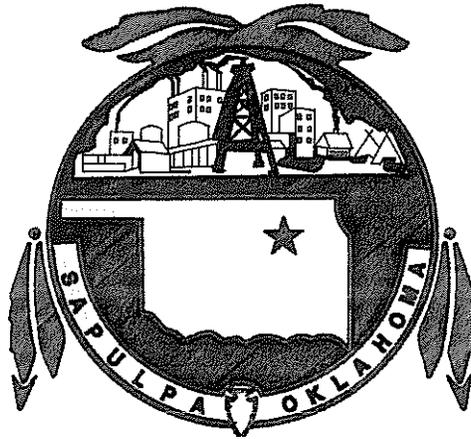


ENGINEERING DESIGN CRITERIA  
AND  
STANDARD SPECIFICATIONS



CITY OF SAPULPA, OKLAHOMA  
SAPULPA MUNICIPAL AUTHORITY

March 18, 2018

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SECTION I. ENGINEERING DESIGN CRITERIA  
FOR THE CITY OF SAPULPA AND  
SAPULPA MUNICIPAL AUTHORITY

PURPOSE, INTENT, AND INTERPRETATION  
OF ENGINEERING DESIGN CRITERIA

The purpose of these Engineering Design Criteria is to establish, as appropriate, target, minimum and/or maximum standards for the design and development of construction plans to be furnished by the Consulting Engineer for development within the City of Sapulpa. While certain interim requirements may be imposed, it is the intent of these Engineering Design Criteria that the consulting (development) Engineer be fully and exclusively responsible for producing an acceptable end product. City of Sapulpa personnel, except where specifically provided for herein, will make reviews for the City to document that an acceptable product is being produced.

Interpretation of these Engineering Design Criteria will be done in such a manner as to allow the Consulting Engineer to control the product which is, in all respects, acceptable. These Engineering Design Criteria should not, however, be interpreted in any manner which allows a consulting Engineer to produce an unacceptable product or endanger the health, safety or welfare of the general public. Only projects in substantial conformance with these Engineering Design Criteria will be accepted by the City of Sapulpa.

Review of development plans, details, submittals and reports may be performed by an outside consulting engineer under contract with the City for providing the review services and herein referred to as the City Engineer and will work under the direction of the Public Works Department. All correspondence shall be directed to the City staff with a copy to the City Engineer. In cases of direct correspondence with the City Engineer, the developer's representative shall copy City staff in the Planning Department and the Public Works Department.

## DIVISION 100 GENERAL

### 100 DEVELOPMENT PROCEDURE OUTLINE

- 100.1 Developer should coordinate the proposed development or project with the Public Works Department office during his/her preliminary studies and before actual design begins.
- 100.2 Developer executes and delivers to *City Agreement Guarantying Installation of Improvements*. Contact the City of Sapulpa for necessary form(s).
- 100.3 Consulting Engineer submits certificates of insurance, including the provision for errors and omissions, providing insurance coverage and in such amount as the City Commission or Municipal Authority shall, by motion, provide (Publicly financed improvements only).
- 100.4 Consulting Engineer shall submit three (3) sets of plans and an estimated cost of construction to the Public Works Department office.
- 100.5 Plans are to be reviewed and approved by City. When plans are not ready for approval, the City will return one marked set of plans and specifications to Consulting Engineer within 10 working days of submittal. Revised plans shall be resubmitted for approval as noted.
- 100.6 Contractor or developer shall furnish maintenance bond(s) or irrevocable letter(s) of credit and certificate of insurance prior to beginning construction. Bonds and insurance will be sent to City Attorney for approval and returned to the Public Works Department office. A copy of a Contractor's Bid or Proposal should accompany the bond or irrevocable letter of credit or the Consulting Engineer's cost estimate will be used in determining the amount of the bond.
- 100.7 A pre-work conference will be conducted with the Contractor, consulting engineer and City engineering staff prior to commencing construction. Construction of improvements will not begin until plans have been approved by the Public Works Department office and a pre-work conference conducted to coordinate construction activities and scheduling.
- 100.8 If it is determined that any change orders are necessary during construction, the Consulting Engineer will submit three (3) sets of the change order plans to the Public Works Department office for approval. Change approval will be required from the City before the changed work is to commence.
- 100.9 Upon completion of construction, the Consulting Engineer will furnish the Public Works Department office three (3) complete sets of heavy bond copies stamped "Record" drawings including those changes made during the construction process. The Consultant shall submit scanned copies of the record drawings in Portable Document File (PDF) format.

