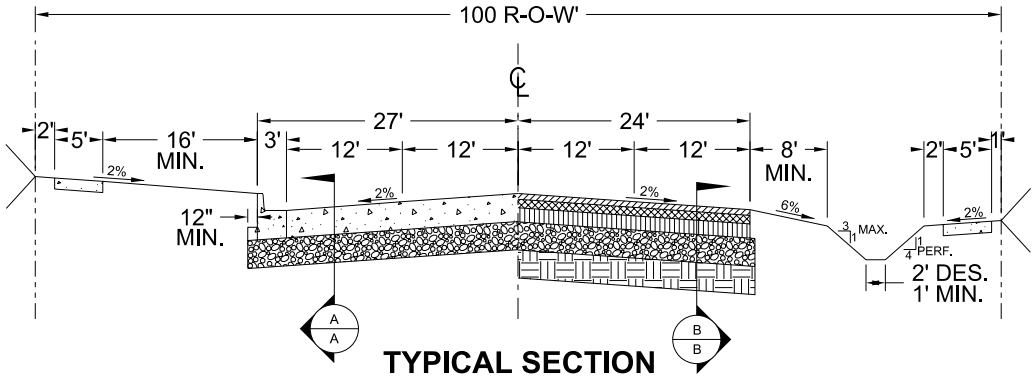
STANDARD NO. **3701**

DRAFT STANDARD



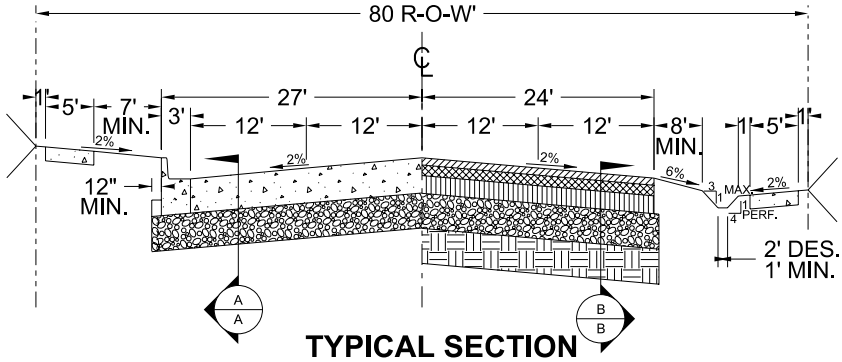
TYPICAL SECTION

PRIMARY ARTERIAL STREET 120' RIGHT - OF - WAY



TYPICAL SECTION

PRINCIPAL ARTERIAL STREET 100' RIGHT - OF - WAY

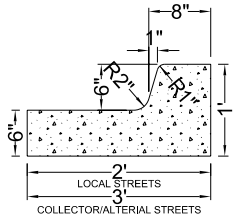


TYPICAL SECTION

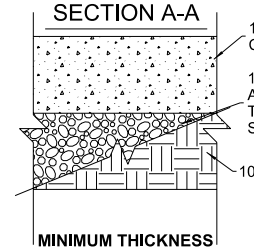
MINOR ARTERIAL STREET 80' RIGHT - OF - WAY

FOR ASPHALT STREET
USE SECTION B-B

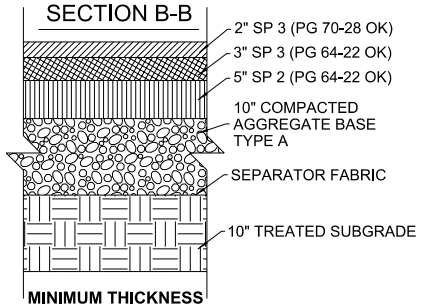
FOR CONCRETE STREET
USE SECTION A-A



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



MINIMUM THICKNESS
CONCRETE CONSTRUCTION
ARTERIAL STREETS



MINIMUM THICKNESS
ASPHALT CONSTRUCTION
ARTERIAL STREETS

NOTES:

1. SECTIONS SHOWN ARE MINIMUM REQUIRED.
2. SUBGRADE MAY REQUIRE ADDITIONAL THICKNESS OF MODIFICATION OR A SUBBASE DRAINAGE SYSTEM WHERE SEVERE SOIL CONDITIONS EXIST.
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.

REVISION	BY	DATE

City of **stillwater**

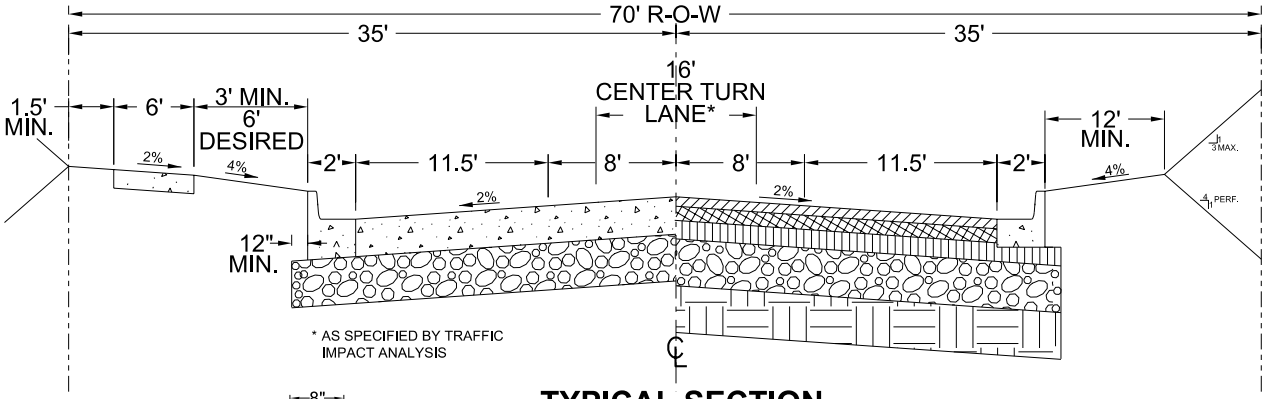
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

ARTERIAL STREETS

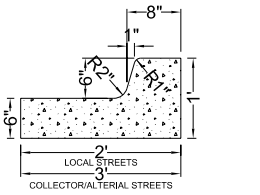
STANDARD DETAILS

DATE: JULY 18, 2011

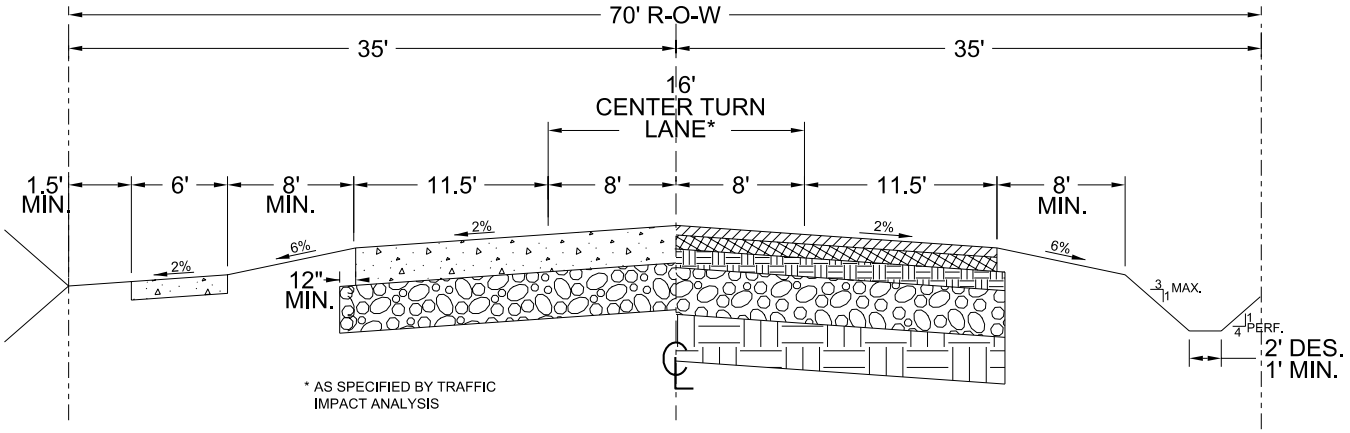
STANDARD NO. **3702**



TYPICAL SECTION
CURB & GUTTER



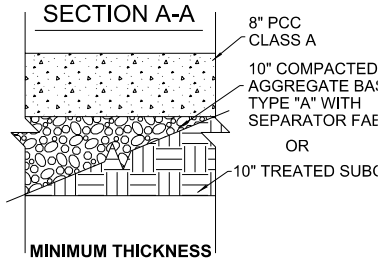
COMBINED CURB & GUTTER (6" BARRIER)
LOCAL, COLLECTOR,
AND ARTERIAL STREETS



TYPICAL SECTION
OPEN GRADED

FOR CONCRETE STREET
USE SECTION A-A

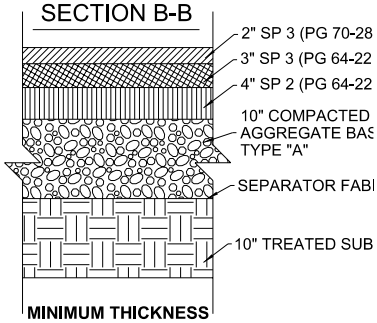
SECTION A-A



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 OF MODIFICATION OR A SUBBASE DRAINAGE SYSTEM WHERE SEVERE SOIL CONDITIONS EXIST.
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.

REVISION	BY	DATE

City of **stillwater**

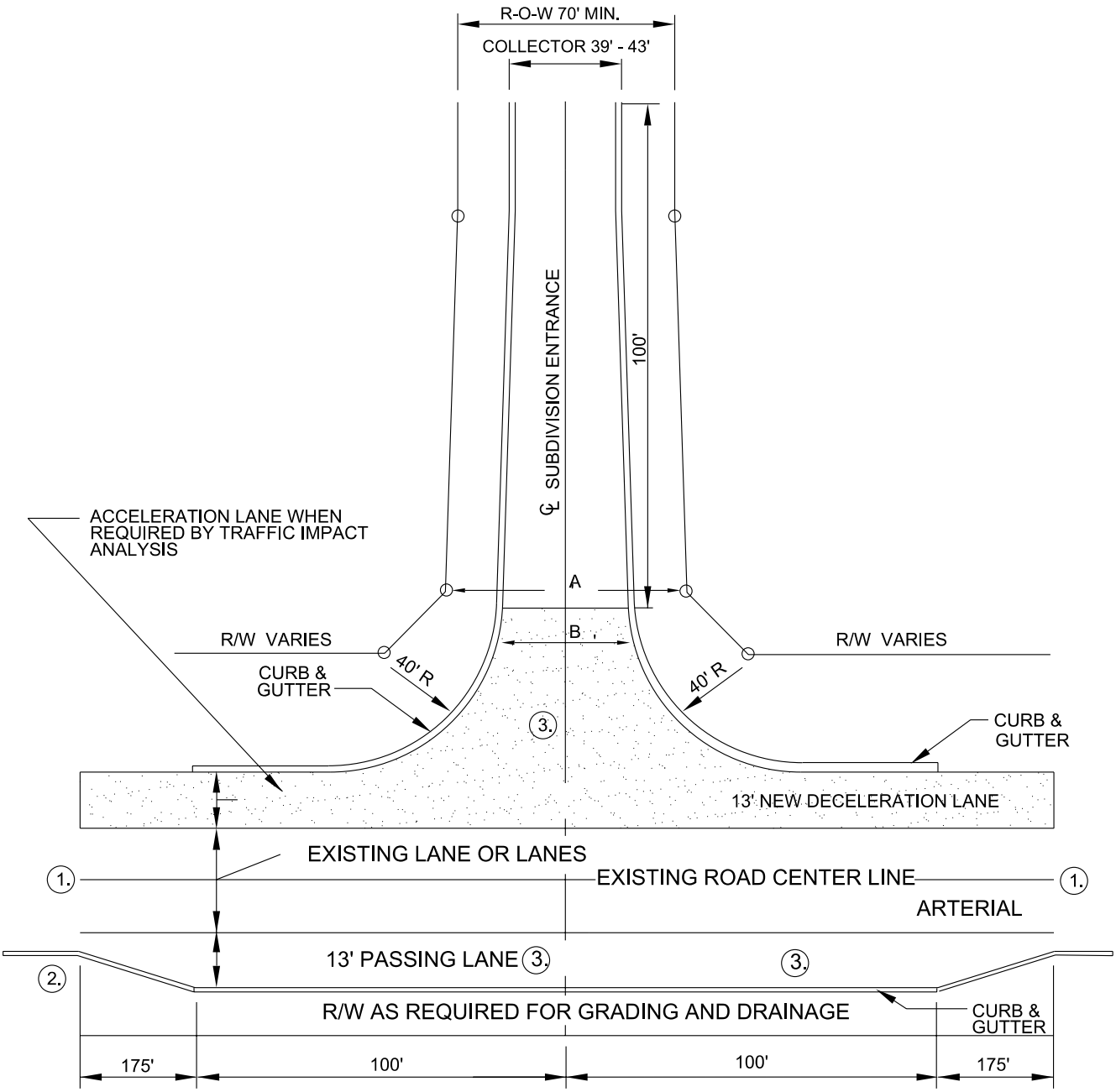
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

COLLECTOR STREETS

STANDARD DETAILS

DATE: FEBRUARY 26, 2011

STANDARD 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

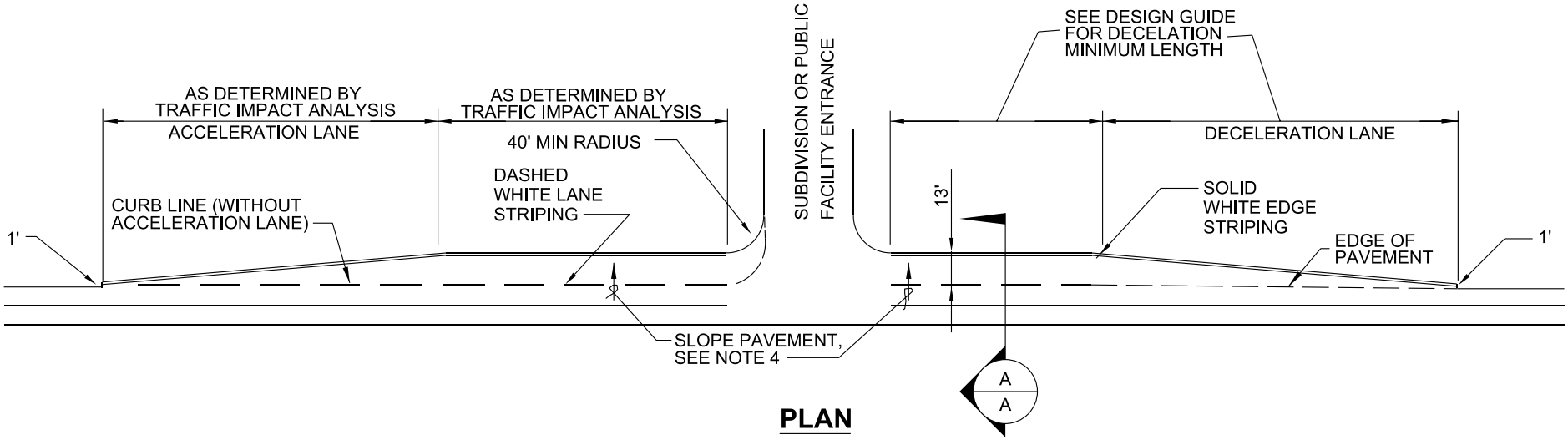
COLLECTOR - INTERSECTION WITH ARTERIAL

STANDARD DETAILS

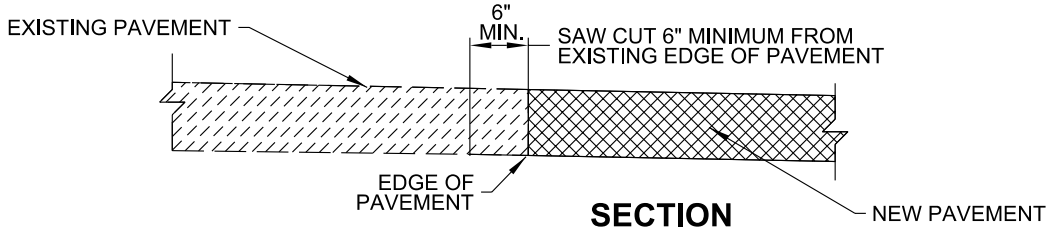
DATE: AUGUST 2010

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

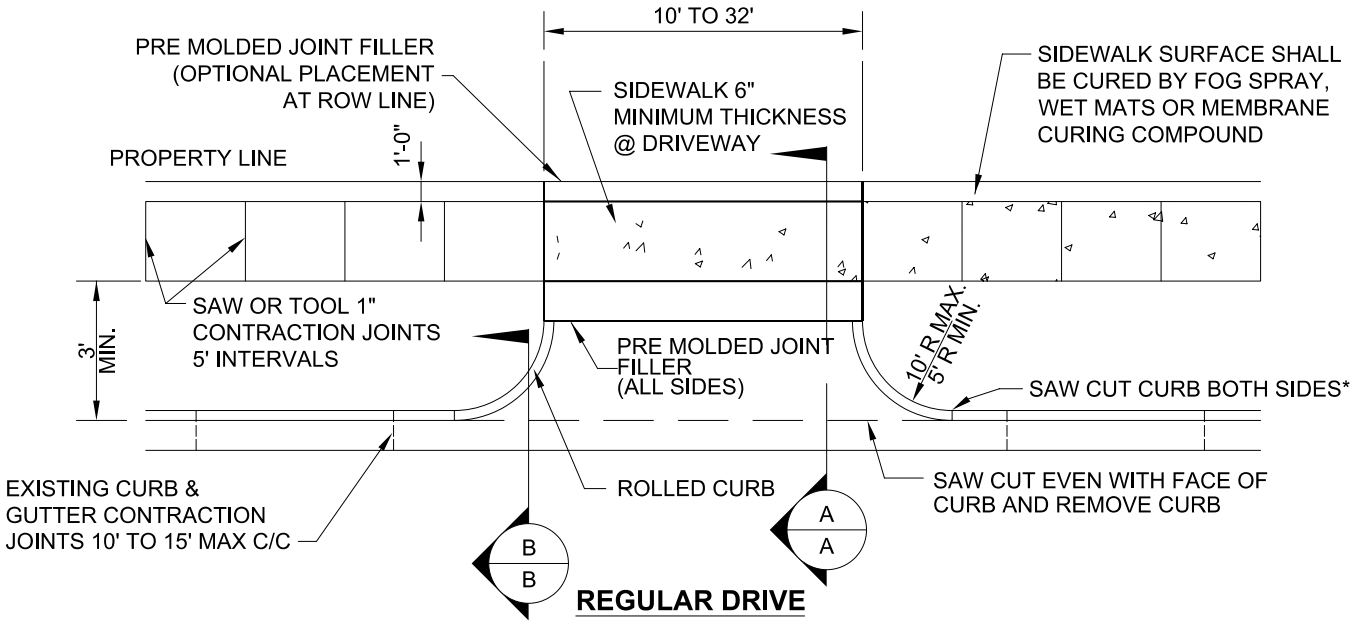
ACCELERATION \ DECELERATION LANES

STANDARD DETAILS

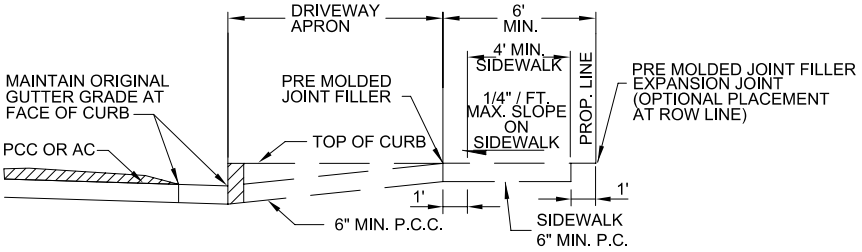
DATE: AUGUST 2010

STANDARD NO. 3705

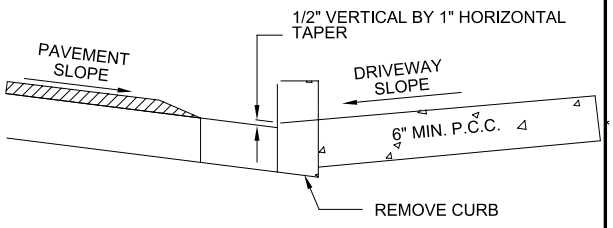
DRAFT STANDARD



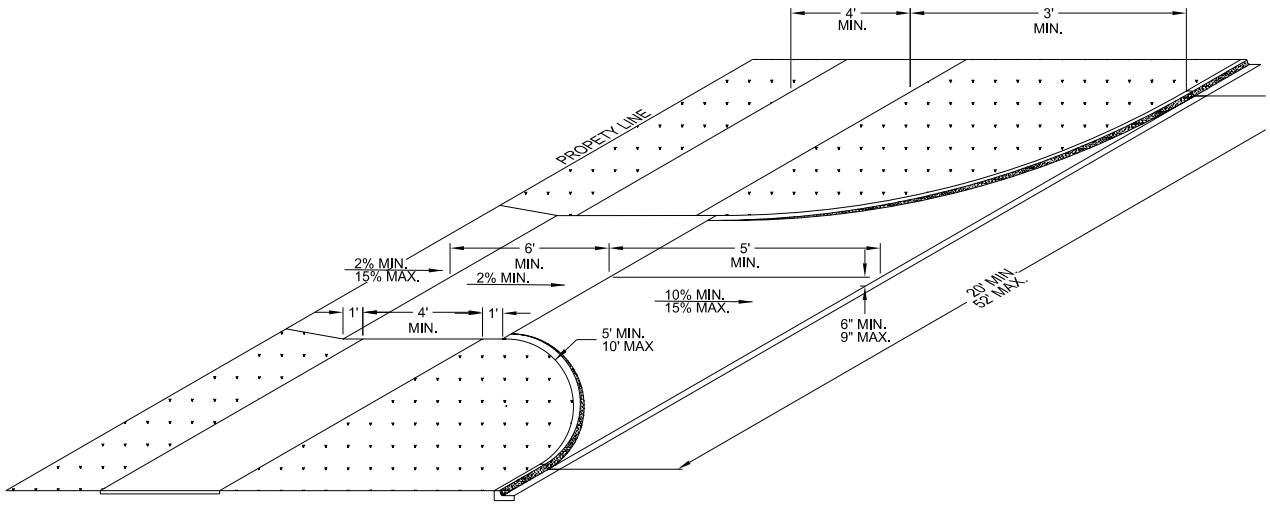
REGULAR DRIVE



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

REVISION	BY	DATE

City of **stillwater**

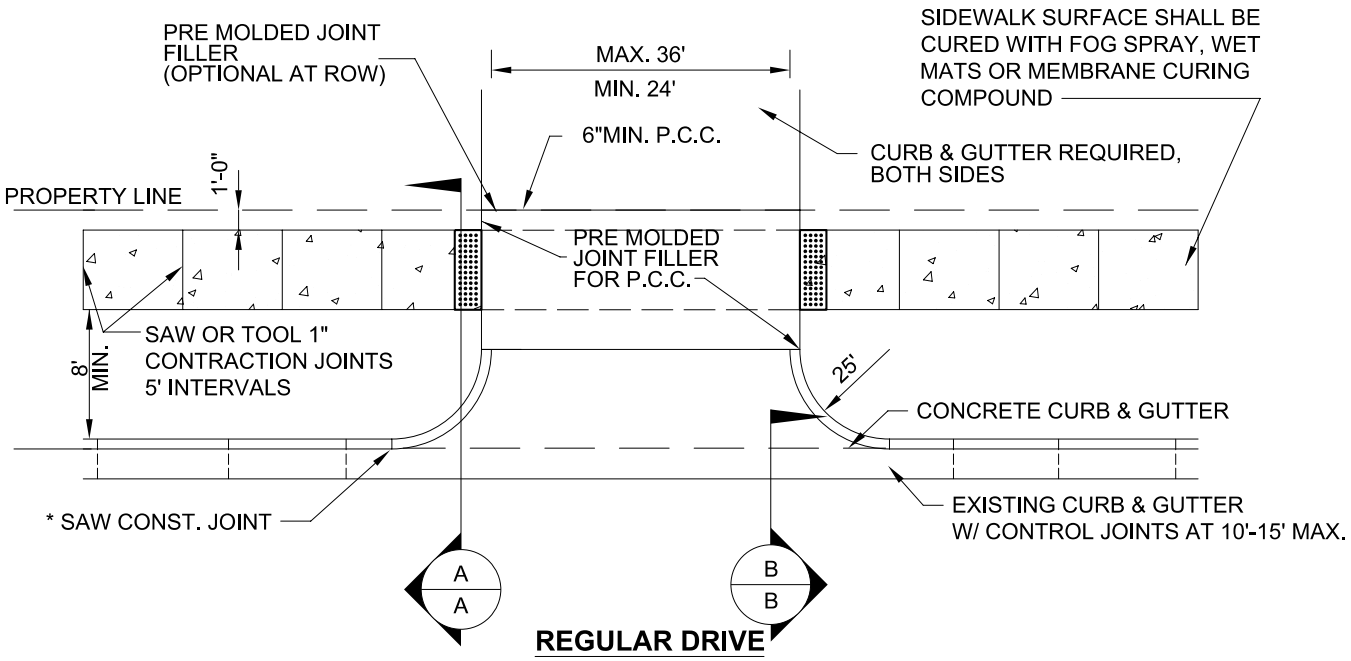
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