100.10 The Public Works Department will make recommendations regarding the acceptability of the improvements to the City Council or Municipal Authority. The City Council or Municipal Authority will decide on whether or not to accept the improvements as constructed. The date on which City Council or Municipal Authority accepts the improvements will be the effective date of the Contractor's maintenance obligation.

## 101 STANDARDS AND SPECIFICATIONS

101.1 All plans will be reviewed in view of how they will affect future site development and how future site development will affect City operated facilities.

101.2 Where on a particular tract, the standards and specifications set forth herein are not necessary or applicable by reason of topography, soils or other conditions peculiar to such tract; other standards may be used with the prior written approval of the Public Works Department.

101.3 For any item of work not covered by the adopted criteria and specifications of the City of Sapulpa, the Consulting Engineer shall include two copies of the design, specifications and/or special provision with his/her first submittal for review and approval by the Public Works Department.

101.4 Approval of plans by the Public Works Department does not release the Consulting Engineer from his/her responsibility to meet the planning and design of the project as required by the Public Works Department office and/or other departments of the City.

101.5 The cover sheet of the plans and the calculation report shall be signed, sealed and dated by a Professional Engineer, registered in the State of Oklahoma, prior to submitting the plans to the Public Works Department office for review.

101.6 Construction pay items and Engineer's cost estimate for each item of work covered by the standard specifications and/or special provisions shall be rounded off to the nearest unit and listed in the proposal clearly indicating the basis for payment.

## 102 DRAFTING

102.1 Construction plans shall be plotted on a durable reproducible medium (vellum or bond).

102.2 Standard sheets shall be either 34 inches wide by 22 inches high or 36 inches wide by 24 inches high having a margin of 1-½ inches along the left border and ½ inch along the top, bottom and right border.

102.3 Consulting Engineer's with the capability to generate AutoCAD system layout drawings (plats, water, sewer, street, drainage, grading, etc.) shall provide the Public Works Department office with working files of "Record" drawings on electronic format compatible with City's computer system and as multi page PDF files.

102.4 All project drawing packages shall include a cover sheet which shall serve to introduce the project. Information contained on the cover sheet shall include the project title,

project location with location map, project owner's name, address, telephone number and contact person if not the owner, Engineer's name, address, and telephone number, drawing index and legend. The cover sheet shall not be used for a plan sheet.

- 102.5 North shall be oriented to the top or right hand side of all plan sheets.
- 102.6 A Title Block shall be located in the lower right hand corner of each sheet and shall include the project title, owner's and Engineer's name, drawing description, page number and date.
- 102.7 The scale shall not be less than 1" = 50' horizontal and 1" = 5' vertical on plan and profile sheets. Minimum scale shall be 1" = 100' on plan sheets. Larger scales may be required where conditions warrant.
- 102.8 All line work shall be of sufficient density to be reproducible by current reproduction processes. Any line work which does not reproduce satisfactorily may be cause for rejection of the plans by the City.
- 102.9 Freehand lettering shall be no smaller than the No. 4 setting on the Ames lettering guide (0.12" minimum height). Mechanical lettering shall be at least comparable to the 100 Leroy guide (0.10" minimum height) except mechanical lettering on plats or records reproduced in the plans may be comparable to the 80 Leroy guide (0.09" minimum height). Typing shall be at least 0.10" minimum height. Adhesive or transfer lettering shall have a minimum height of 0.10". These lettering sizes are the minimum sizes. Sizes, greater than these, are desirable and suggested.
- 102.10 All base maps shall be referenced to existing land lines (section corners, etc.). Property lines, rights-of-way, easements, building lines, etc. shall be located and dimensioned.
- 102.11 No public improvements shall be installed without dedication of right-of-way or appropriate easements. These easements shall be submitted for review and acceptance prior to filing. All easement shall be in favor of the City. Restricted easements will be filed by the City.
- 102.12 All structures (manholes, junction boxes, headwalls, etc.) shall be numbered and labeled both and in profile and detailed on plans. Numbers shall correspond to the convention used by the City.
- 102.13 Waterlines, sanitary sewer and storm sewer lines shall be identified on both plan and profile sheets by letter or number.
- 102.14 Drawings shall show all obstructions existing and proposed, above and below ground. These shall be located vertically and horizontally. The Engineer shall be responsible for contacting ALL utilities to obtain locations of their facilities. This also applies to various affected pipeline companies.
- 102.15 Drawings shall show existing and proposed elevations.

- 102.16 A list of construction pay items and estimate of quantities shall be shown on the plans.
- 102.17 The Contractor shall be responsible for coordinating all street crossings with the Public Works Department office and securing approval for crossing, and for method of construction (bore, tunnel or open cut).
- 102.18 Consulting Engineer shall submit check prints of "Record" drawings for review and approval of Public Works Department. Upon approval, Engineer shall submit prints on heavy bond paper of "Record" drawings as outlined in Section 102.

103 BENCH MARKS

- 103.1 All elevations shown on the plans shall be based on USGS or USC&GS datum (NGVD88).
- 103.2 Horizontal coordinates shall be on the basis of the NGS Oklahoma State Plane Coordinate System, Oklahoma South, and latest revision. Northings and Eastings shall be shown for all structures, roadway alignments and control points. Horizontal and vertical control shall conform to NAD 83(93), NAVD 88. Assumed coordinate system or elevations shall not be used. Survey control shall be established and certified by a Professional Land Surveyor licensed in Oklahoma.
- 103.3 Two permanent control points shall be placed in locations where they will not be disturbed by construction. Each control point shall have the location and description noted on the survey data sheet of the plans. The control points shall have horizontal and vertical coordinate values recorded on the plans. Permanent control points may have capped iron pins.
- 103.4 All temporary bench marks used for control of the project shall be designated on the plans stating elevation, location and description. The nearest such bench mark shall be shown on each sheet. Temporary benchmarks may be chiseled marks, or iron pins.
- 103.5 A permanent bench mark shall be established on the project. This permanent bench mark will be a brass cap or aluminum cap set in concrete in a location approved by the Public Works Department. The cap shall read "City of Sapulpa Bench Mark" together with a letter and/or numerical designation assigned to it by the Public Works Department office. The location, description and elevation of the permanent bench marks shall be shown on the survey data sheet of the plans.
- 103.6 Level notes shall be provided to the Public Works Department office for all permanent and temporary bench marks. All level notes shall be of closed loop survey. Survey notes shall show the seal and signature of the surveyor.

## DIVISION 200 DESIGN CRITERIA FOR WATER MAINS

### 200 GENERAL

- 200.1 The minimum design criteria for all public water facilities shall be the latest edition of Title 252 Oklahoma Administrative Code, Chapter 625 Public Water Supply Facilities and Construction Standards. These standards are amended as provided for herein.
- 200.2 All plans pertaining to distribution and treatment of public drinking water must be approved by Oklahoma Department of Environmental Quality (ODEQ). The Developer shall submit two (2) additional sets of plans, as approved by the Public Works Department, to be submitted to ODEQ by the City for review and approval. The Developer will be responsible for the plan review fee.
- 200.3 If a water main is within 2 feet vertically or 10 feet horizontally of a sanitary sewer, Oklahoma State Department of Health requirements shall govern.
- 200.4 The Public Works Department office will furnish to the Consulting Engineer normal working pressures in the area of the proposed improvements for proper selection of air relief valves and the minimum pressure class for pipe which will be required.
- 200.5 All water pipe shall conform to the current American Water Works Association (AWWA) specifications for ductile iron pipe, steel pipe, reinforced concrete pipe, or polyvinyl chloride (PVC) pipe. PVC pipe shall be restricted from use under or adjacent to arterial streets.
- 200.6 A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 100.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a one-year period.