URBAN RESIDENTIAL DRIVEWAY AND CURB CUT

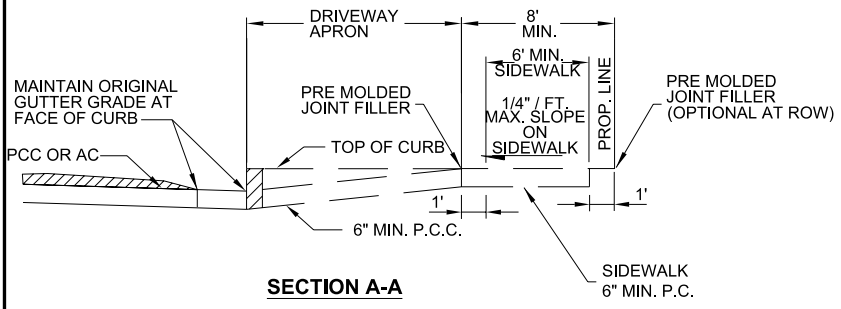
STANDARD DETAILS

DATE: FEBRUARY 26, 2013

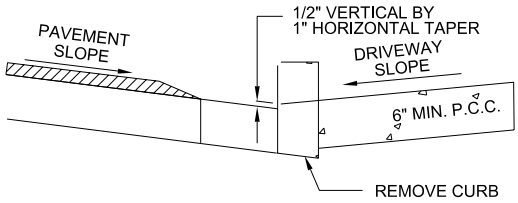
STANDARD NO. 3706



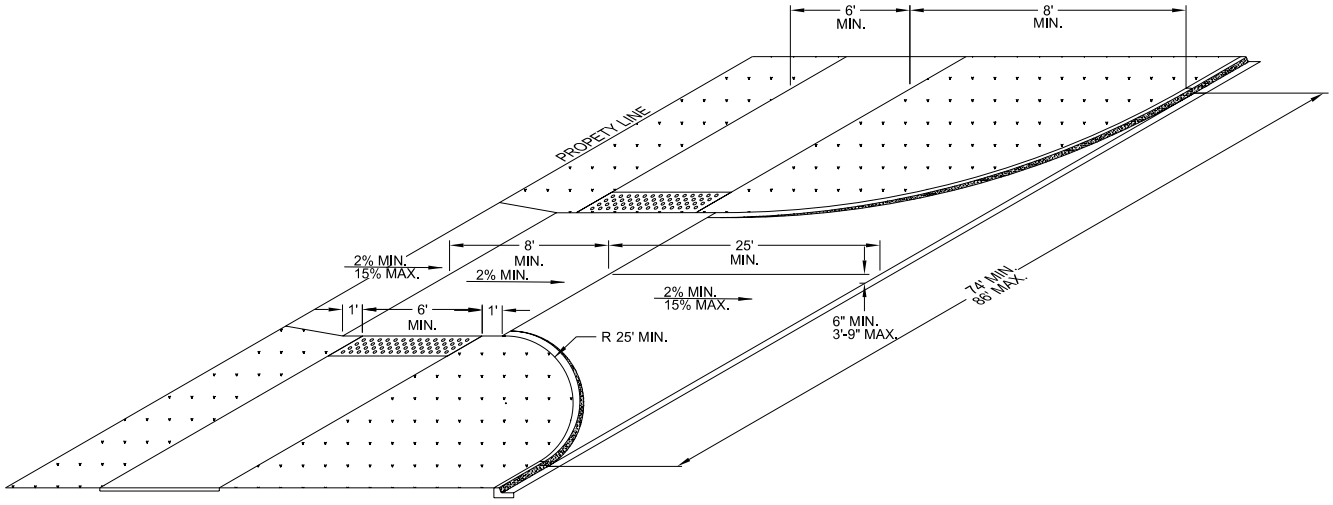
REGULAR DRIVE



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.
3. DRIVEWAY SHALL BE DESIGNED FOR HEAVIEST RECURRING LOAD POSSIBLE
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

REVISION	BY	DATE

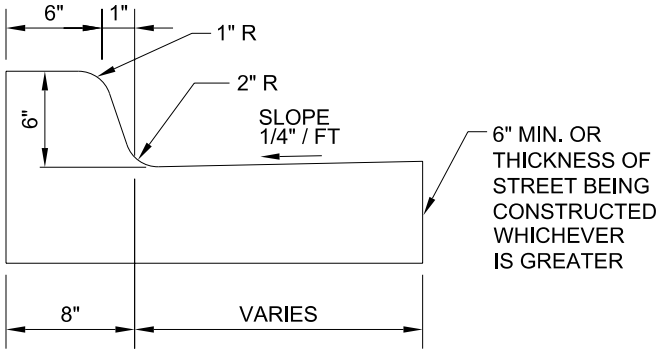
City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

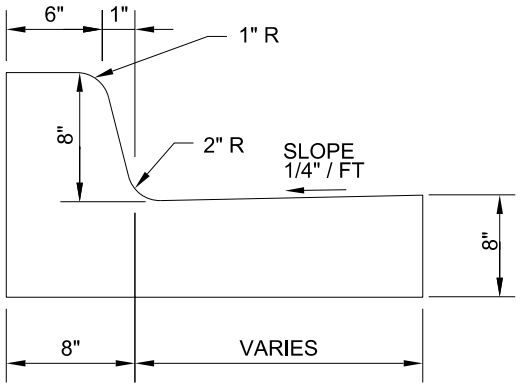
COMMERCIAL DRIVEWAY

STANDARD DETAILS

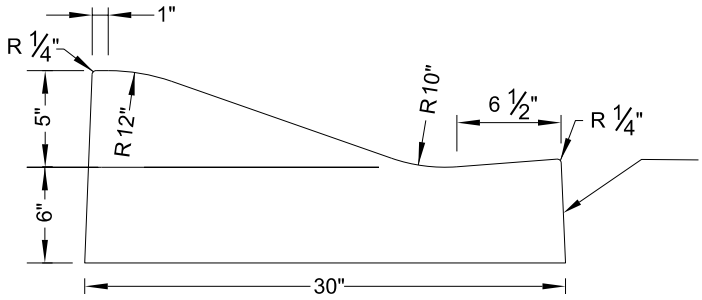
DATE: FEBRUARY 26, 2013 STANDARD NO. 3707



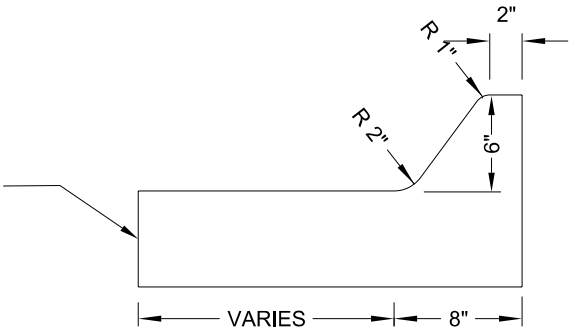
6" BARRIER CURB & GUTTER



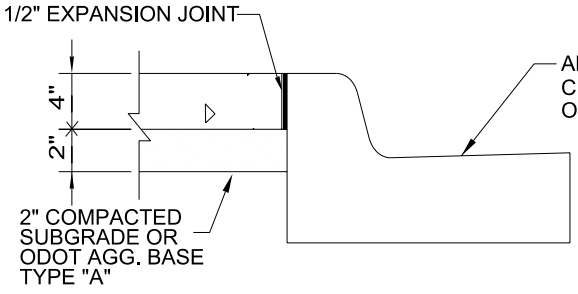
8" BARRIER CURB & GUTTER



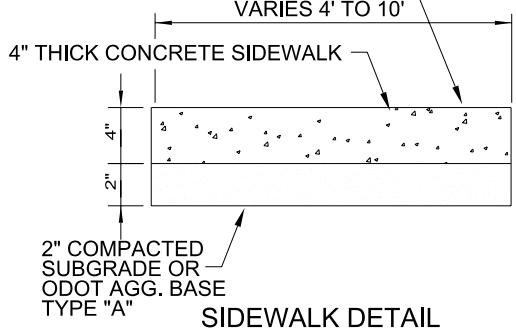
5" MOUNTABLE CURB & GUTTER



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**

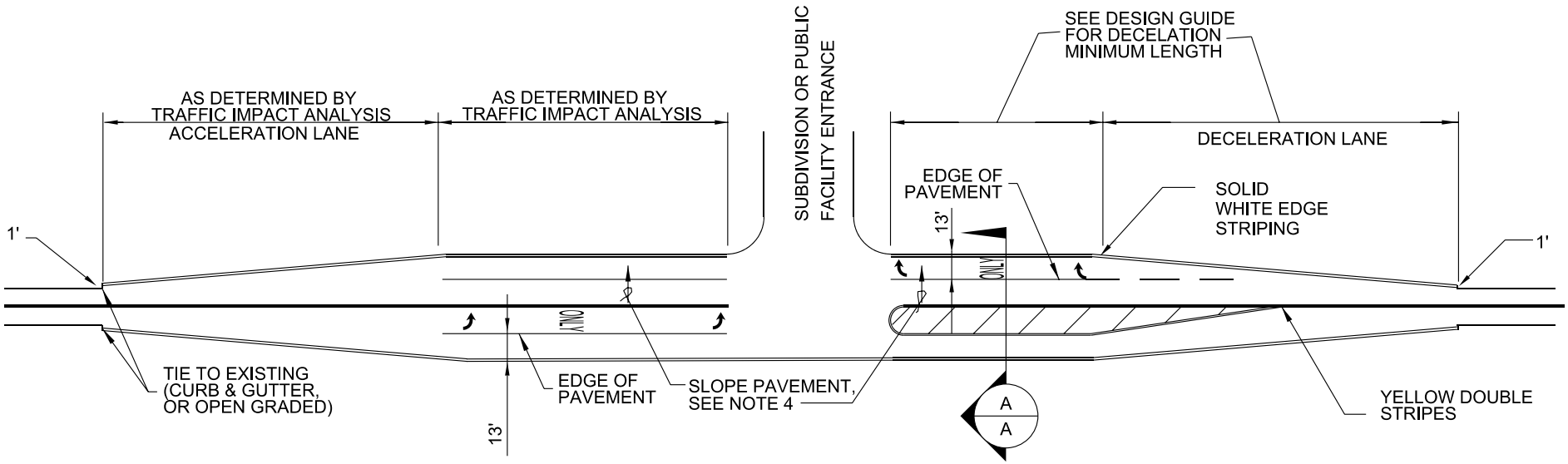
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

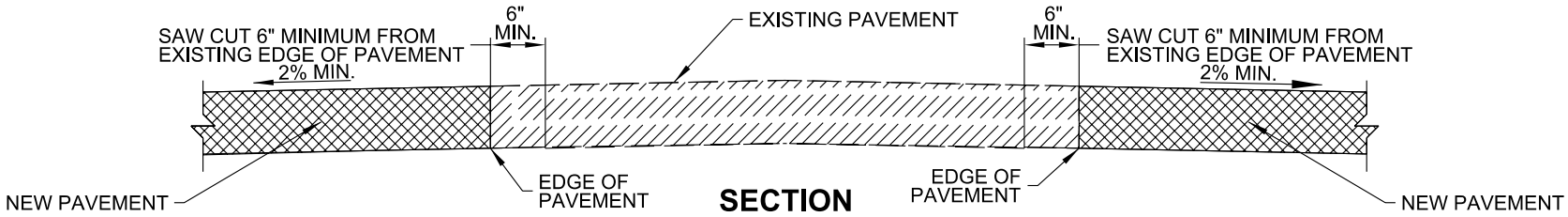
CURB, GUTTER, AND SIDEWALK

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.)

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

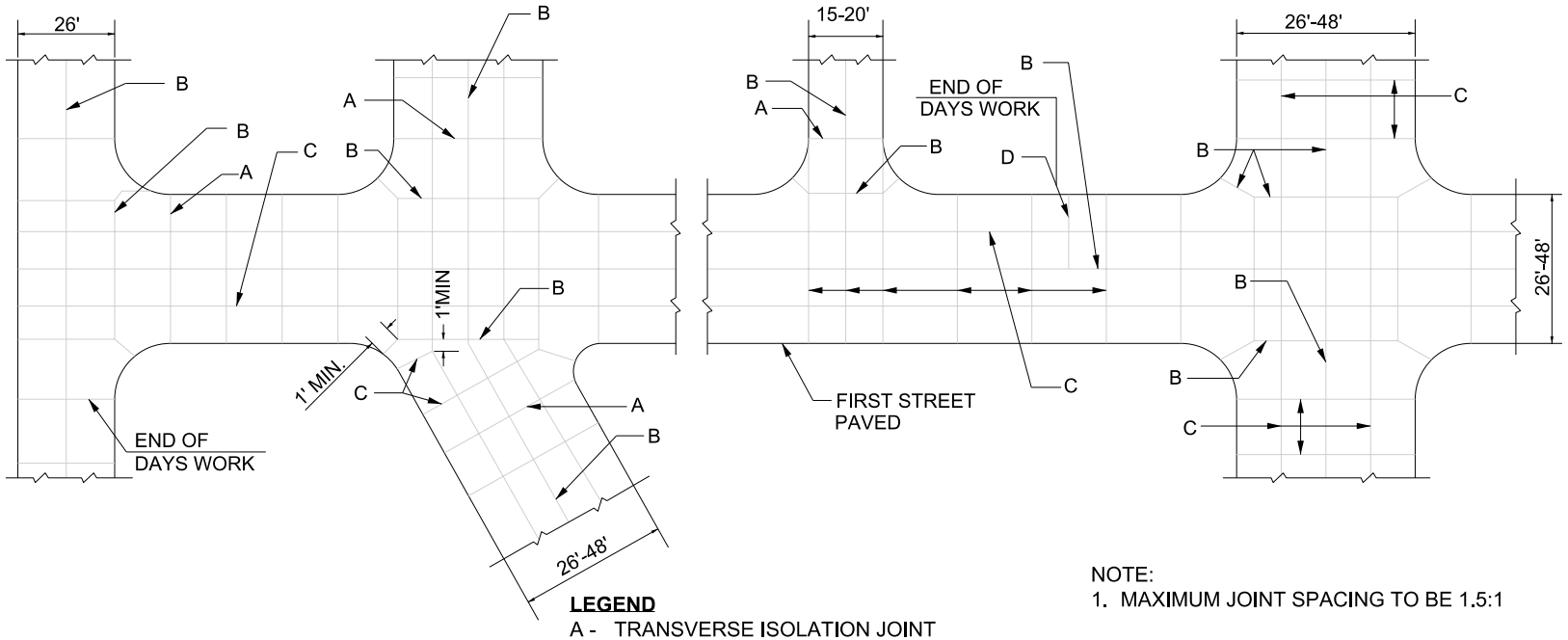
ACCELERATION \ DECELERATION WITH PASSING LANE

STANDARD DETAILS

DATE: AUGUST 2010

STANDARD NO. 3709

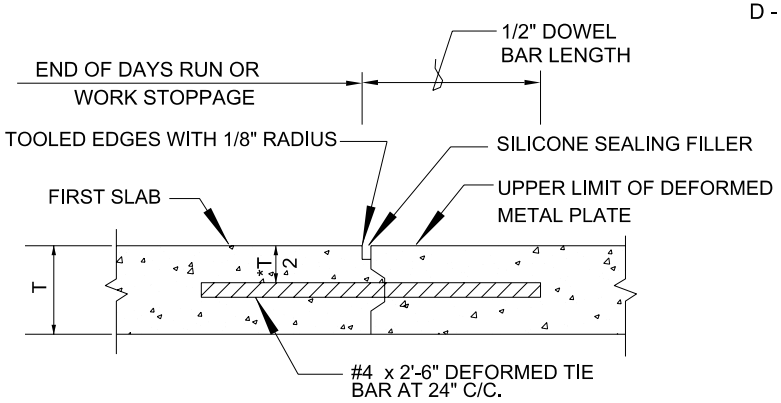
DRAFT STANDARDS



LEGEND

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

NOTE:
1. MAXIMUM JOINT SPACING TO BE 1.5:1



TRANSVERSE KEYWAY 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 SAW CUT AND SEAL THE JOINT BETWEEN THE OLD AND NEW PLACEMENTS

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

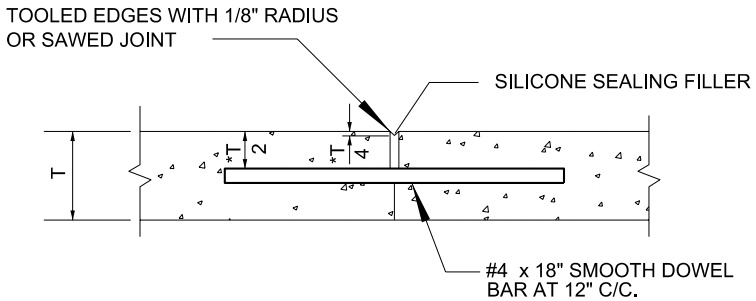
CONCRETE PAVEMENT JOINT PLAN (INTERSECTIONS & LANES)

STANDARD DETAILS

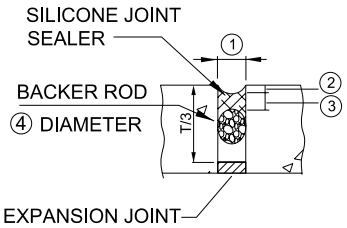
DATE: AUGUST 2010

STANDARD NO. 3710

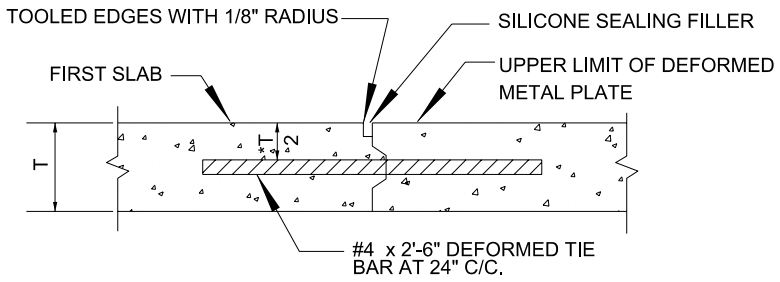
DRAFT STANDARD



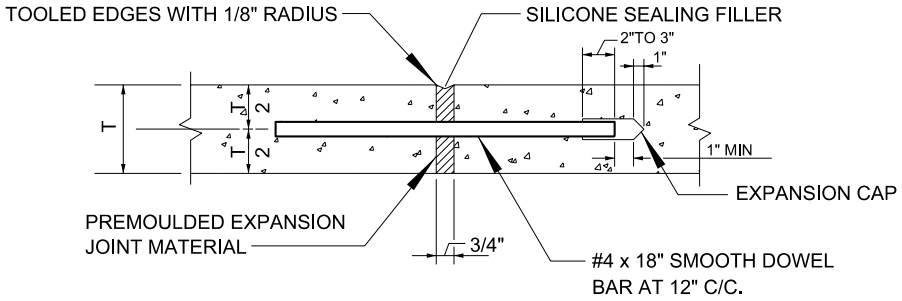
TRANSVERSE CONTRACTION JOINT



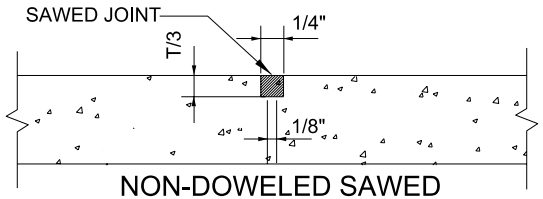
SEALED EXPANSION JOINT



TRANSVERSE KEYWAY CONSTRUCTION JOINT

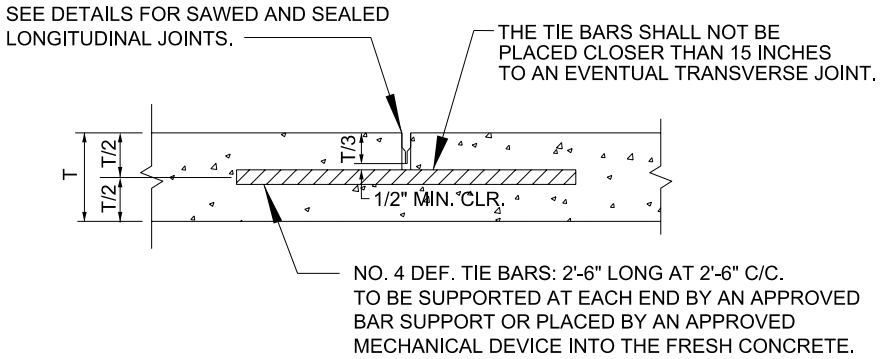


ISOLATION JOINT



NON-DOWELED SAWED TRANSVERSE CONTRACTION JOINT

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



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 ASPHALT OR GREASE TO PREVENT BOND WITH CONCRETE.
   SMOOTH DOWEL BARS ACROSS EXPANSION JOINTS SHALL BE PROVIDED WITH EXPANSION CAPS, AND COATED WITH ASPHALT OR GREASE AS NOTED ABOVE.
2. GROOVES IN JOINTS MAY BE FORMED BY:(1)TEMPORARY EMBEDMENT OF A SUITABLE MANDREL,(2)INSTALLATION OF THIN STRIP OF PREMOULDED JOINT FILLER MATERIAL,(3) SAWING THE PAVEMENT AFTER THE CONCRETE HAS HARDENED.
3. VIBRATORY COMPACTION OF JOINTS REQUIRED.
4. T = PAVEMENT THICKNESS
5. DOWELS SHALL CONFORM TO AASHTO M31, GRADE 40 OR 60.