### 201 ENGINEERING REPORT

- 201.1 An engineering report(s) containing the information requested in the standard ODEQ engineering report form shall be included in the initial submittal of construction plans.
- 201.2 Pressure information can be obtained from the Public Works Department, if current pressures are available.

### 202 WATER LINES

- 202.1 Water mains shall be on the South or East side of right-of-way, 8 feet off property line, unless otherwise approved. Water mains not in street right-of-way shall be centered in a minimum 15 foot restricted waterline easement.
- 202.2 The minimum size of water main on all section lines shall be 12 inches in diameter, 8 inches in diameter on half-section lines and all collector streets. The minimum size of

all other mains shall be 6 inches in diameter, except on dead-end street less than 500 feet in length and a fire hydrant being located within 500 feet of all proposed or existing building sites, then a 4 inch diameter main may be allowed.

- 202.3 Maximum permissible depth of cover is 8 feet, and minimum cover is 3 feet, except at air relief valves where a 4.5 feet bury depth is required. At fire hydrants, a minimum of 4.5 feet is required.
- 202.4 The centerline grade above water mains and curb grade, or centerline of street grade, shall be shown on profile.
- 202.5 If PVC pipe is used, detectable Mylar marking tape shall be required for location of water pipe.
- 202.6 Cover over water lines at creek crossings shall be 4 feet minimum. Water lines shall be restrained joint pipe through the creek crossing area.
- 202.7 If conduits are planned to be installed for future long services, the plan sheet should be revised to show the exact location and depth of the conduits. The conduit location should be marked on the curb or paving.
- 202.8 Dead ends shall be minimized by looping of all mains whenever practical. Future plans eventually connecting them to other mains to provide circulation of water is strongly recommended.
- 202.9 Pipe joint restraint shall be designed to the working pressure with a safety factor of 2.25.
- 202.10 Mechanical joint restraint and blocking design shall be submitted for review.

### 203 FIRE HYDRANTS

- 203.1 All fire hydrants shall be located in street right-of-way 1.5 feet from right-of-way line on extension of lot line and the finish grade elevation at the point shown. Normally, fire hydrants will have a 4.5 foot bury, with extensions as needed. Fire hydrants shall be Mueller. A base elevation for each fire hydrant shall be shown on the profile. Fire hydrants shall be installed on a minimum of a 6 inch water line.
- 203.2 All fire hydrants shall be located such that all proposed or existing building sites are within 500 feet of a hydrant. Maximum spacing between hydrants shall be 1,000 feet.
- 203.3 Fire hydrant connection to the water main shall be in accordance to standard details provided by the Public Works Department office. All fire hydrants shall be installed with valves to isolate the fire hydrant.

### 204 COMMERCIAL FIRE PROTECTION

- 204.1 Developer shall coordinate all fire protection with the Sapulpa Fire Marshall. All systems shall be designed in accordance with the Nation Fire Protection Association (NFPA) Codes and Standards.

- 204.2 All fire suppression systems shall be designed by an engineer trained and certified in fire protection, licensed in the State of Oklahoma.
- 204.3 Building fire suppression systems shall be designed with an approved pumper connection located on the face of the building or on a separate standpipe with unrestricted access by the Fire Department meeting Standard UL 405.
- 204.4 204.4 Flow detection equipment meeting or exceeding Factory Mutual (FM) Standards shall be required on the system.