REVISION	BY	DATE

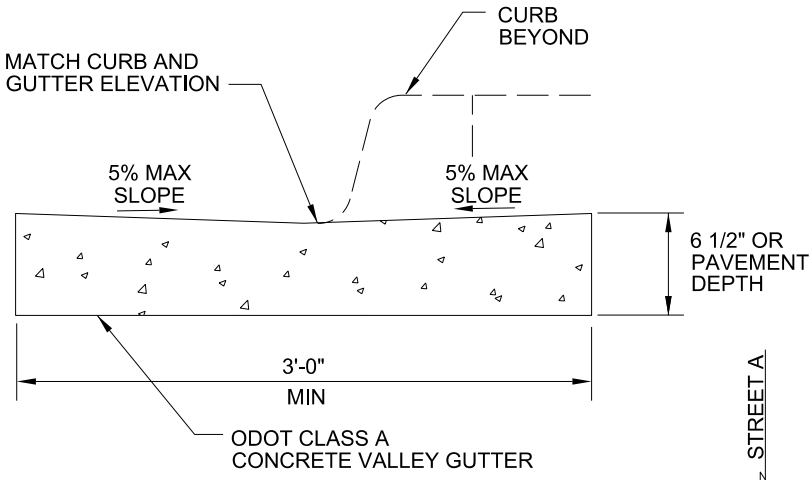
City of **stillwater**
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CONCRETE PAVEMENT - JOINT DETAILS

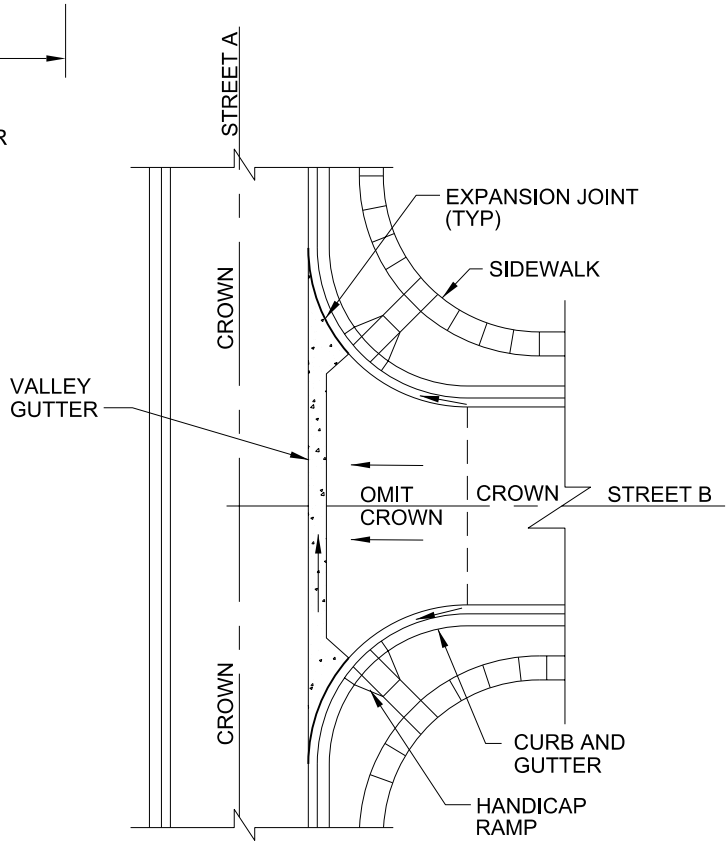
STANDARD DETAILS

DATE: JULY 18, 2011 | STANDARD NO. 3711

DRAFT STANDARDS



SECTION



PLAN

VALLEY GUTTER

NOTES:
1. VALLEY GUTTER MAY BE USED IN LIEW 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.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

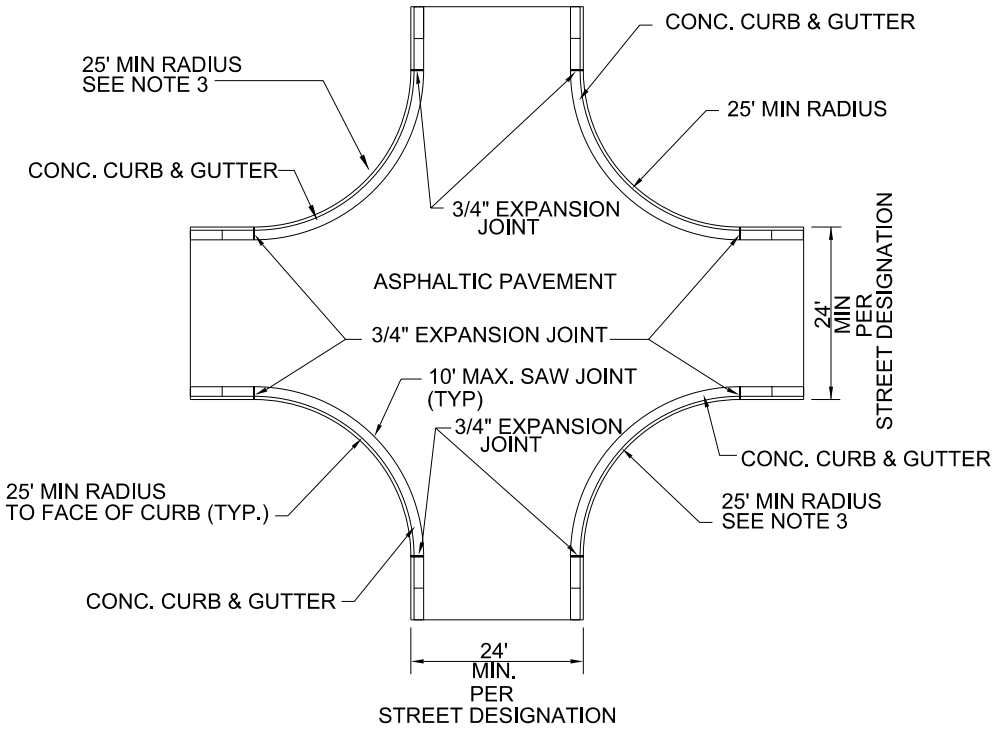
VALLEY GUTTER

STANDARD DETAILS

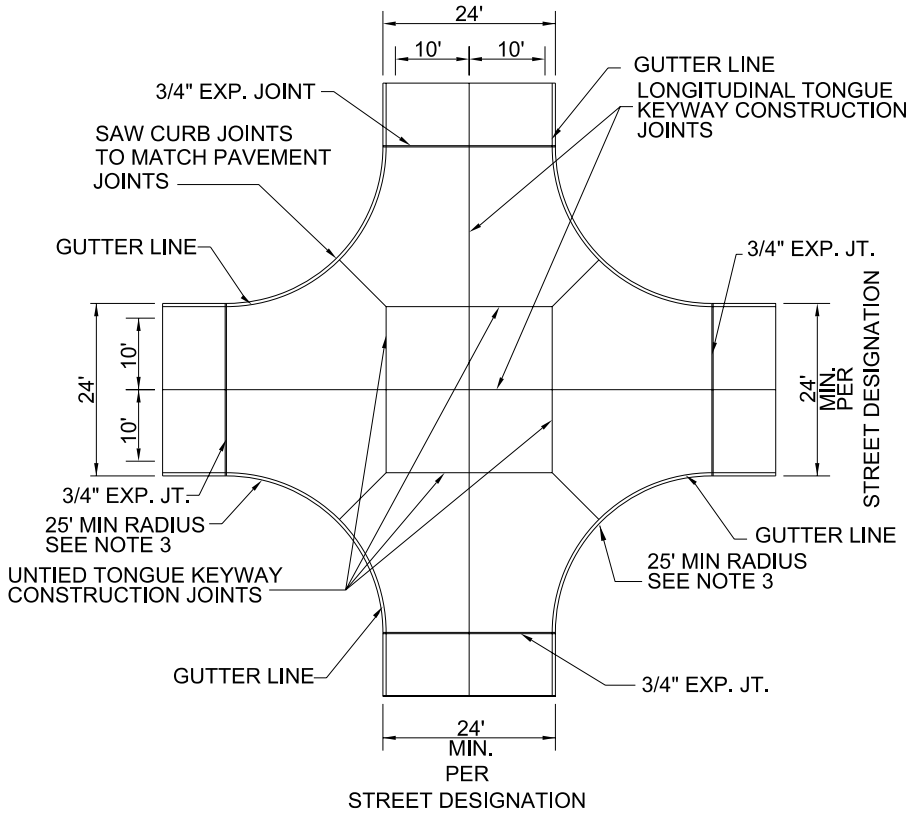
DATE: JULY 18, 2011

STANDARD NO. 3712

DRAFT STANDARDS



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**

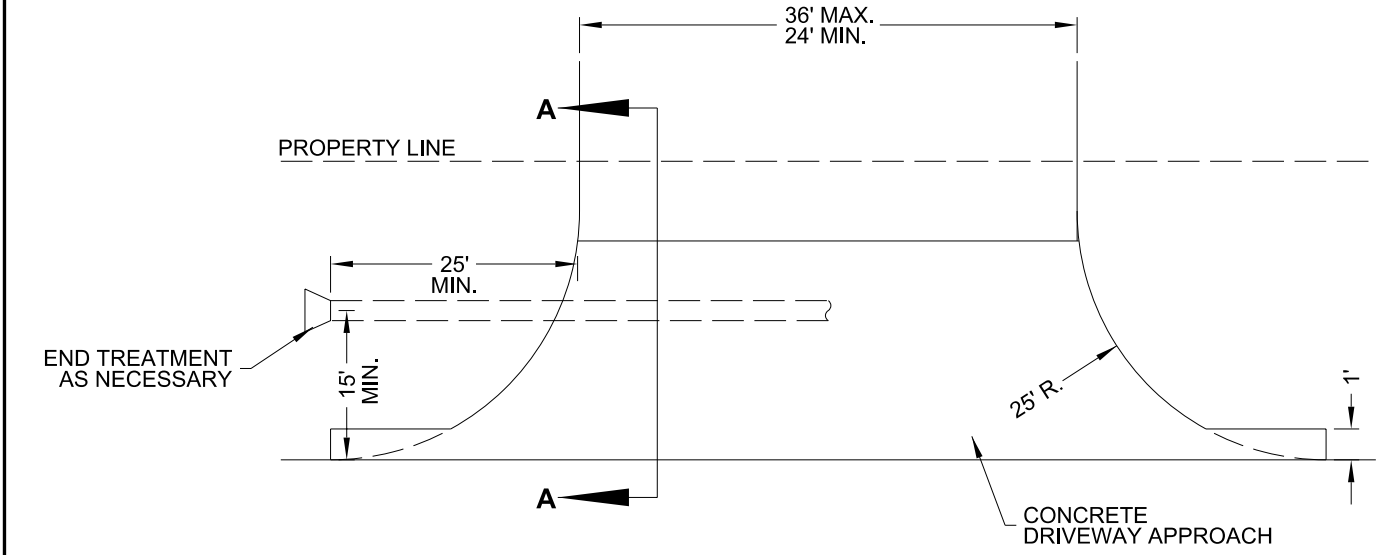
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

STREET INTERSECTION LAYOUT

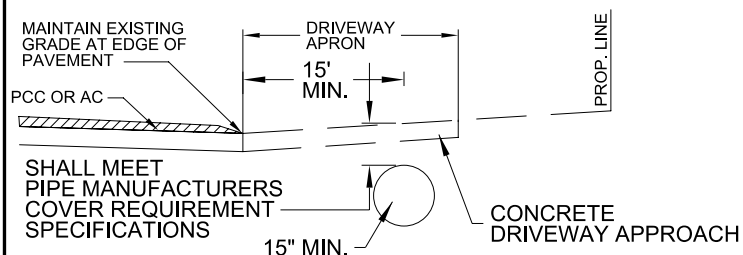
STANDARD DETAILS

DATE: JULY 18, 2011 | STANDARD NO. 3713

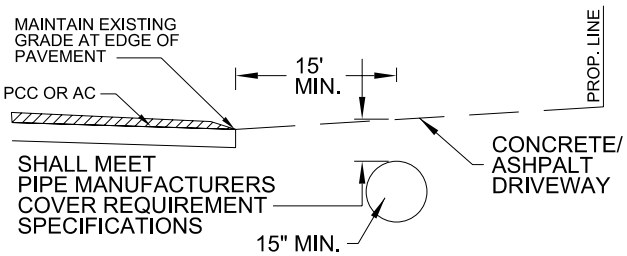
DRAFT STANDARD



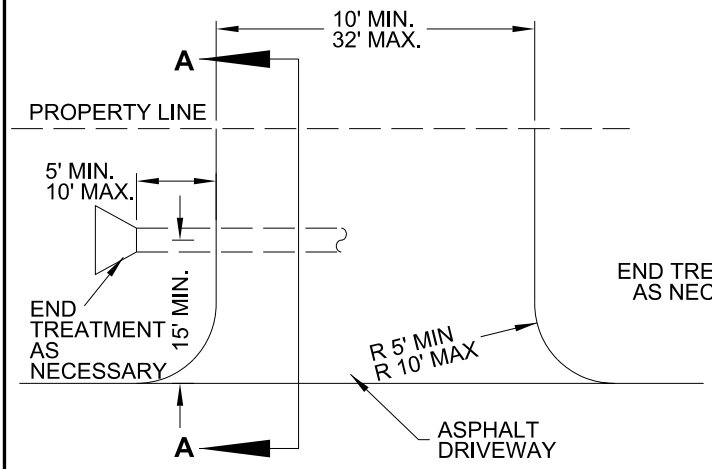
COMMERCIAL RURAL DRIVE



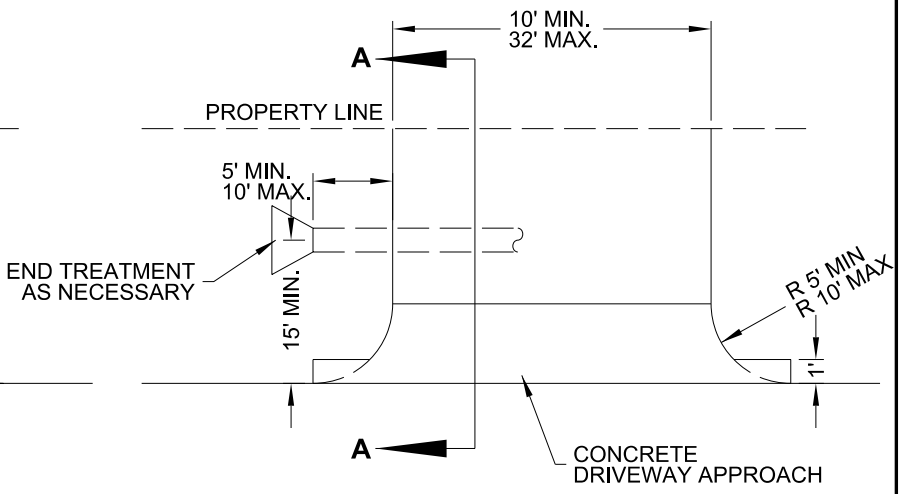
SECTION A-A
COMMERCIAL RURAL DRIVE



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**

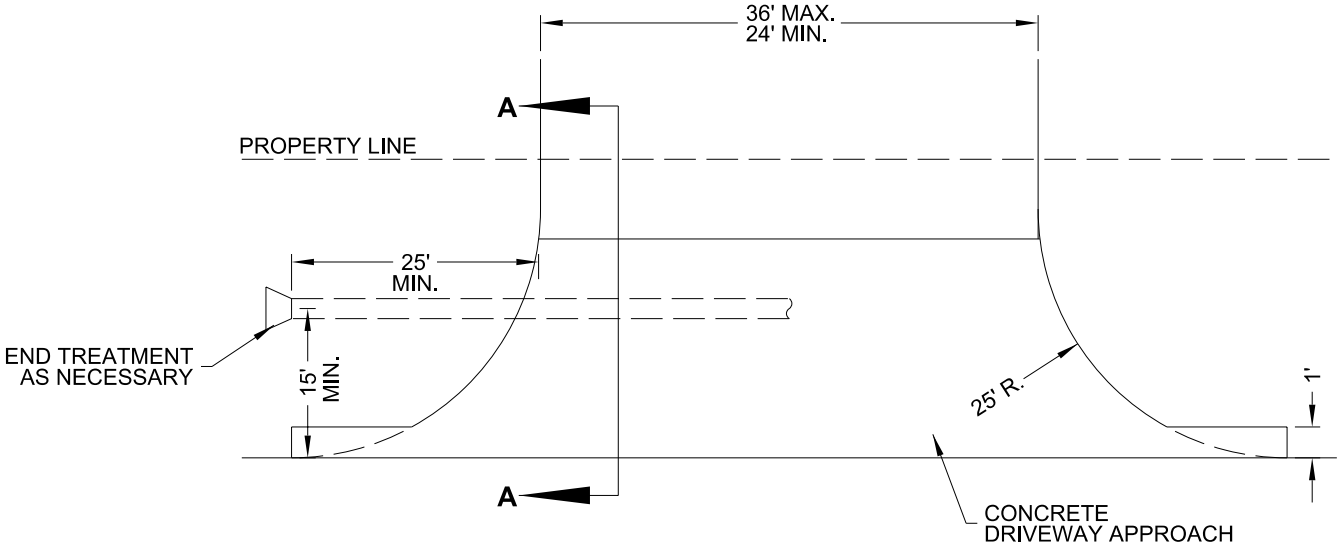
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

RURAL COMMERCIAL & RESIDENTIAL DRIVEWAY

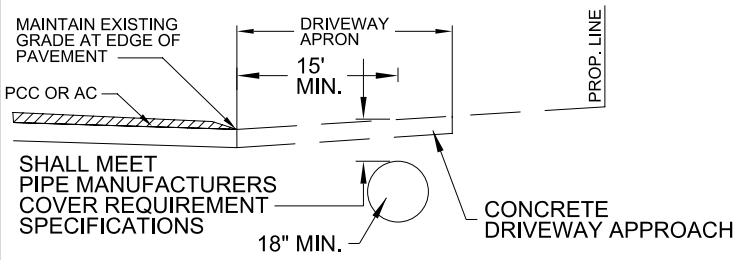
STANDARD DETAILS

DATE: FEBRUARY 26, 2013

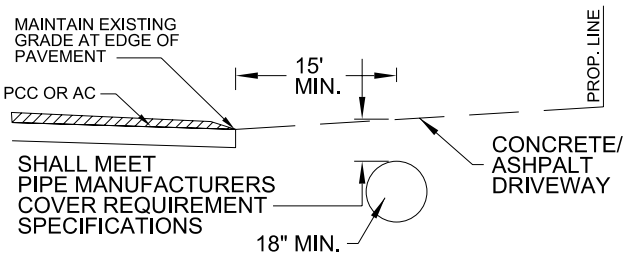
STANDARD NO. 3714



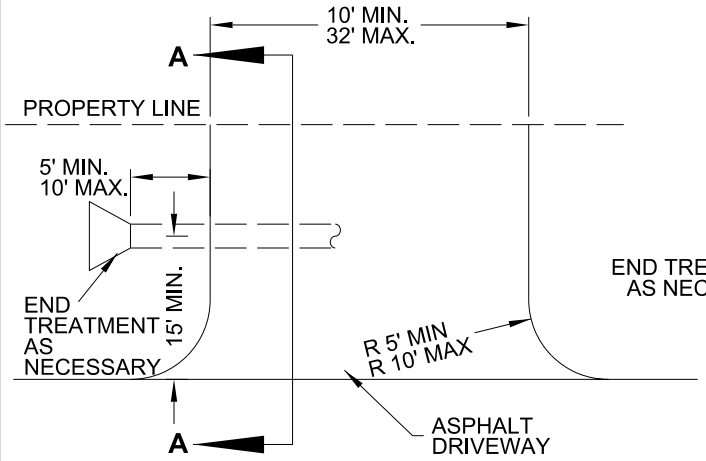
COMMERCIAL RURAL DRIVE



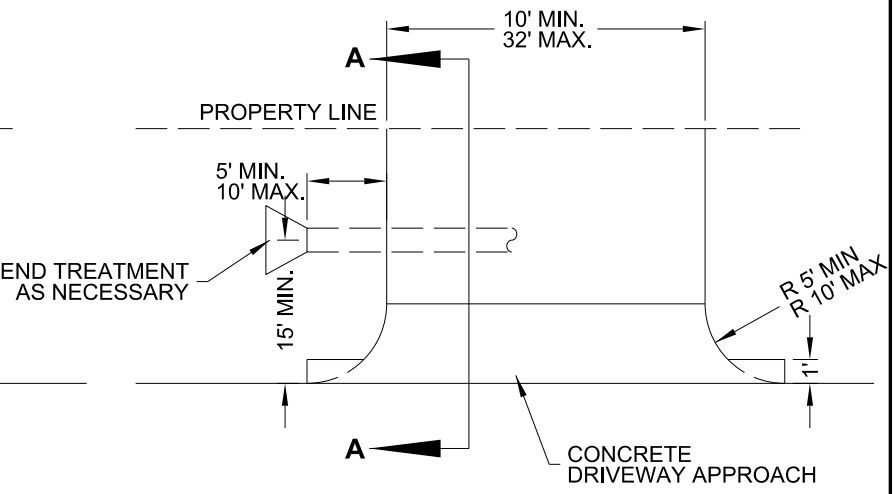
SECTION A-A
COMMERCIAL RURAL DRIVE



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

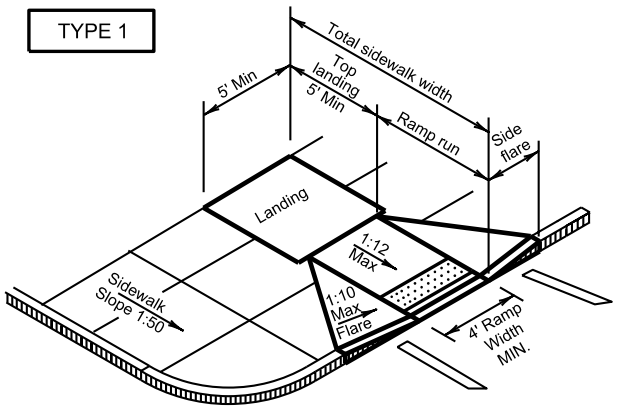
RURAL COMMERCIAL & RESIDENTIAL DRIVEWAY

STANDARD DETAILS

DATE: JULY 18, 2011

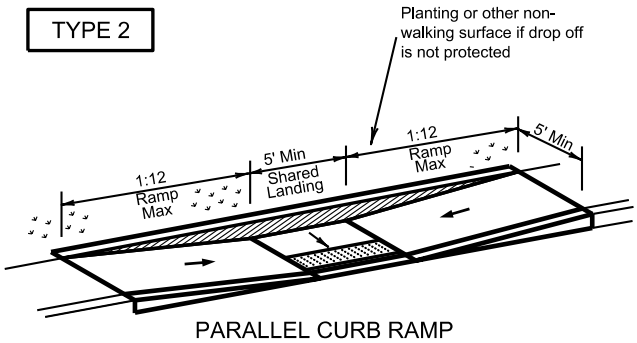
STANDARD NO. 3714

TYPE 1



PERPENDICULAR CURB RAMP

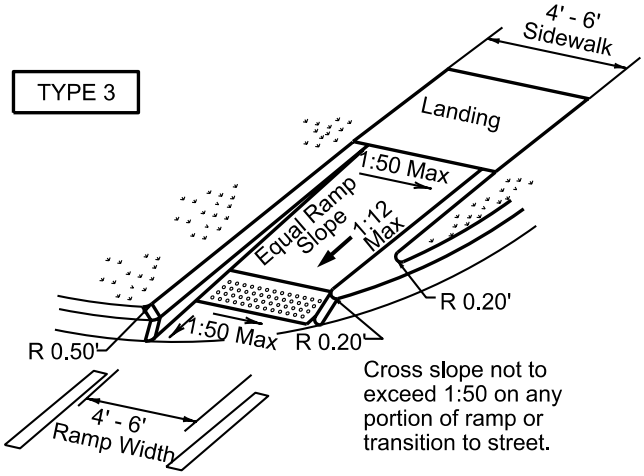
TYPE 2



PARALLEL CURB RAMP

(Use only where water will not pond in the landing.)

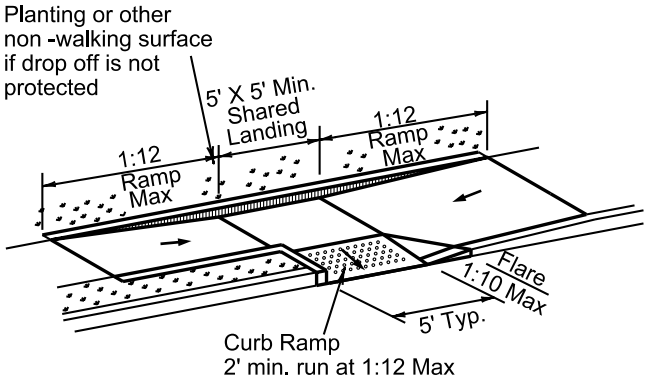
TYPE 3



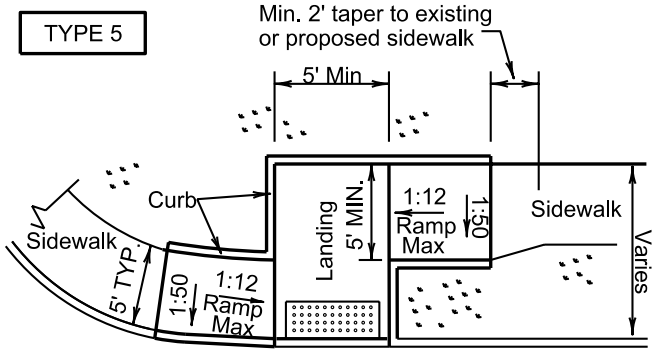
DIRECTIONAL RAMP WITHIN RADIUS

(Sidewalk set back from curb)

TYPE 4

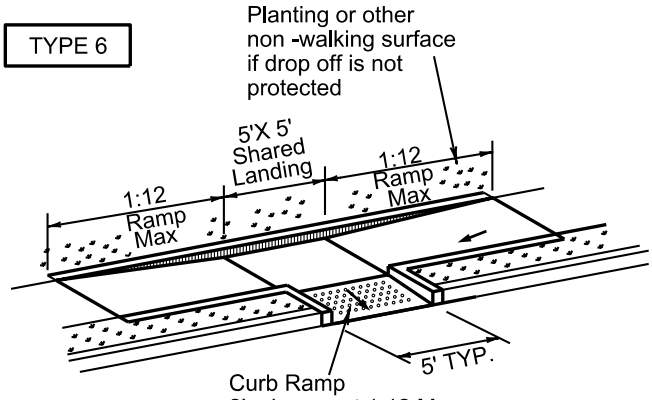


TYPE 5



OFFSET PARALLEL CURB RAMP

TYPE 6



SLOPE CONVERSION
1:50 = 2%
1:20 = 5%
1:12 = 8.33%
1:10 = 10%
1:6.67 = 15%

NOTES:

See Accessible General Notes Sheet more information.

Denotes planting or non -walking surface.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

ACCESSIBLE RAMP DETAILS

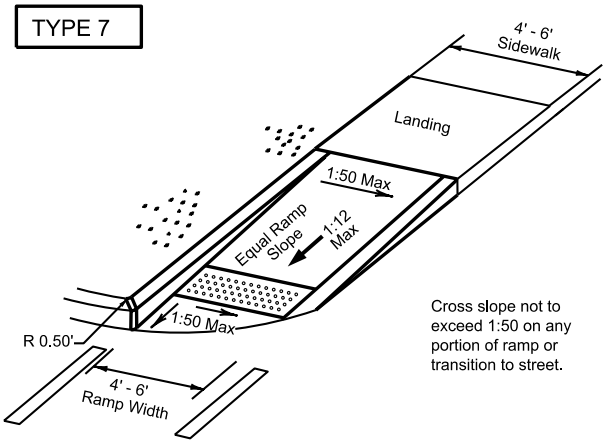
STANDARD DETAILS

DATE: AUGUST 2010

STANDARD NO. 3715 A

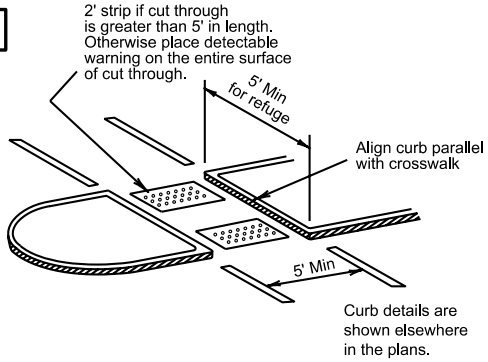
DRAFT STANDARD

TYPE 7



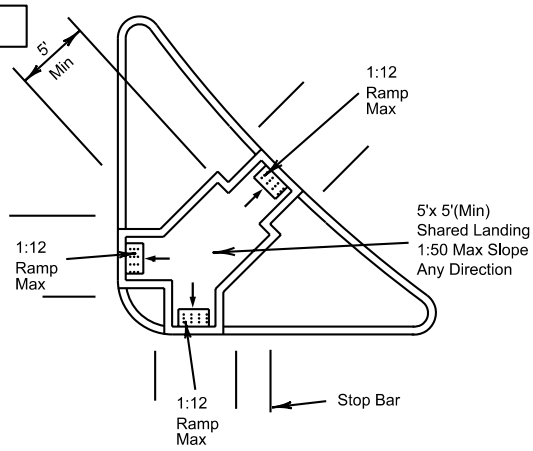
DIRECTIONAL RAMP WITHIN RADIUS
(Sidewalk adjacent to curb)

TYPE 8

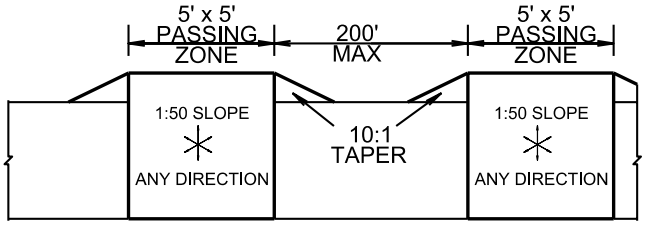


CURB RAMPS AT MEDIAN ISLANDS

TYPE 9



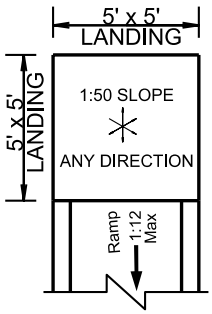
COMBINATION ISLAND RAMPS
USE WITH DIAGONAL COMBINATION CURB RAMPS



NOTE:

IF SIDEWALK IS LESS THAN 5' WIDE,
A 5' x 5' PASSING ZONE WITH SLOPES
NO GREATER THAN 1:50 IN ANY DIRECTION
SHALL BE PROVIDED AT NO GREATER
THAN A 200' SPACING. THE PASSING
ZONE MAY BE INCLUDED IN A DRIVEWAY
AS LONG AS THE SIZE AND GRADE
REQUIREMENTS ARE MET.

PEDESTRIAN PASSING ZONE



ACCESSIBLE RAMP LANDING

SLOPE CONVERSION
1:50 = 2%
1:20 = 5%
1:12 = 8.33%
1:10 = 10%
1:6.67 = 15%

NOTES:
See Accessible General Notes Sheet more information.
Denotes planting or non -walking surface.

REVISION	BY	DATE

City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

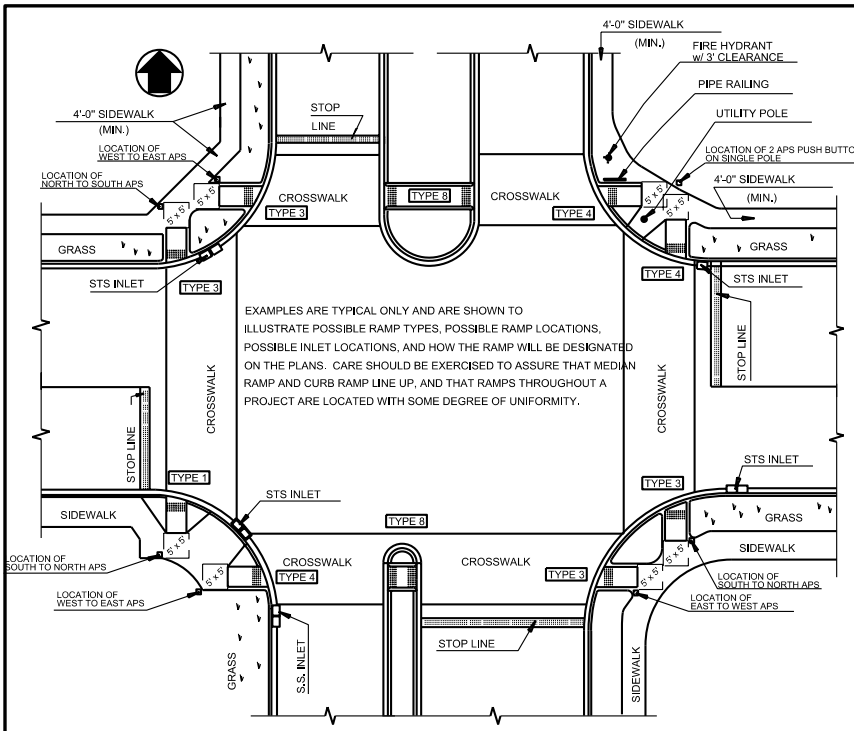
ACCESSIBLE RAMP DETAILS

STANDARD DETAILS

DATE: AUGUST 2010

STANDARD NO. 3715 B

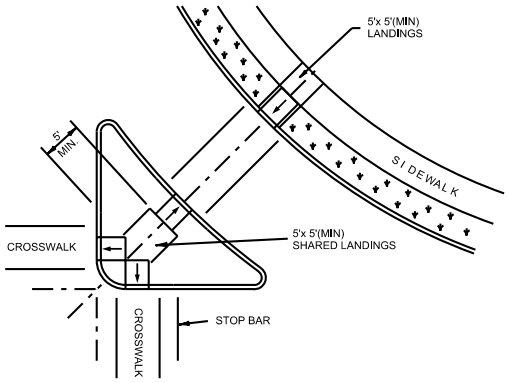
DRAFT STANDARD



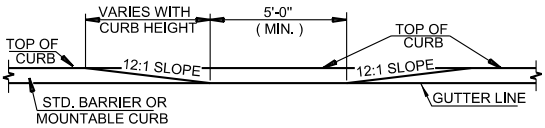
TYPICAL CROSSING LAYOUTS

General Notes

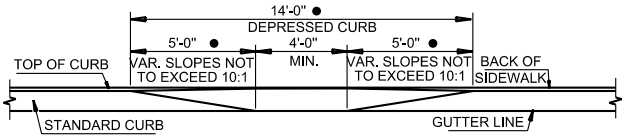
1. Street grades and cross slopes shall be as shown elsewhere in the plans.
2. Ramps are shown here without detectable warnings for simplicity. Detectable warnings are required at the locations shown on the Accessible Standard (Sheets 1 - 3 of 3) and in accordance with the details shown below.
3. Small channelization islands, which can not provide a minimum 5' x 5' landing at the top of ramps, shall be cut through level with the surface of the street.



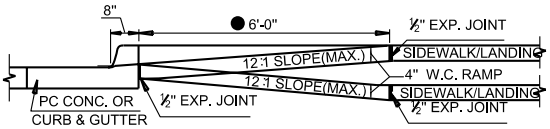
AT INTERSECTION
W/ FREE RIGHT TURN & ISLAND



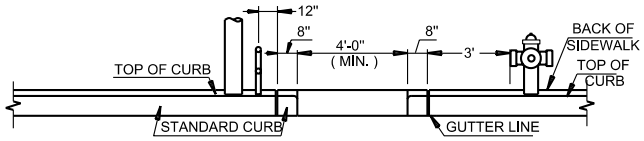
ELEVATION OF PARALLEL RAMP



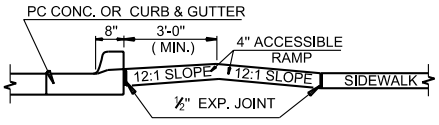
ELEVATION OF RAMP WITH FLARES



ACCESSIBLE RAMP PROFILES



ELEVATION OF RAMP WITH RETURNED CURBS



ACCESSIBLE RAMP PROFILES

1. RAMP DIMENSIONS SHOWN ARE BASED ON THE A CURB HEIGHT OF SIX INCHES. THE DIMENSIONS SHOULD BE ADJUSTED FOR OTHER CURB HEIGHTS. THE MAXIMUM PERMISSIBLE SLOPES OF THE ACCESSIBLE RAMPS IS 1:12 (8.33%) RAMP SLOPE MAY BE 1:10 (MAX) ALONG FACE OF TAPERED CURB.
2. DRAINAGE STRUCTURES SHALL NOT BE PLACED IN LINE WITH THE RAMPS
3. THE NORMAL GUTTER LINE PROFILE SHALL BE MAINTAINED THOUGH THE AREA OF THE RAMP WITH A 1:5 SLOPE (MAX), SEE NOTE 9.
4. ACCESSIBLE RAMPS SHOULD BE LOCATED SO THAT THE RAMP WILL BE ON THE TRAFFIC APPROACH SIDE OF ANY OBSTACLE.
5. ACCESSIBLE 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.
6. PIPE RAILING CONSTRUCTION DETAIL, WHEN REQUIRED AT ACCESSIBLE RAMPS, WILL BE SHOWN ON THE PLANS.
7. ALL FEATURES OF CONSTRUCTION INCLUDING, BUT NOT LIMITED TO, SIDEWALKS, CURB RAMPS AND CROSSWALK MARKINGS 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 FEATURES. THE CONTRACTOR SHALL NOT PROCEED WITH ANY ASPECT OF THE WORK WHICH IS NOT IN FULL COMPLIANCE WITH THE ADA WITHOUT THE PRIOR WRITTEN APPROVAL FROM THE ENGINEER, ANY WORK WHICH IS NOT PERFORMED WITHIN THE GUIDELINES OF THE ADA, FOR WHICH THE CONTRACTOR OES NOT HAVE WRITTEN APPROVAL, SHALL BE CORRECTED AT THE CONTRACTORS EXPENSE.
8. ALL LANDINGS SHALL HAVE A MAXIMUM SLOPE OF 2% IN ANY DIRECTION.
9. LOCATION OF CROSSWALKS AND STOP LINES SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF THE MUTCD.
10. TACTILE WARNING DEVICES ARE REQUIRED AT ALL STREET CROSSINGS, ALLEYS, AND COMMERCIAL DRIVES.
11. CROSS SLOPE ON ACCESSIBLE ROUTE SHALL NOTE EXCEED 50:1 (2%).
12. HAND RAIL OR GUARD RAIL SHALL BE REQUIRED WHEN THE SLOPE ADJACENT TO ACCESSIBLE ROUTE EXCEEDS 1:3 (33.3%) TYPE SHALL BE APPROVED Y THE CITY ENGINEER.
13. NO CURB RAMP SHALL EXCEED A DISTANCE OF 15 FEET AT A 1:12 (8.33%) RUNNING SLOPE.
14. WHEN ACCESSIBLE PEDESTRIAN SIGNALS (APS) ARE TO BE USED THEY SHALL MEET THE CURRENT MUTCD AND ADAAG SPECIFICATIONS.
15. WHEN APS ARE USED THEY SHALL BE ACCOMPANIED BY CITY OF STILLWATER STANDARD DETAILS "ACCESSIBLE PEDESTRIAN SIGNAL"

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

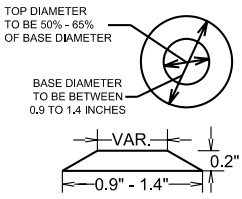
ACCESSIBLE RAMP DETAILS

STANDARD DETAILS

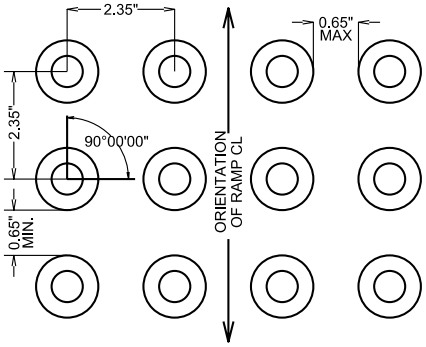
DATE: AUGUST 2010

STANDARD NO. 3715 C

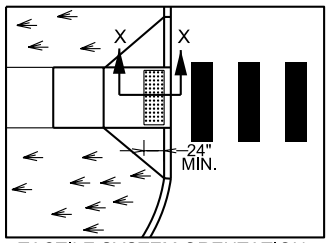
DRAFT STANDARD



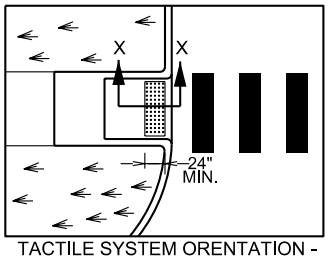
TACTILE WARNINGS
TRUNCATED DOMES



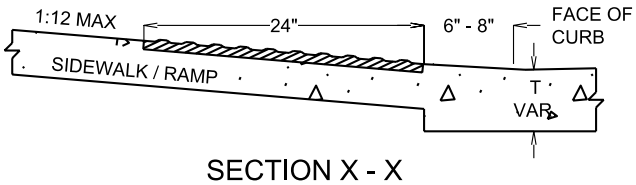
90º GRID DOME PATTERN
(SEE GENERAL NOTE NUMBER 9 & 10)



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 (CAST IN TACT OR CAST IRON). UNLESS OTHERWISE APPROVED BY THE CITY ENGINEER

16. CAST IRON TACTILE WARNING SURFACES SHALL BE DIPPED WITH A BLACK ASPHALT COATING.

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.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

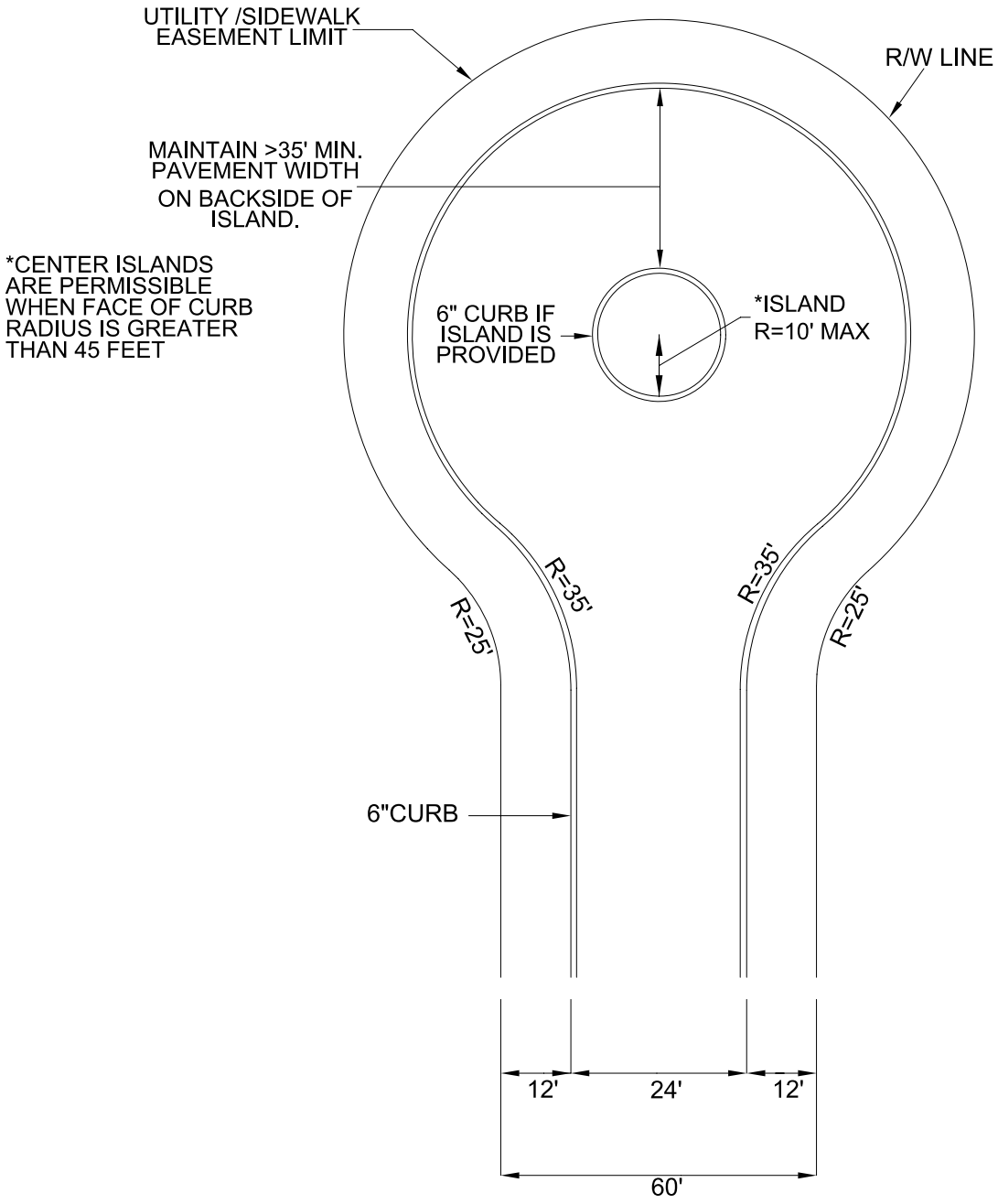
TACTILE WARNING DEVICE DETAILS

STANDARD DETAILS

DATE: AUGUST 2010

STANDARD NO. 3716

DRAFT STANDARD



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**

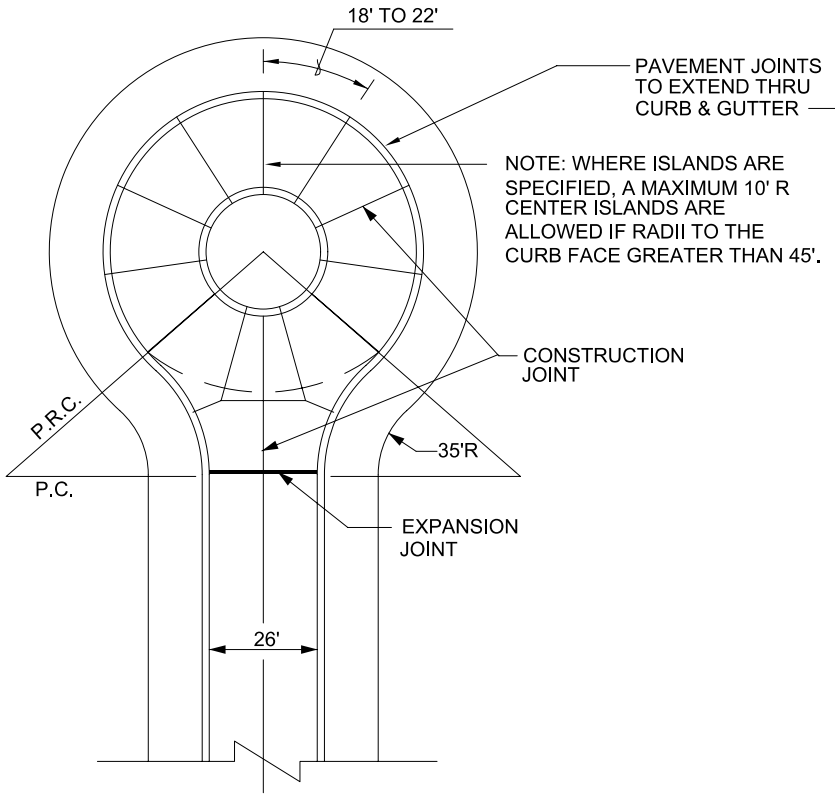
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CUL-DE-SAC (ASPHALT PAVING)