## DIVISION 300 DESIGN CRITERIA FOR SANITARY SEWER

### 300 GENERAL

- 300.1 The minimum design criteria for all sanitary sewer collection and treatment facilities shall be the latest edition of Water Pollution Control and Construction standards.
- 300.2 All plans pertaining to the collection and treatment of public wastewater plants must be approved by ODEQ before construction may commence. The Developer shall submit two (2) additional sets of plans, as approved by the City Engineer, to be submitted to ODEQ by the City for review and approval. The Developer will be responsible for the ODEQ review fee.
- 300.3 If a water main is within 2.0 feet vertically or 10.0 feet horizontally of a sanitary sewer, Oklahoma Department of Environmental Quality requirements shall govern.
- 300.4 All sewer lines shall be located within a dedicated easement. Sewer lines will be located in an easement adjacent to the street right-of-way. Sewer lines shall be located in the south or west half of back-to-back easements, 7.0 feet from the property line may be permitted. Total back-to-back easement width is 22.0 feet minimum. Sewers shall be located 12.5 feet from property line in perimeter easements which are a minimum of 17.5 feet. Any location not standard shall be approved by the City Planning Department. Side lot easement widths will be based upon other utilities in the easement and the location and depth of the sewer.
- 300.5 A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 100.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a one-year period.

### 301 ENGINEERING REPORT

- 301.1 Engineering report(s) containing the information requested in the standard ODEQ engineering report form shall be included in the initial submittal of construction plans.

### 302 DESIGN FLOWS

- 302.1 Sanitary sewer systems shall be designed to comply with the latest version of the ODEQ regulations:
- A. Consider the maximum hourly domestic flow, industrial flow, inflow and infiltration and the topography regarding the slope and plumbing needs.
  - B. Design for an average daily per capita flow of 100 gallons per capita day, assuming three persons per residence (or residential lot) which includes normal infiltration. Peak design flow must be based on an acceptable infiltration/inflow (I/I)

study or, for new sewer extensions, the ratio of peak to average daily flow from a widely recognized engineering standard.

C. For industrial and commercial properties, the design engineer shall make the appropriate assumptions to determine design flow. Design calculations shall be provided to the Engineer.

302.2 The average household size shall be assumed to be 3 persons, so that each lot shall be assumed to produce 300 GPD average. For new sewer extensions, the Engineer has determined that use of the following peaking factors, (which include I/I), is adequate and commonly quoted in engineering standards:

1. A peaking factor of 4 for laterals and sub-mains (pipe diameter less than or equal to 12 inches) and
2. A peaking factor of 2.5 for mains and interceptors (pipe diameter greater than 12 inches). Sewer lines shall carry the peak flow at 1/2 pipe capacity.

302.3 Exclude storm water from roof drains, streets, and other areas.

302.4 Other designs parameters: Sanitary sewage systems shall include the following parameters:

1. Maximum hourly quantity of domestic sewage.
2. Additional maximum sewage or waste from industrial plants or high use businesses.
3. Future upstream development of the basin.

### 303 SEWERS

303.1 No public gravity sewer shall be less than eight (8) inches in diameter.

303.2 Sewers terminating in a manhole shall project a minimum of 15.0 feet into the property served, or 10.0 feet where a lamphole is used.

303.3 All sewer pipes shall conform to the current specifications. All installations in excess of 16 feet deep shall require special approval. Polyvinyl chloride SDR 35 (PVC) pipe shall be restricted from use under streets and adjacent to arterial streets, except AWWA C-900 PVC Class 200 pipe. AWWA C-151 Ductile Iron pipe will be used under streets. Ductile iron pipe may be used on sewers in lieu of other materials. Ductile Iron pipe shall have a corrosion resistant interior coating and a poly wrap on the exterior of the pipe. Other pipe material may be considered provided acceptable testing documentation

is provided and the pipe is shown to be equal or better than that what has been specified above.