STANDARD DETAILS

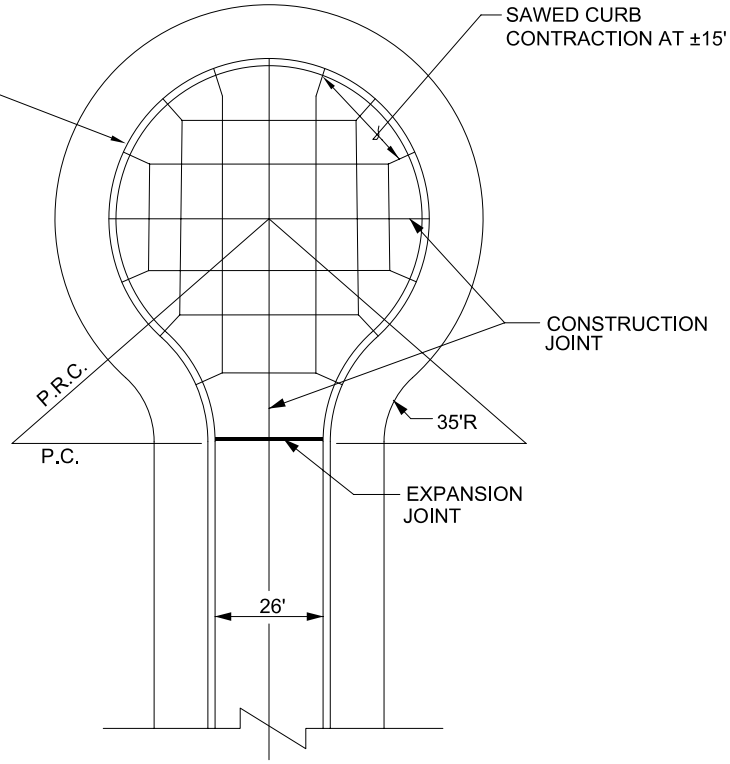
DATE: JULY 28, 2012

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

REVISION	BY	DATE
R1	MAS	6/28/12

City of stillwater

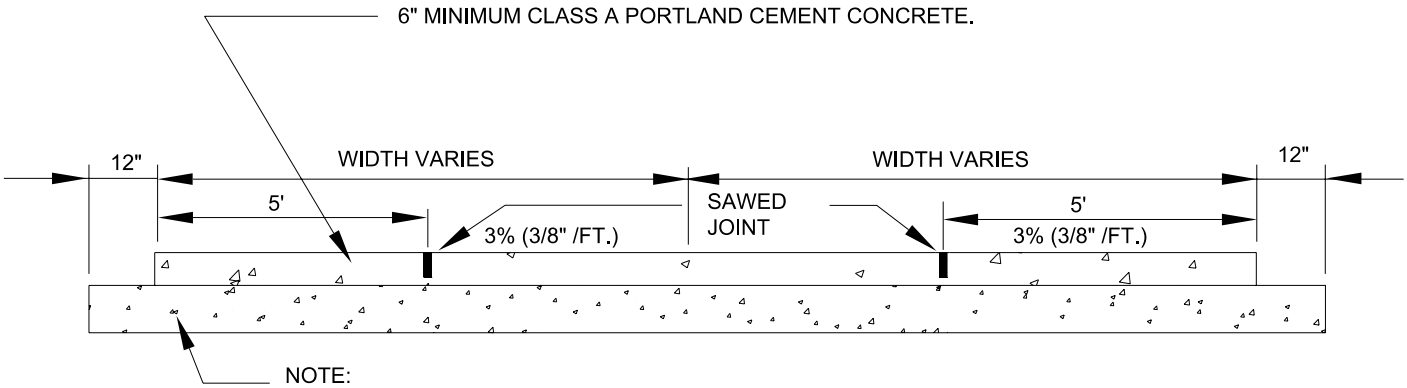
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CONCRETE PAVEMENT JOINT PLAN (CUL-DE-SAC)

STANDARD DETAILS

DATE: JUNE 28, 2012

STANDARD NO. 3718



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

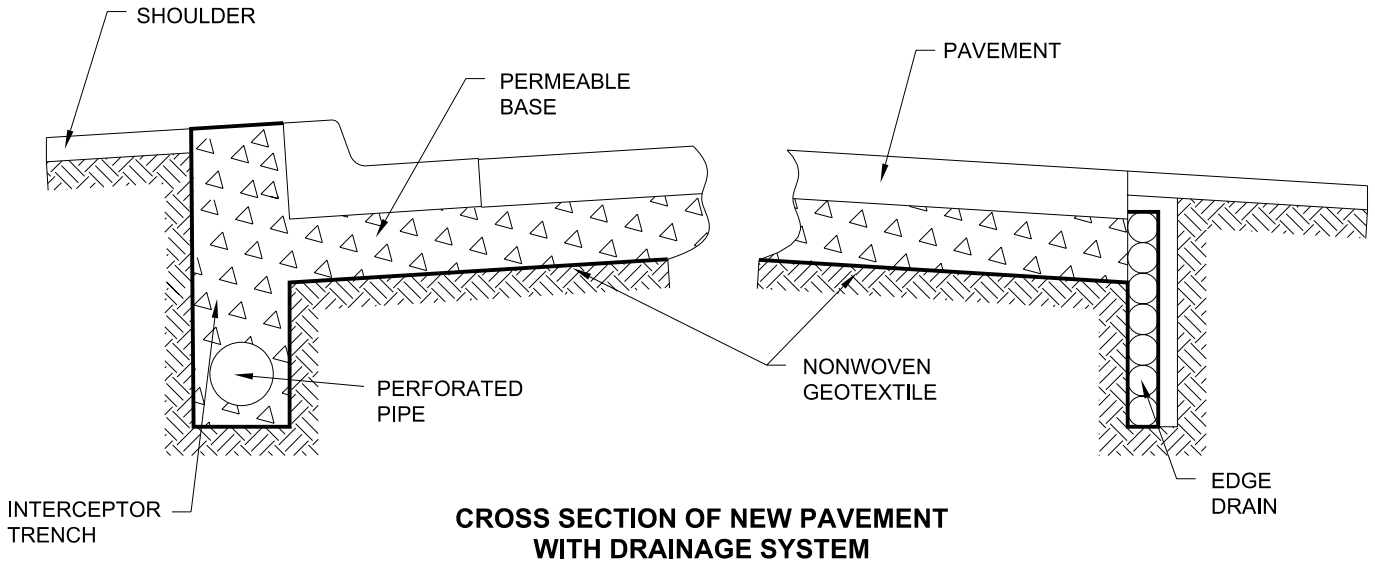
City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

ALLEY PAVING

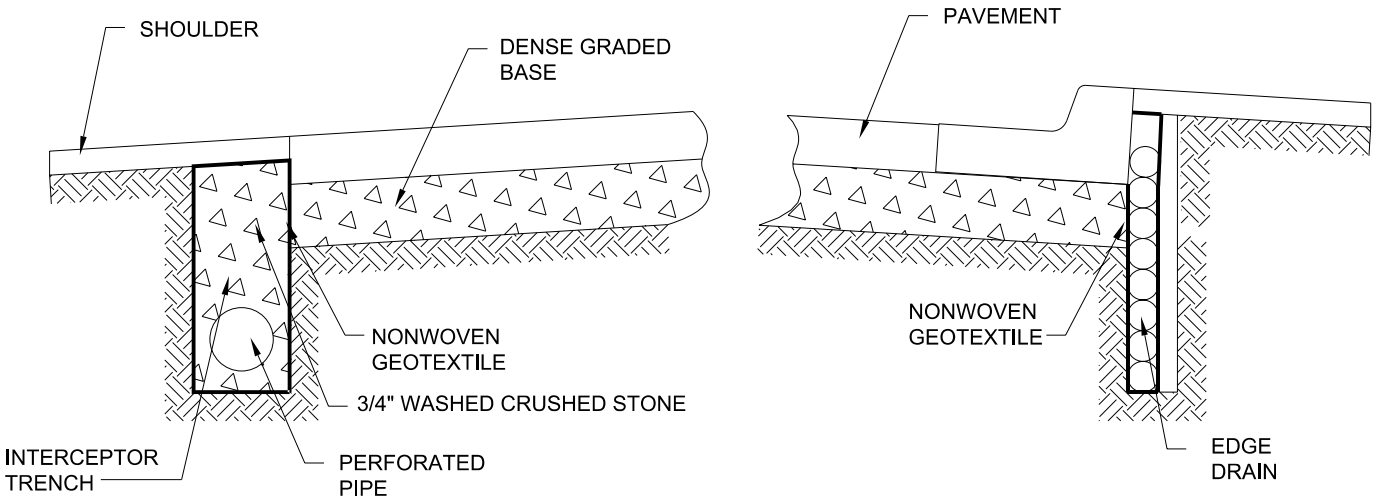
STANDARD DETAILS

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 1S 4" 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 CONSIDER DISCHARGE LOCATIONS IMPACTS SURROUNDING AREAS.

REVISION	BY	DATE

City of **stillwater**

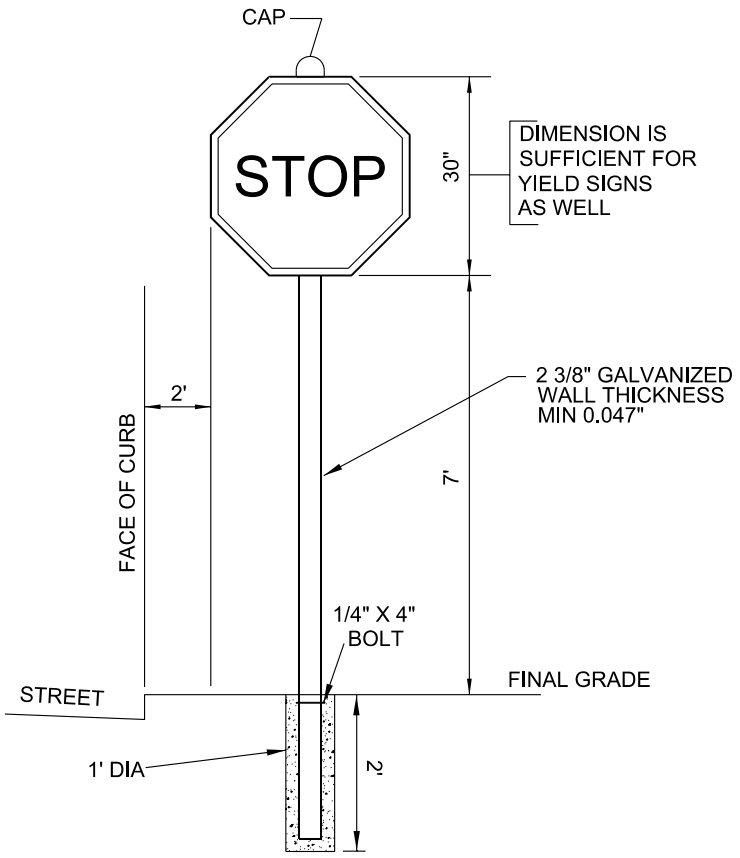
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

PAVING BASE DRAINAGE

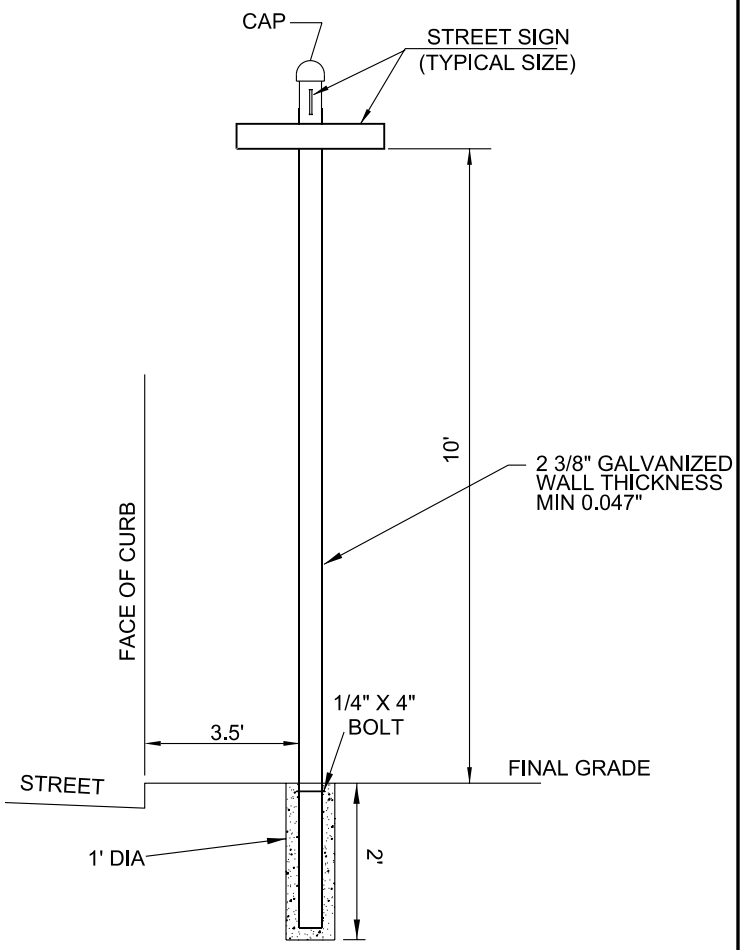
STANDARD DETAILS

DATE: JULY 18, 2011

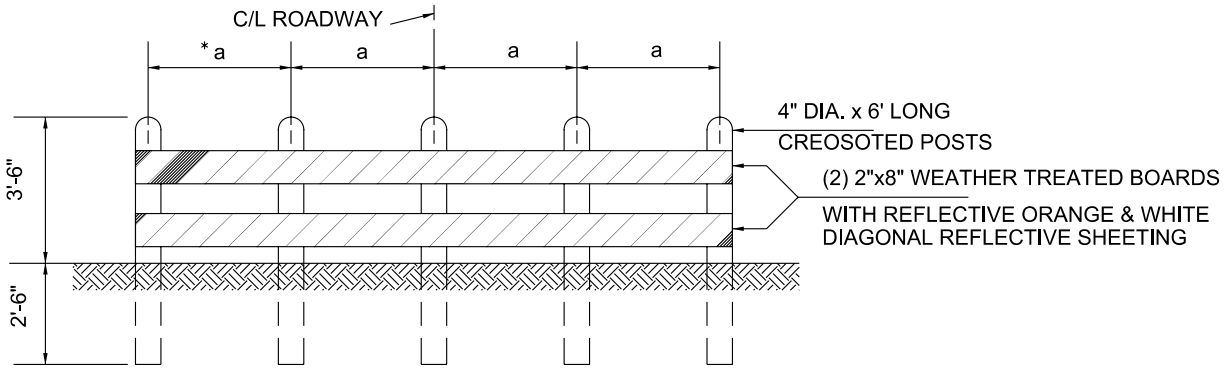
STANDARD NO. 3721



STOP SIGN DETAIL
CONCRETE BASE



STREET SIGN DETAIL
CONCRETE BASE



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

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

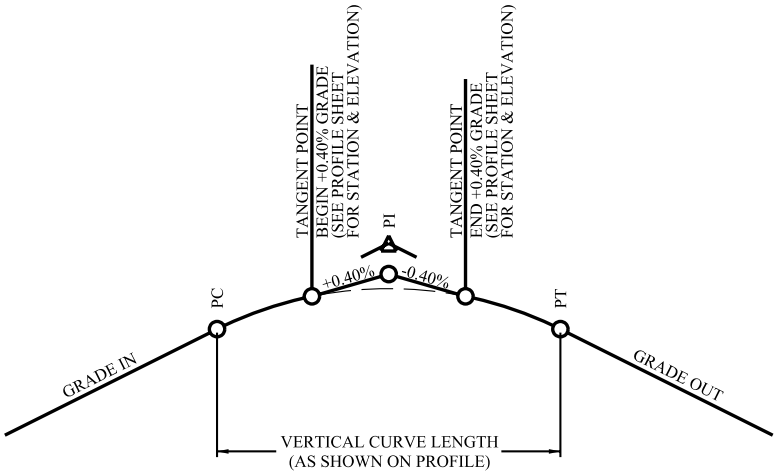
STOP SIGN & BARRICADE

STANDARD DETAILS

DATE: SEPTEMBER 2010

STANDARD NO. 3722

DRAFT STANDARD DETAIL

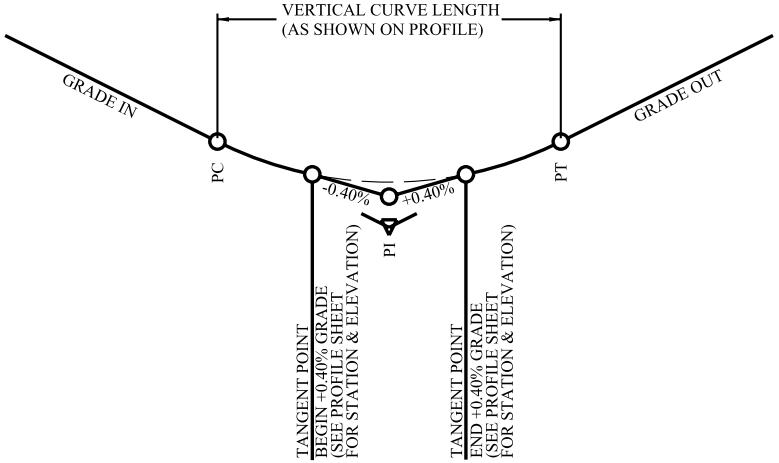


CREST VERTICAL CURVE

N.T.S.

NOTE:

MINIMUM SLOPE FOR GRADE IN/GRADE OUT IS 0.5%



SAG VERTICAL CURVE

N.T.S.

REVISION	BY	DATE

City of stillwater

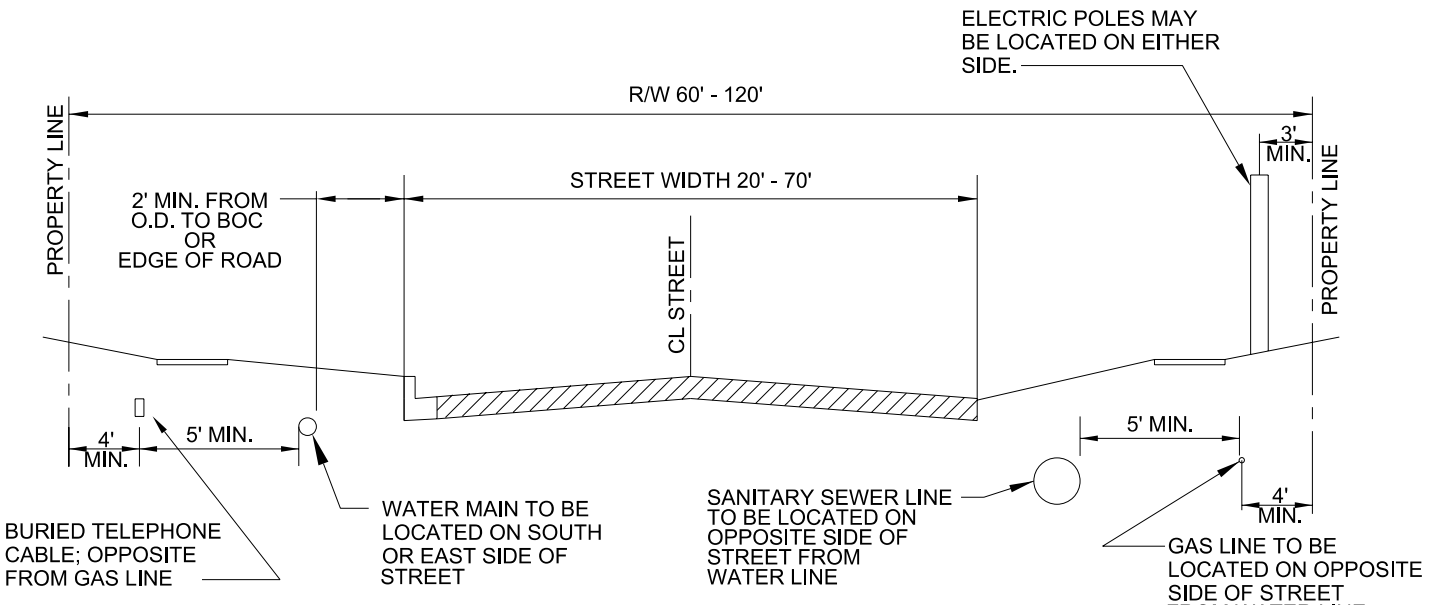
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

MINIMUM LONGITUDINAL SCOPE REQUIREMENTS

STANDARD DETAILS

DATE: AUGUST 2010

STANDARD NO. 3723



ALL RIGHT-OF-WAY WIDTHS

NOTES:
1. THESE ARE TYPICAL LOCATIONS PLANED 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

REVISION	BY	DATE

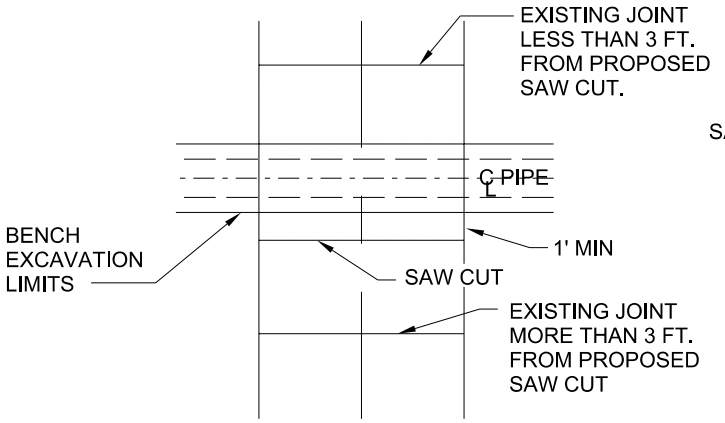
City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

UTILITY LOCATIONS AT STREETS

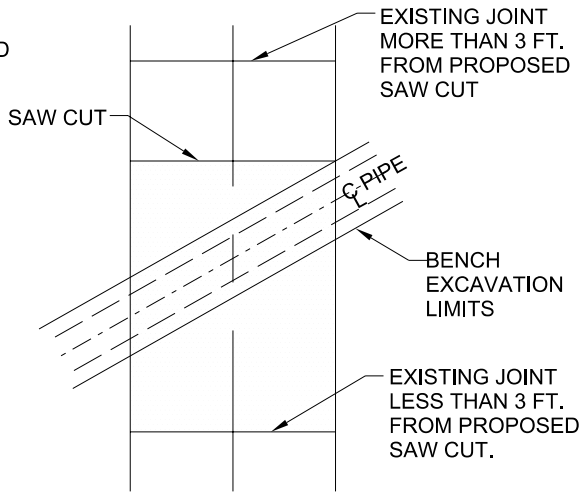
STANDARD DETAILS

DATE: JULY 18, 2011

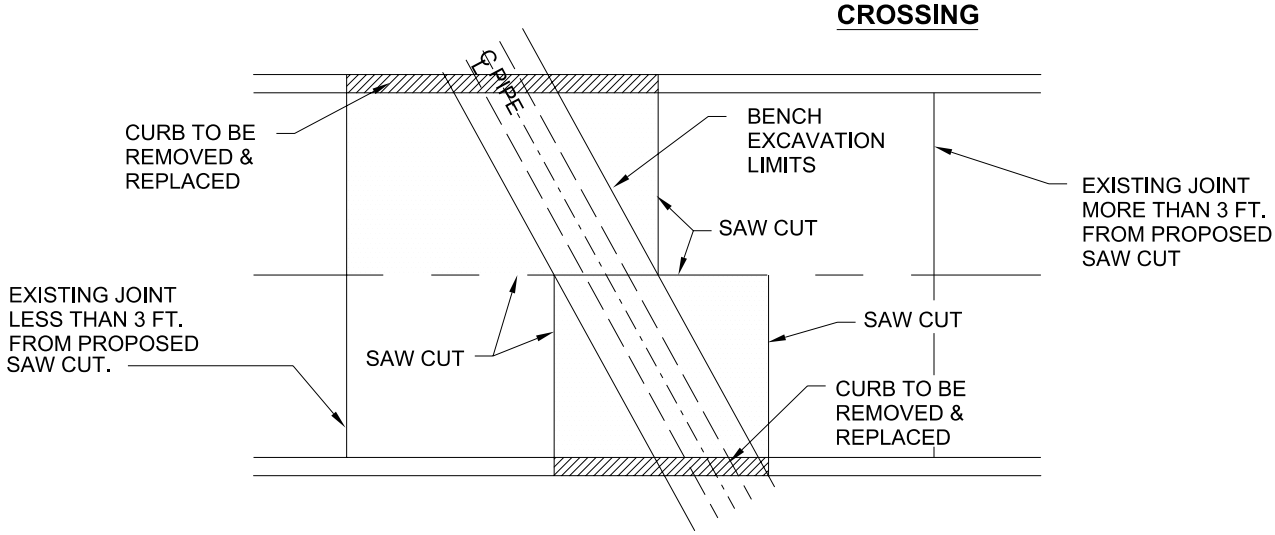
STANDARD NO. 3725



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.