303.4 Alignment, size and grade of lines shall be subject to approval.

#### 304 MANHOLES AND LAMPHOLES

304.1 Manhole spacing shall be a maximum of 400 feet. Lampholes shall not be more than 100 feet from the nearest manhole except as approved by the City. In order to accommodate cleaning, using power equipment, 500 feet spacing will be allowed when manholes are located in street right-of-way or parking lots. Adjustments in manhole spacing may be made to allow locations adjacent to the streets.

304.2 Manholes shall be 4.0 feet deep minimum, or a special structure will be required. Rim elevation shall be 1.0 foot, minimum, above 100 year flood or Base Flood Elevation (BFE) in floodplain areas. Water tight manhole covers may be installed in flood areas. Watertight manhole cover shall be submitted for approval. Exact manhole rim elevations shall be shown on profile and staked in field unless matching existing grade. All manholes shall match inverts in and out (no splash), or inside drop manhole shall be constructed (minimum difference in inverts shall be 2.0 feet, or as required for construction).

304.3 Where a lamphole is used a long radius 90 degree elbow shall be installed. A concrete base, a minimum of 18 inches by 18 inches, shall be constructed around opening of lamphole.

#### 305 SERVICE CONNECTIONS

305.1 In-line Tees shall be installed for all platted lots and at any point where a sanitary sewer service connection is anticipated. Specify the tee size, and station the tee from the downstream manhole on the plan and profile. Tees shall remain sealed until ready for connection. The location of tees shall be marked in such a way that they can be easily located later. Tee markers shall be weather resistant material.

305.2 Maximum permissible depth for service connections to property is 16 feet.

305.3 Design depth shall be based on service line stub-out a minimum of 1.5 feet below surface, 2.08 (1/4 inch per foot) percent minimum grade, and a 1.5 feet drop into the sewer main line.

#### 306 CROSSINGS

306.1 Concrete encasement of ductile iron pipe shall be required where the depth of cut from the ground elevation to the top of pipe is 4.0 feet or less; Concrete Cradle where centerline cut exceeds 16 feet; Water Table Cradle shall be used where trench conditions require.

306.2 Cover over sewer at channel or creek crossings shall be 4.0 minimum. Concrete encased ductile iron pipe shall be used at these crossings. The ductile iron pipe shall extend a minimum of 10.0 feet into both banks. No concrete encasement On PVC.

## DIVISION 400 DESIGN CRITERIA FOR STREETS

### 400 GENERAL REQUIREMENTS

- 400.1 Streets shall include earthwork, proper subgrade, base course(s), wearing surface, concrete curb and gutters, proper backfill, and proper drainage structures, including storm sewers and inlets. All streets shall be designed in accordance with the American Association of State Highway and Transportation Officials (AASHTO) Manual for the Geometric Design of Roadways.
- 400.2 Maintenance Bond or Irrevocable Letter of Credit shall be posted in an amount based on a percent of the determined amount of construction costs for a period, following completion and acceptance of all improvements, defined as follows:
- A. Privately financed projects: 25% for a three year period.
  - B. Publicly financed projects: 100% for one year plus 15% for the succeeding four-year period.
- 400.3 When “pot holing” operations are performed to locate existing utilities under an existing street the following will be required:
- A. Right-of-Way Permit. Contact the City of Sapulpa for necessary form(s).
  - B. The maximum size of a drilled “pot hole” shall be 6 inches in diameter. The operations will be performed in locations out of vehicle wheel paths.
  - C. Traffic barricades approved by the City Engineer will be used for safety.
  - D. Holes will be backfilled with 6 inches of sand immediately above the pipe and 3000 psi concrete to the street surface for Portland Cement Concrete streets. For asphalt streets, the same as Portland Cement (PC) concrete streets, except that the top of the boring equivalent in depth to the asphalt paving shall be refilled with an approved asphalt patching material.
- 400.4 Should repairs on the either privately or publicly financed projects be necessary during the maintenance bond period, the repairs made shall also be bonded for an additional one year period from the date of completion and acceptance of the repair work by the City.