REVISION	BY	DATE

City of **stillwater**

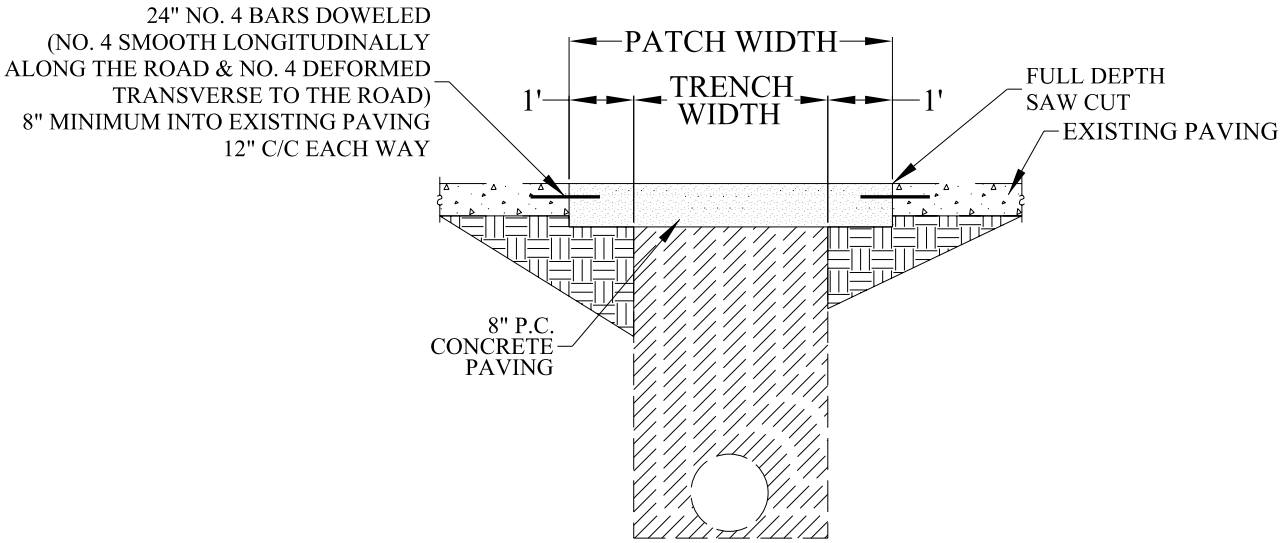
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

PAVEMENT CUTS FOR UTILITIES

STANDARD DETAILS

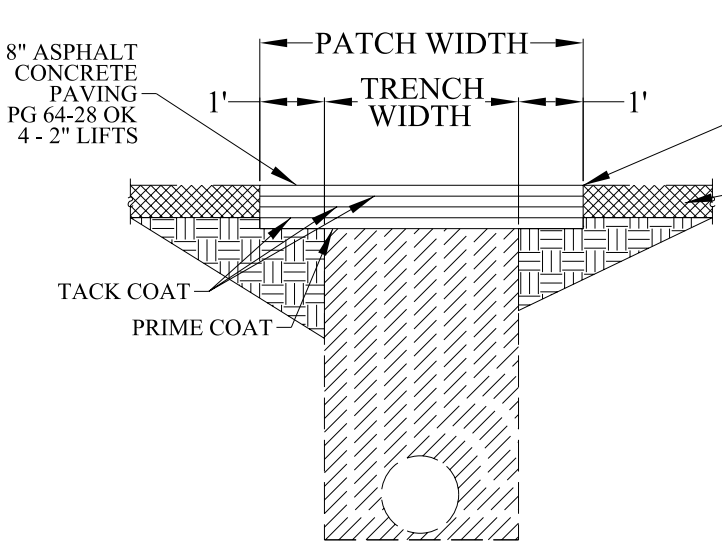
DATE: May 2011

STANDARD NO. 3727



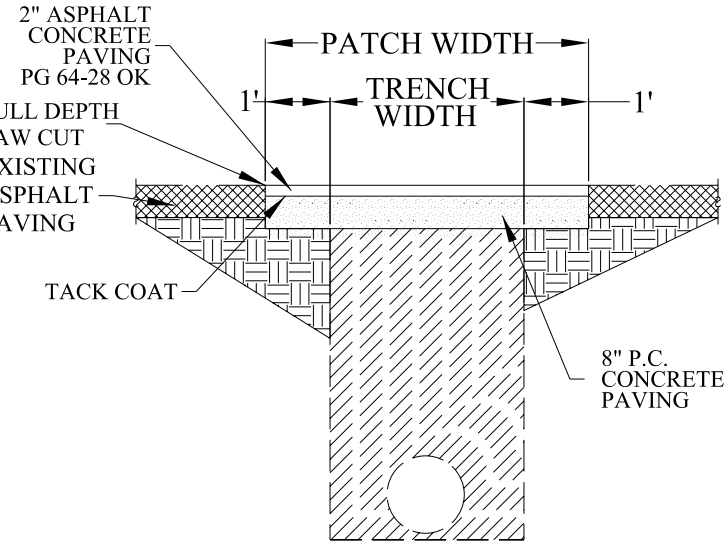
CONCRETE PAVEMENT REPAIR DETAIL

NOT TO SCALE



ASPHALT PAVEMENT REPAIR DETAIL A

NOT TO SCALE



ASPHALT PAVEMENT REPAIR DETAIL B

NOT TO SCALE

NOTES:

1. CONSTRUCTION JOINTS TO MATCH EXISTING WHERE APPLICABLE. SEE STANDARD DETAIL 3727
2. NEW PCC PAVING TO BE 2" THICKER THAN EXISTING PAVEMENT 8" MINIMUM.
3. EXISTING CONCRETE ROADS WITH ASPHALT CONCRETE OVERLAY SHALL HAVE CONCRETE PAVING PATCH DOWELED INTO EXISTING PAVING PER CONCRETE PAVEMENT PATCH DETAIL.
4. THE CITY SHALL DECIDE WHICH TYPE OF PAVEMENT PATCH IS APPLICABLE.
5. BACKFILL MATERIAL AND PLACEMENT SHALL BE IN ACCORDANCE WITH CITY OF STILLWATER STANDARD SPECIFICATIONS AND DETAILS.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

ASPHALT & CONCRETE PAVEMENT PATCH

STANDARD DETAILS

DATE: JULY 18, 2011

STANDARD NO. 3728

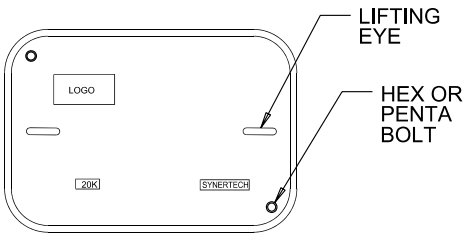
DRAFT STANDARD

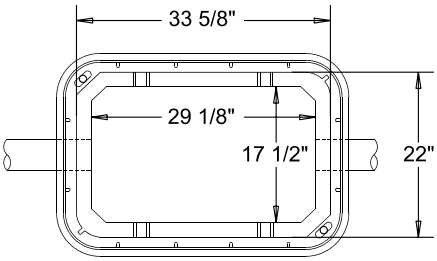
JUNCTION BOX FEATURES

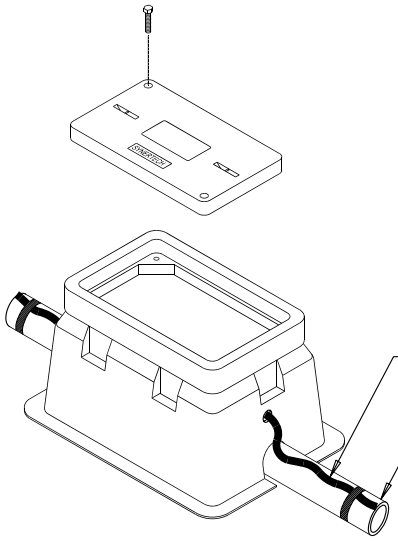
- SHEET MOULDING COMPOUND (SMC) BODY.
- DUOMOLDING CONSTRUCTION.
- HIGH DENSITY POLYMER CONCRETE (HDPC) RING.

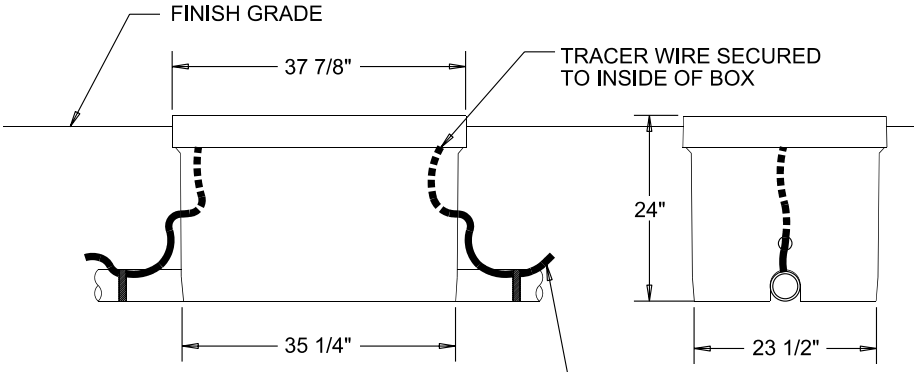
COVER FEATURES

- SHEET MOULDING COMPOUND (SMC) LINING.
- DUOMOLDING CONSTRUCTION.
- HIGH DENSITY POLYMER CONCRETE (HDPC).

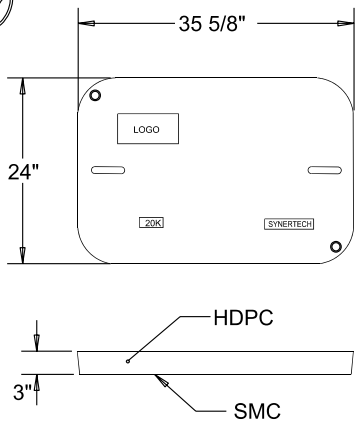








JUNCTION BOX 24 X 36 X 24
CATALOG NO.S2436B24FA



COVER 24 X 36
CATALOG NO.S2436HCB0A01

REVISION	BY	DATE

City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

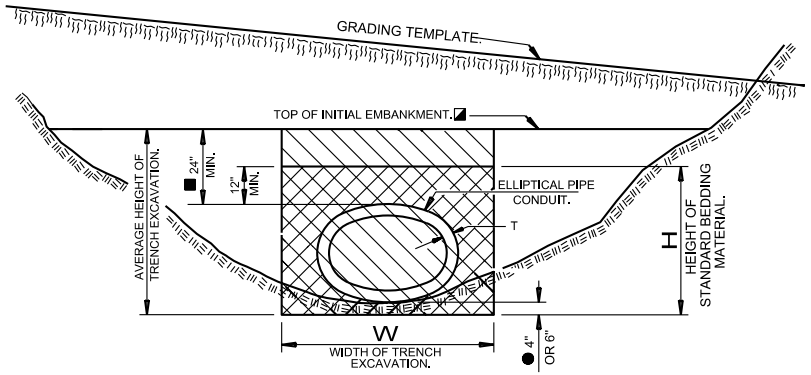
PULL BOX 24 X 36 X 24

STANDARD DETAILS

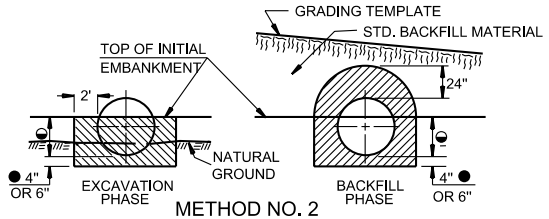
DATE: OCTOBER 2010

STANDARD NO. 3730

DRAFT STANDARD DETAIL

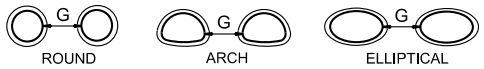


METHOD NO. 1
TRENCH EXCAVATION IN EMBANKMENT SECTIONS



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"

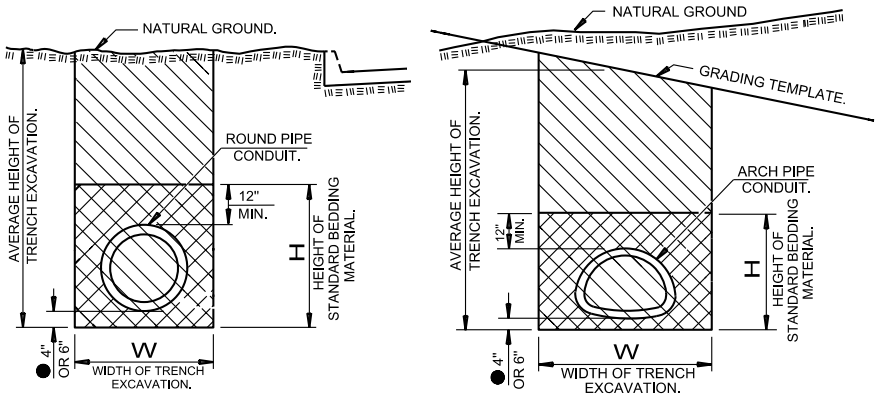
	CONDUIT SHAPE			DIST. G
	ROUND	ARCH	ELLIPTICAL	
FOR DIAM. OR SPAN	UP TO 24"	UP TO 36"	UP TO 36"	12"
	25" TO 72"			D/2"
		37" TO 108"	37" TO 108"	D/3"
	OVER 73"	OVER 108"	OVER 108"	36"



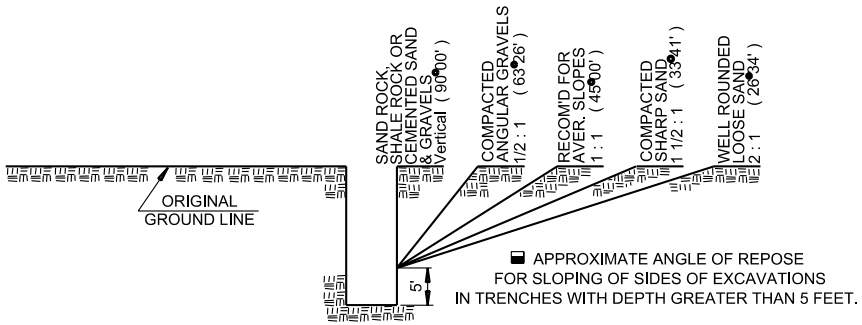
DOUBLE PIPE INSTALLATION

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 2009 ODOT STANDARD SPECIFICATIONS.
2. TRENCH EXCAVATION AND BEDDING MATERIAL WILL NOT BE REQUIRED FOR PIPE INSTALLATION OF SIDE DRAINS UNLESS OTHER WISED 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.

REVISION	BY	DATE

City of **stillwater**

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

TRENCH EXCAVATION AND EMBANKMENT

STANDARD DETAILS

DATE: OCTOBER 2010

STANDARD NO. 3802

DRAFT STANDARD DETAIL

DIRECTION OF STREET STATIONING

DESIGN

1

1A

1B

1C

1(2A)

1(A+B)

1(A+C)

1(2B)

1(B+C)

1(2C)

2

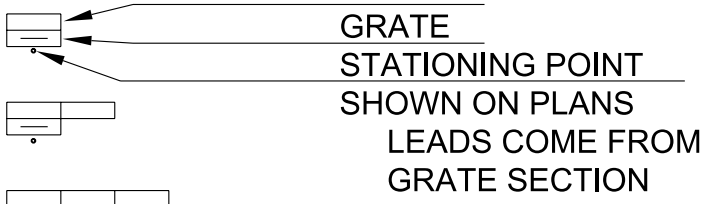
2(B)

2(D)

2(2B)

2(B+D)

2(2D)



NOTE:

EXPANSION JOINTS ARE REQUIRED BETWEEN SIDEWALK, CURB/GUTTER AND STORM INLET BOXES.

REVISION	BY	DATE

City of **stillwater**

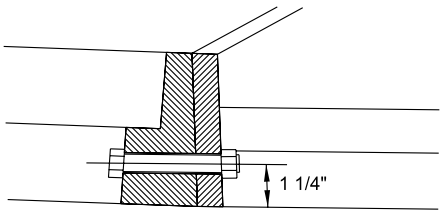
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CONFIGURATION OF CAST IRON CURB INLETS

STANDARD DETAILS

DATE: OCTOBER 2010

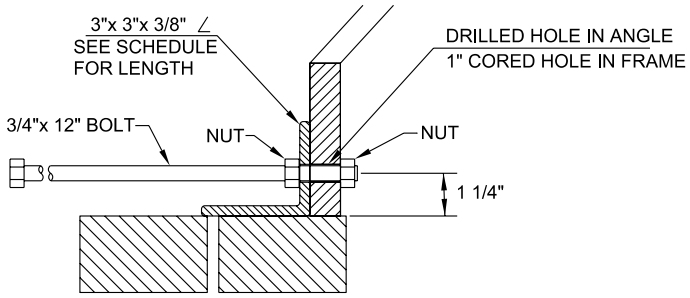
STANDARD NO. 3803



DETAIL OF CONNECTION

FRAME AND CAST IRON CURB

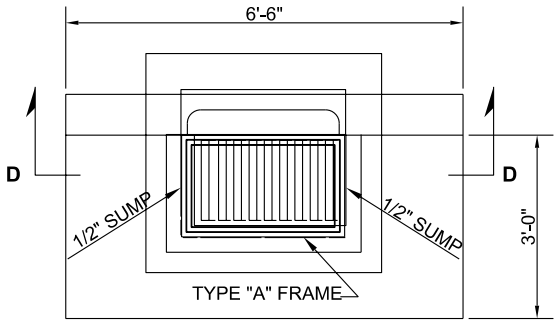
NOTE: FRAME TO BE BOLTED TO THE CURB WITH
3 EACH 3/4" x 4 1/2" MACHINE BOLTS



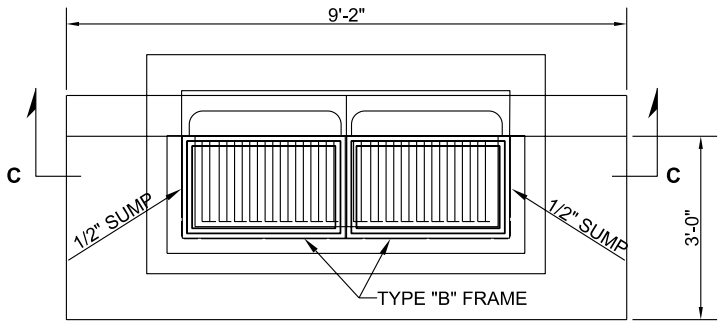
DETAIL OF CONNECTION

ANGLE IRON & CAST IRON CURB

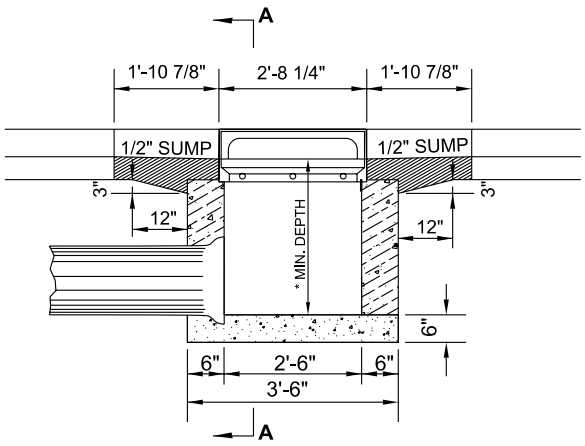
NOTE: ANGLE IRON TO BE BOLTED TO CURB
WITH 3 - 3/4"x 12" MACHINE BOLTS
IN EACH CURB SECTION



PLAN

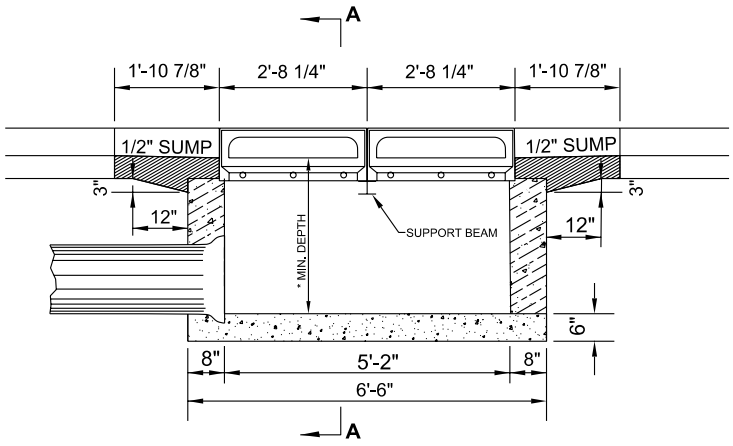


PLAN



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

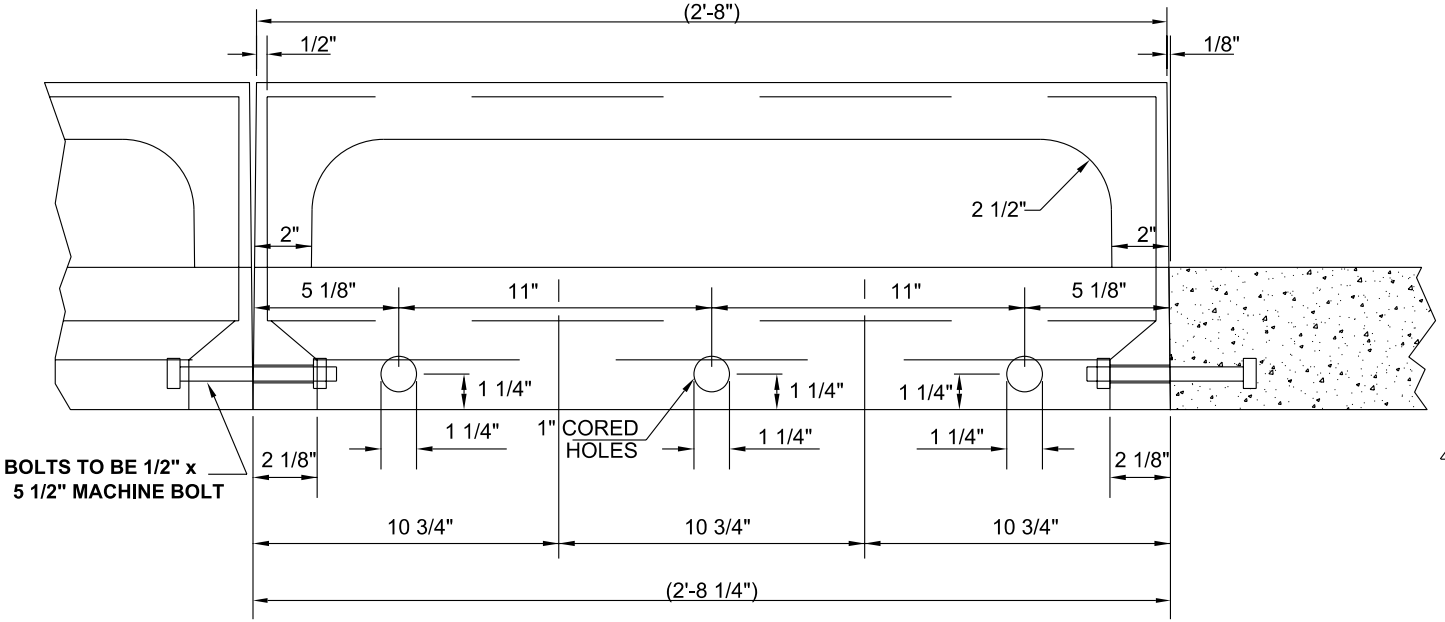
CURB INLET SHEET 1

STANDARD DETAILS

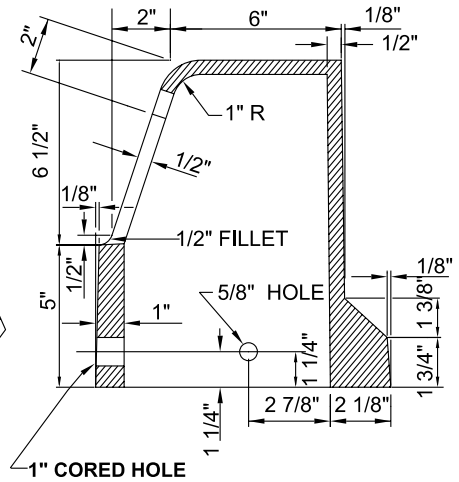
DATE: OCTOBER 2010

STANDARD NO. 3807

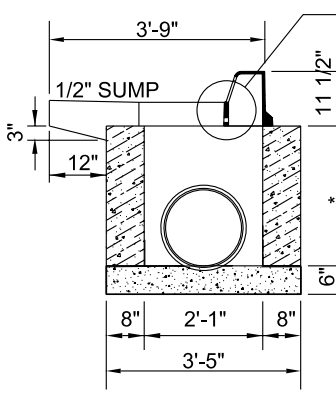
DRAFT STANDARD DETAIL



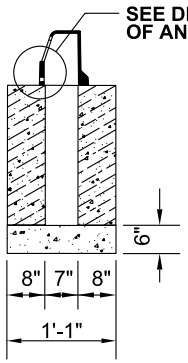
CAST IRON STORM SEWER CURB HOOD
NEENAH R-3076-6BOK
OR AN APPROVED EQUAL



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



SECTION A-A

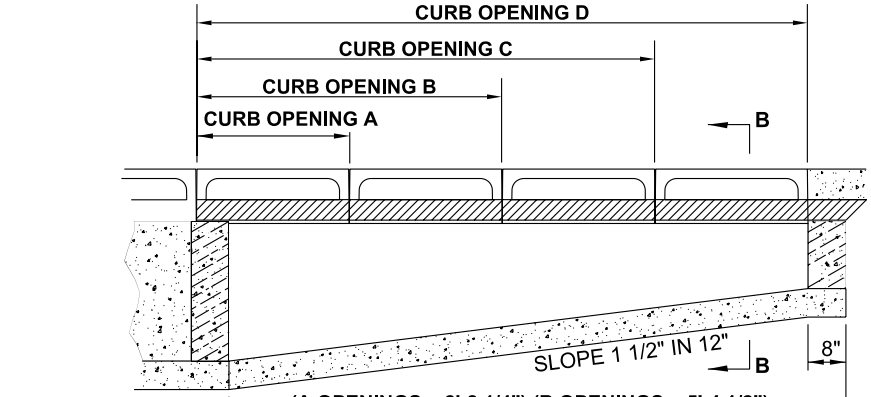


SECTION B-B

*** 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

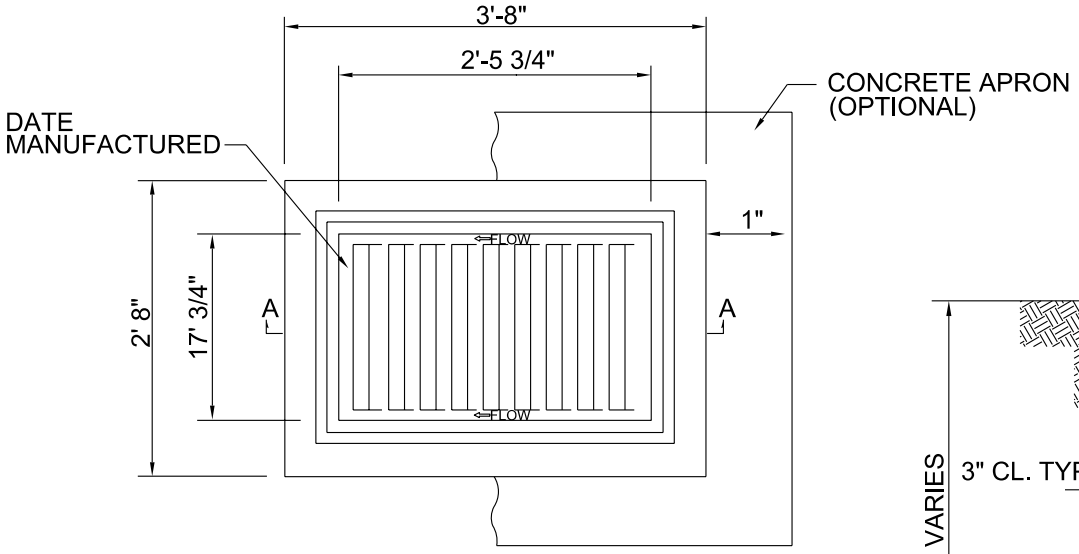
City of **stillwater**
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

CURB INLET SHEET II

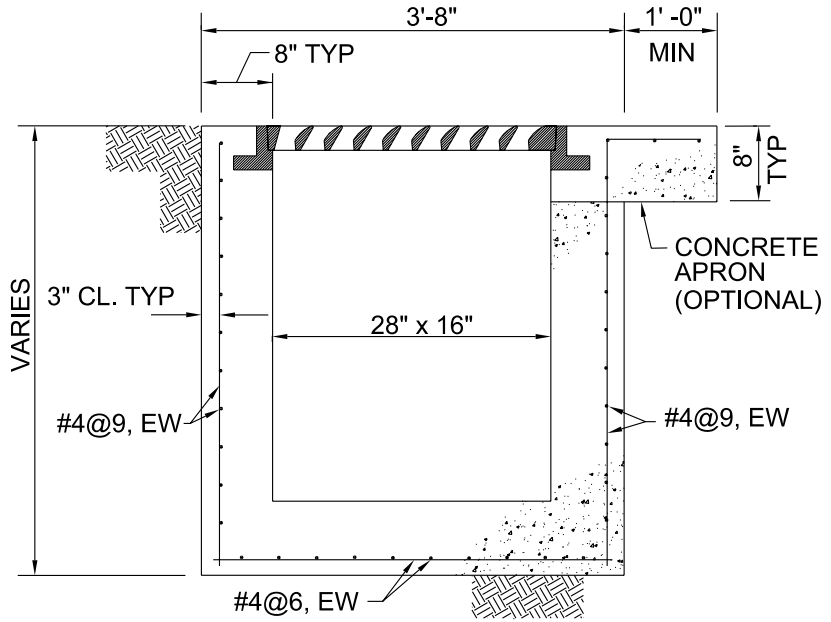
STANDARD DETAILS

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

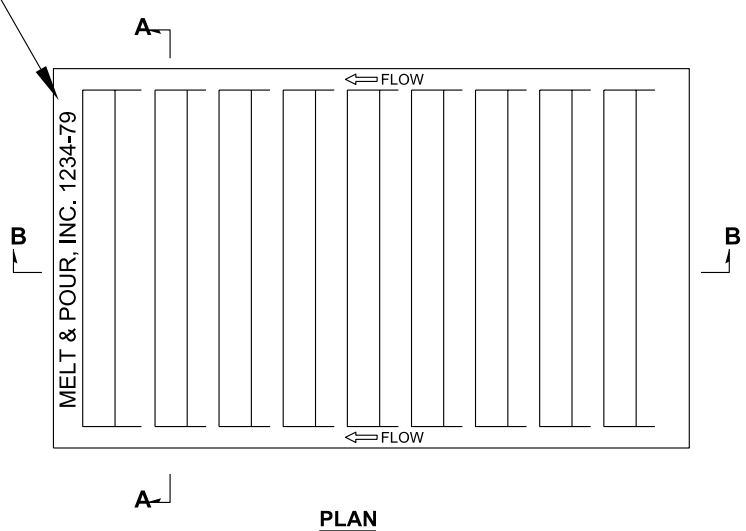
STANDARD DETAILS

DATE: October 2010

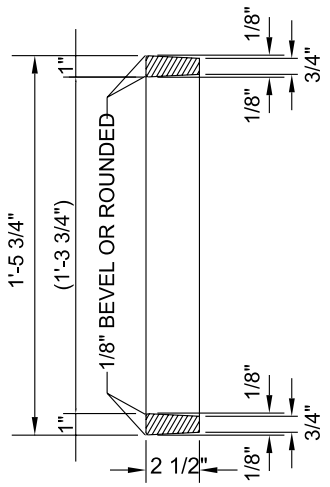
STANDARD NO. 3809

DRAFT STANDARD DETAIL

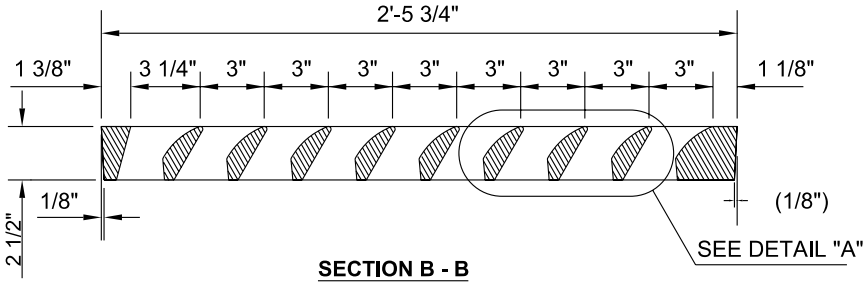
LETTERING TO IDENTIFY FOUNDRY OR DISTRIBUTOR. LETTERING TO BE NO HIGHER THAN 3/4". HEAT NUMBER OR OTHER IDENTIFICATION OF PRODUCT MAY BE INCLUDED.



PLAN



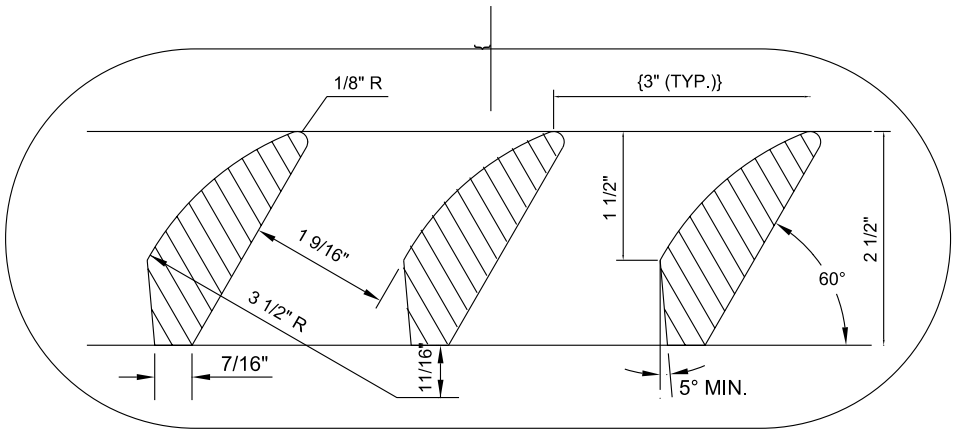
SECTION A - A



SECTION B - B

CAST GRATE

NEENAH R-3076 OR AN APPROVED EQUAL



DETAIL "A"

REVISION	BY	DATE

City of stillwater

TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

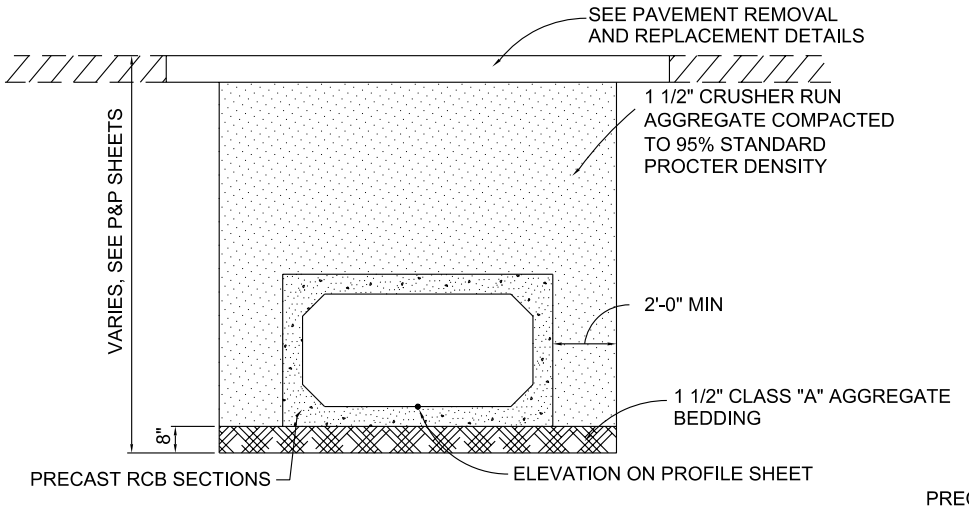
STORM SEWER BOX GRATE

STANDARD DETAILS

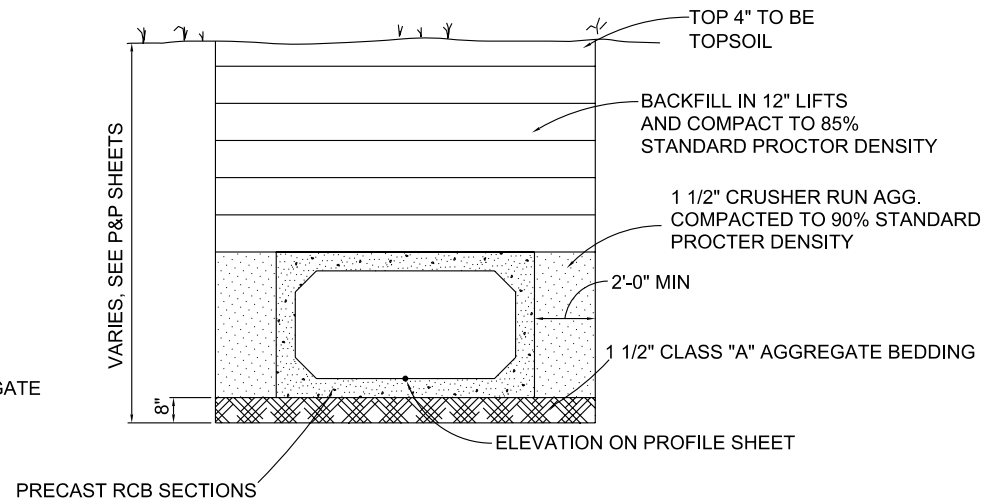
DATE: OCTOBER 2010

STANDARD NO. 3810

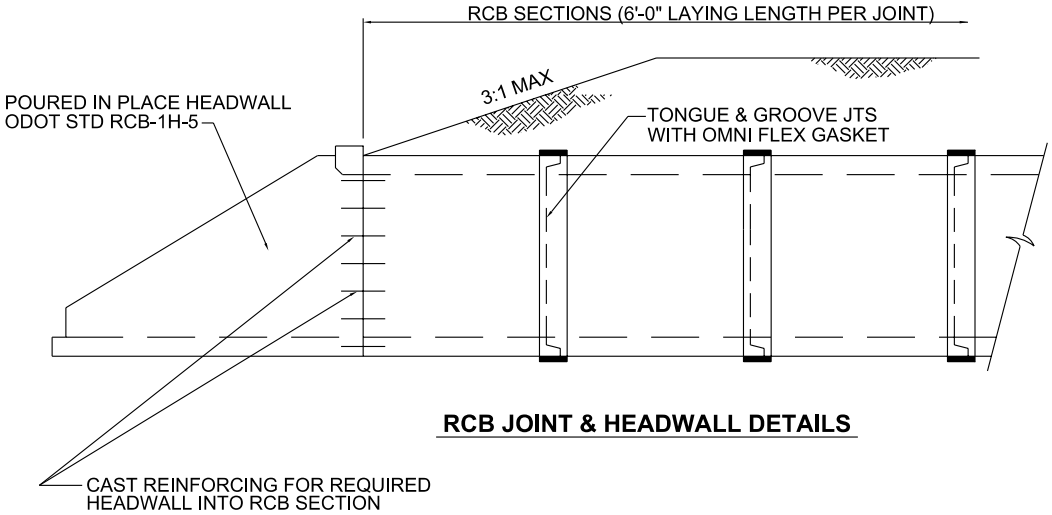
DRAFT STANDARD DETAIL



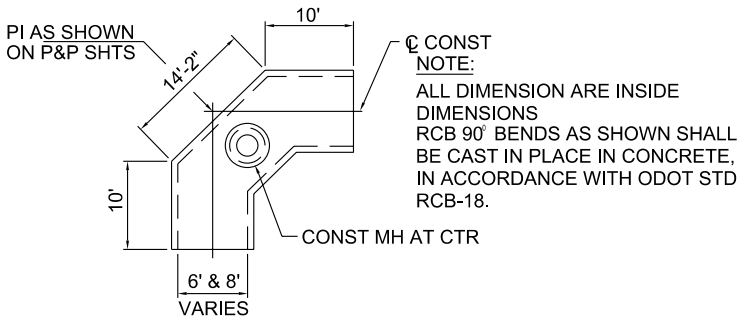
RCB DETAIL - PAVED AREAS



RCB DETAIL - OPEN AREAS



RCB JOINT & HEADWALL DETAILS



RCB 90° BEND DETAIL

REVISION	BY	DATE

City of **stillwater**

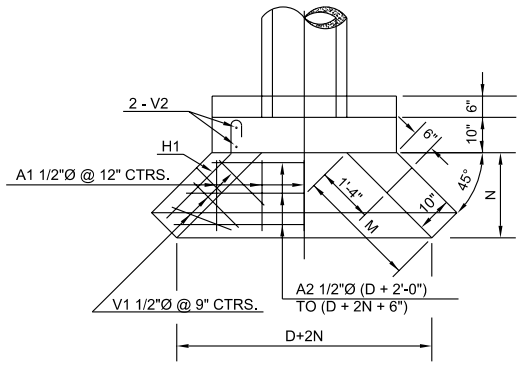
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

STORM SEWER BOX CULVERT

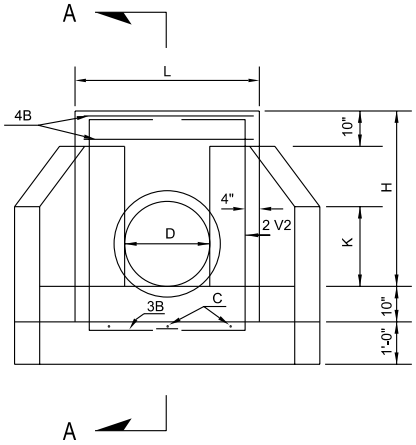
STANDARD DETAILS

DATE: OCTOBER 2010 | STANDARD NO. 3811

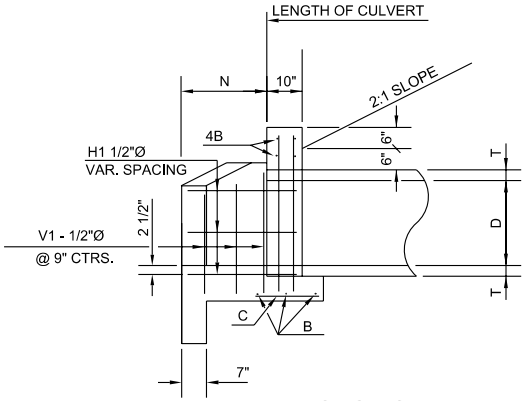
DRAFT STANDARD DETAIL



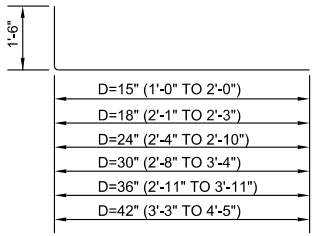
PLAN



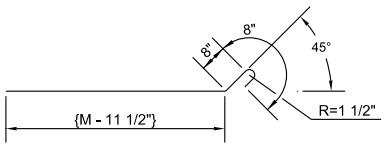
ELEVATION



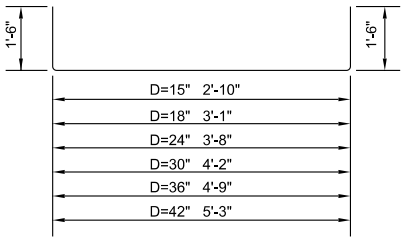
SECTION A-A



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"	REINF.
								NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	NO.	LGTH.	CONC., C.Y.	STEEL, LBS.
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

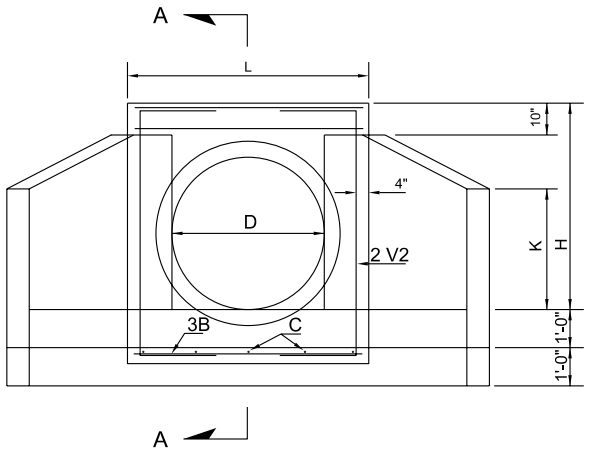
STORM SEWER HEADWALL SHEET 1

STANDARD DETAILS

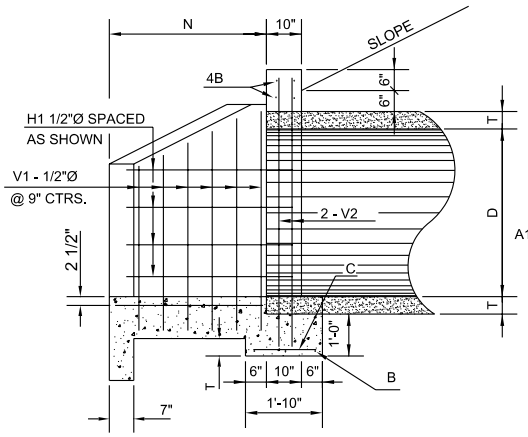
DATE: OCTOBER 2010

STANDARD NO. 3812

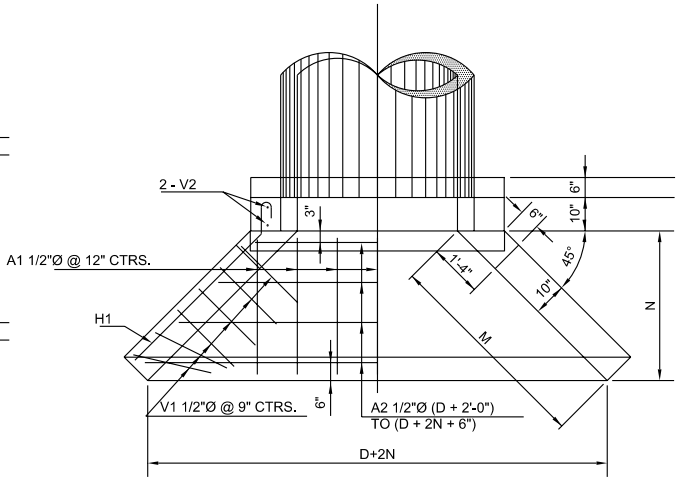
DRAFT STANDARD DETAIL



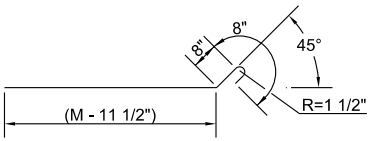
ELEVATION



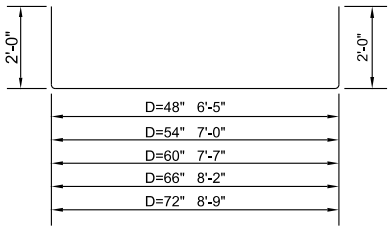
SECTION A-A



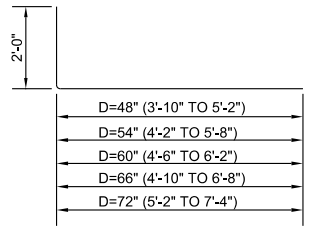
PLAN



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

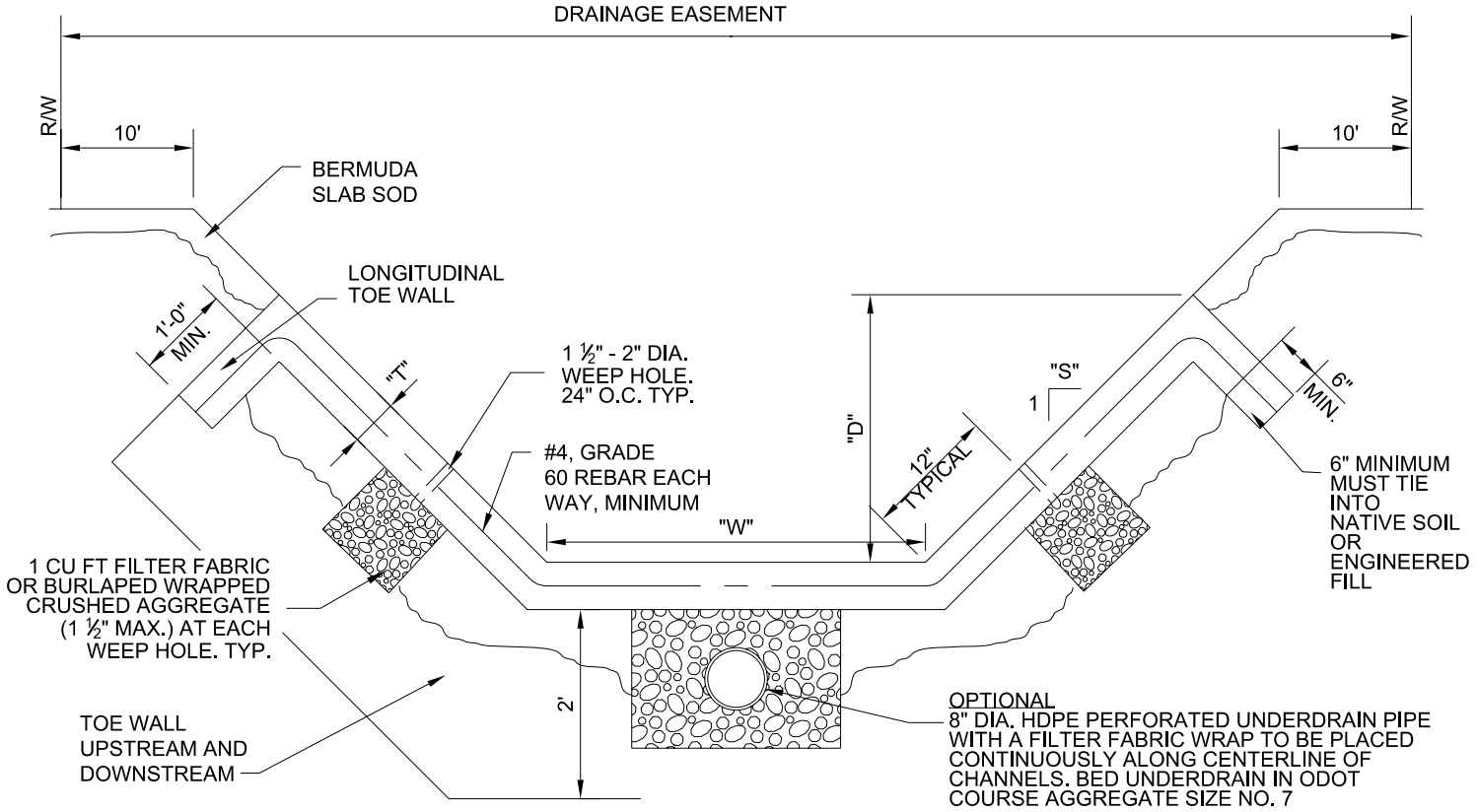
STORM SEWER HEADWALL SHEET II

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

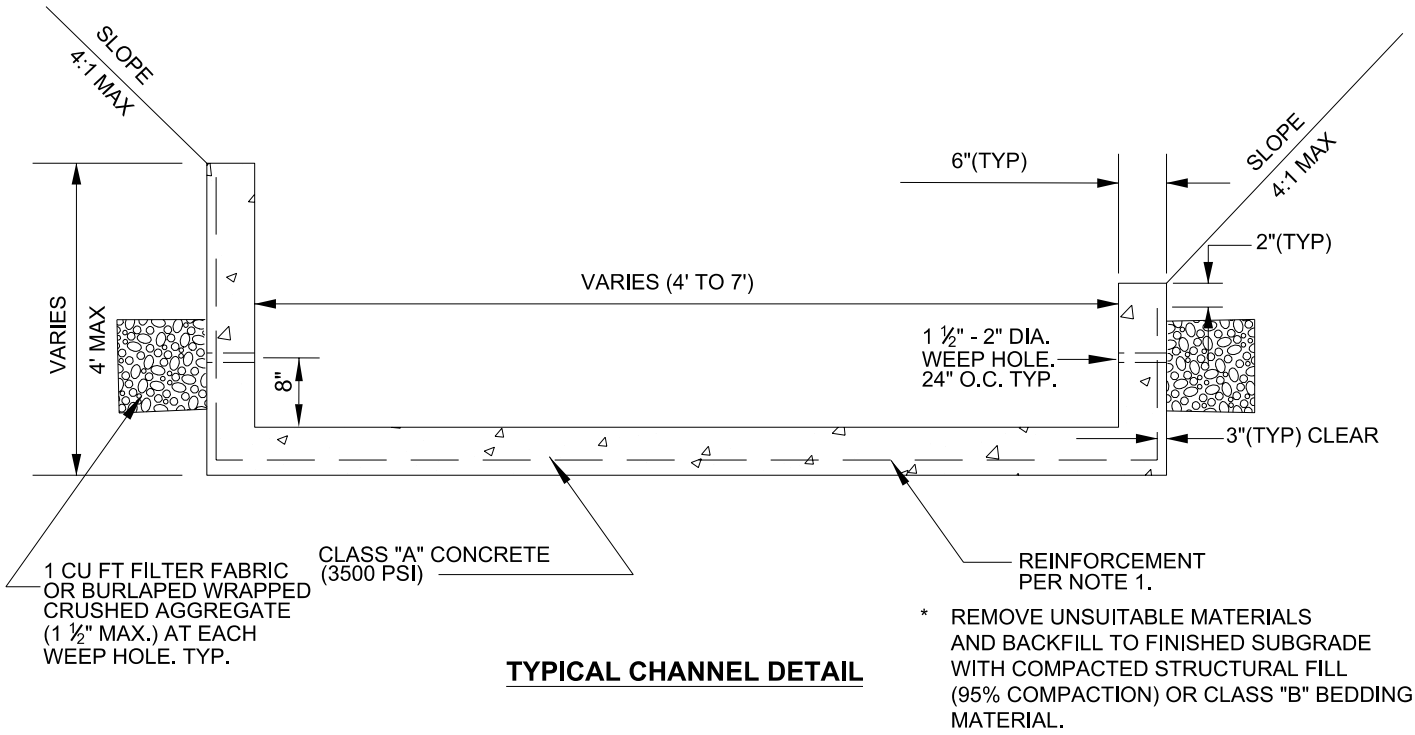
City of **stillwater**

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

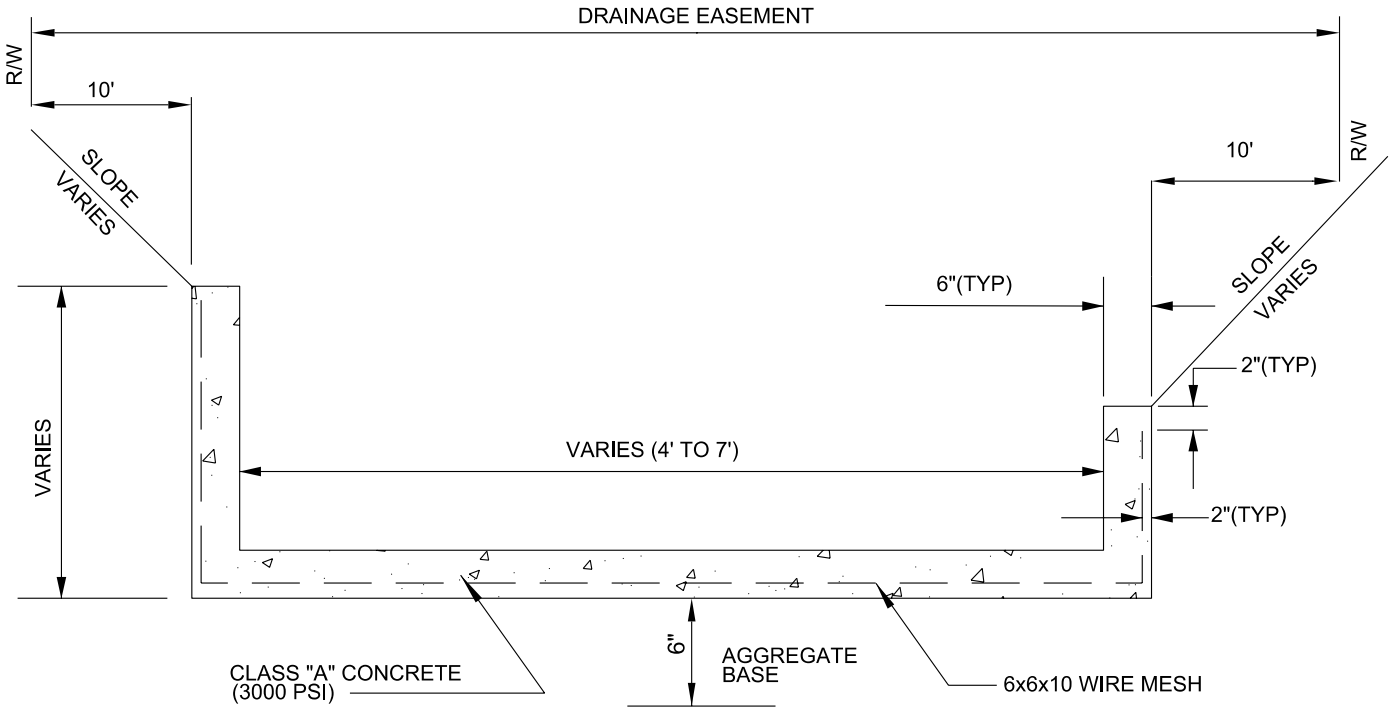
STANDARD DETAILS

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

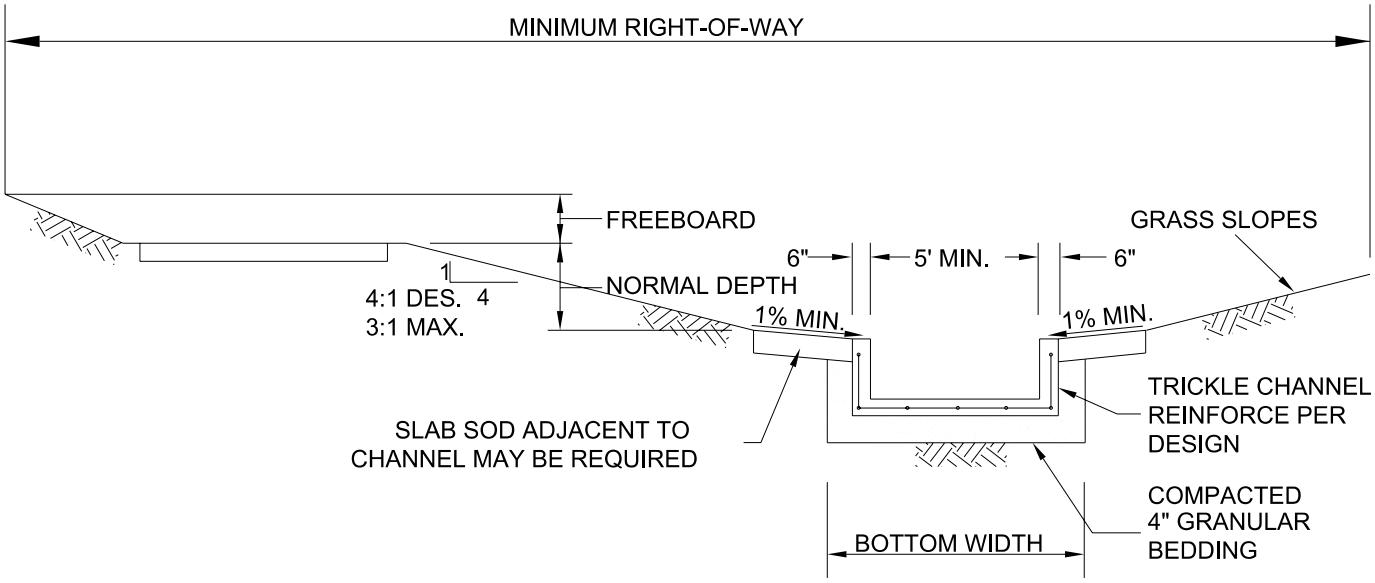
City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

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

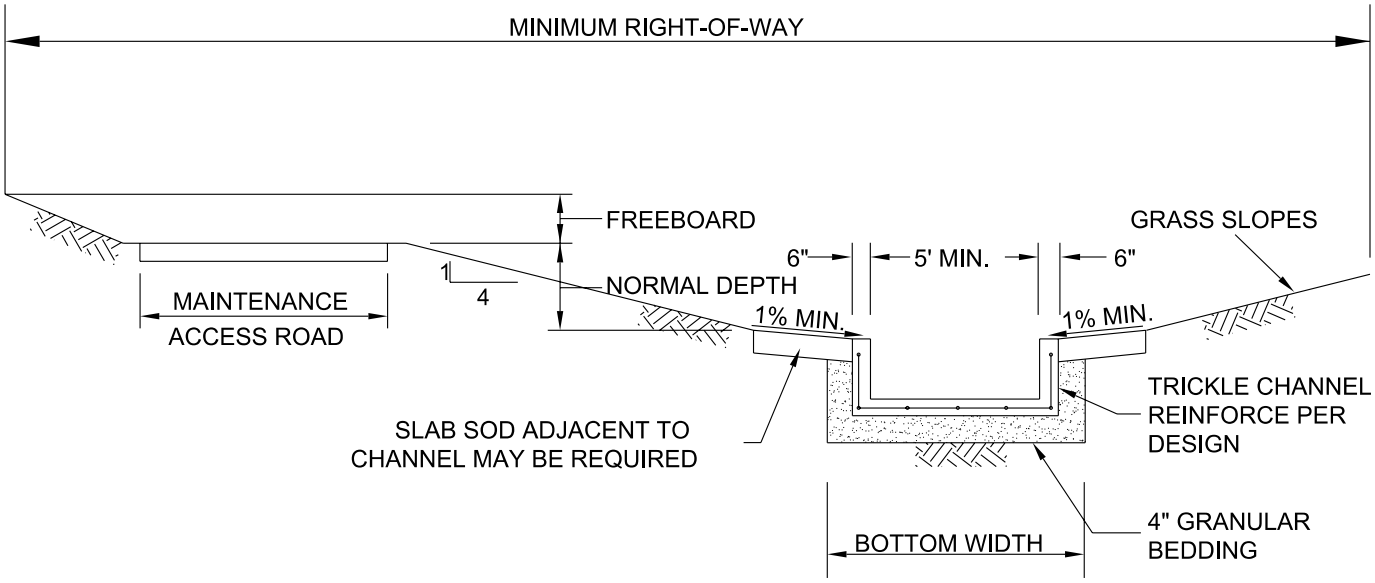
City of **stillwater**

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

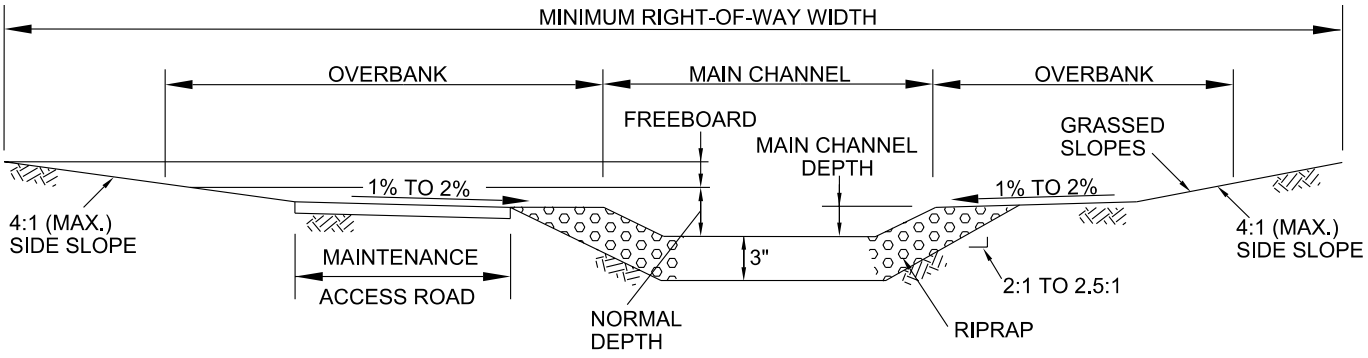
City of stillwater
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

GRASS LINED CHANNEL, TYPE A

STANDARD DETAILS

DATE: OCTOBER 2010 | STANDARD NO. 3816

DRAFT STANDARD DETAIL



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

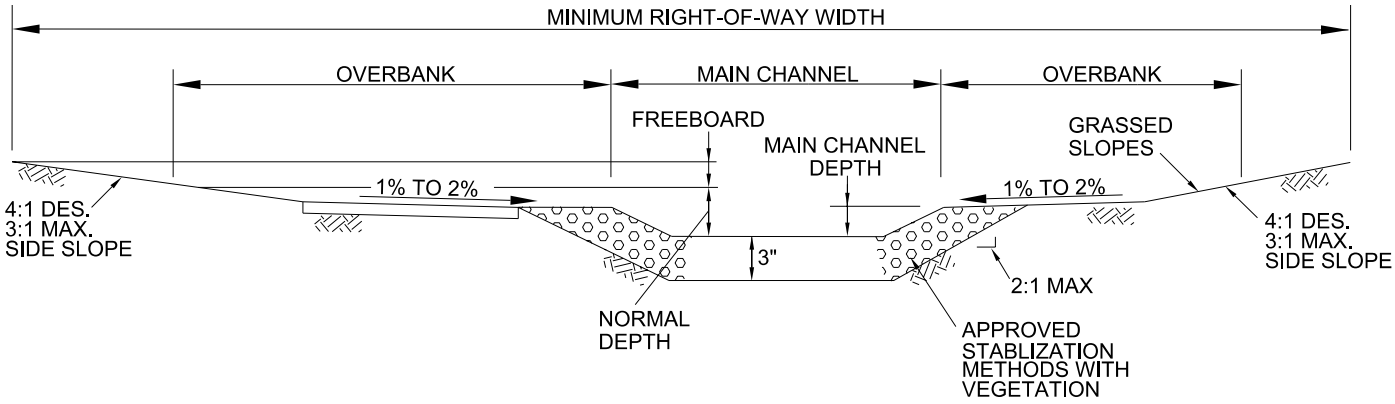
TRANSPORTATION DEPARTMENT - ENGINEERING DIVISION

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