### 401 PLAN SHEETS AND PROFILES

- 401.1 All intersections, cul-de-sacs, and other critical locations shall be shown in plan detail at a minimum scale of 1 inch equals 20 feet, including direction of drainage, top of curb elevation at PC's, PT's and high or low points. All curve information and drainage structures shall be shown in detail.

- 401.2 Where cul-de-sac radii varies so that the distance from face of curb to the right-of-way line is less than 12 feet, an additional easement will be granted to accommodate sidewalks and/or utilities.
- 401.3 A site plan showing proposed locations and elevations of all utilities shall accompany the street and storm sewer plans.
- 401.4 All drainage areas shall be clearly marked on the drainage area plan sheet; showing acreage, runoff and off site pickup points.
- 401.5 The profile may be either three separate profiles or one single profile.
- A. Three separate profiles: When using three separate profiles, the top and bottom shall show existing property line and proposed top of curb. The middle profile shall show only existing center line profile. Stationing shall be along center line.
  - B. One single profile: When using one single profile both property lines shall be shown along with the proposed top of curb. The center line profile shall not be shown. Stationing shall be along center line. A typical section shall show cross slopes.
- 401.6 All fill areas within the street right-of-way shall be cross hatched on the profile and notation shall be made that the fill area shall be compacted to a minimum of 95 percent standard proctor density. When storm sewer pipes are located in fill area, the fill shall be made and compacted to finish grade, then trenched for storm drain excavation.
- 401.7 Curb returns with elevations shall be clearly labeled on profile.
- 401.8 Vertical curves in profile shall give the top of curb elevation at the VPC, VPI, VPT and high or low point, at a minimum interval of 50 feet.
- 401.9 Storm sewer mains shall not be located under street pavement unless approved by City Engineer.
- 401.10 Utility line (i.e. Petroleum lines, gas lines, etc.) shall not be located under street pavement except at crossings. Pipelines are not permitted to exist longitudinally with the paved area of a street or within 3 feet of depth within a minimum of 10 feet of the edge of pavement, unless approved by the City Engineer.
- 402 GEOTECHNICAL REPORT
- 402.1 A geotechnical report indicating existing conditions at the proposed development site shall be included in the initial submittal of construction plans. This report shall address soil types, existing groundwater conditions and any other condition which could affect the construction and later maintenance of all infrastructure. The location, number and depth of test holes and/or core holes will be at the discretion of the geotechnical engineer and shall be representative of the total development area. The geotechnical report shall include a pavement section recommendation.

403 STREET FUNCTIONAL CLASSIFICATION

403.1 Streets and roadways shall be designed in accordance with the Tulsa Metropolitan Area Major Street and Highway Plan as prepared by the Indian Nations Council of Governments (INCOG).

404 STREETS

404.1 Minimum Street Width: Width of streets shall be according to the classifications as provided for in the City Urban Development Department of the currently adopted Land Use Plan. Width shall be measured from curb face to curb face or from edge of design strength pavement.

404.2 All streets shall be constructed with concrete curbs or approved shoulders in accordance with the Oklahoma Department of Transportation (ODOT) Standard Specifications and the Standard for Construction, latest edition.

404.3 The centerline of paving shall be the centerline of right-of-way where dedication has been made according to the INCOG Major Street and Highway Plan or adopted City Highway Plan.

404.4 The minimum design grade for streets and gutters shall be 0.6 percent with minimum constructed grade of 0.5 percent or greater. The maximum grade for non-arterial streets shall be limited to 8 percent. Where the topography is hilly, grades will be permitted up to a maximum of 12 percent providing they do not exceed 500 feet in length from beginning to the point or flatter slope, except in areas near intersections, where the 8 percent maximum will apply.

404.5 All vertical and horizontal curves shall be designed according to the current AASHTO Specifications using the criteria of safe stopping sight distance.

404.6 Vertical sag curves shall be the minimum length available for the two intersecting grades as defined by the AASHTO publication titled, A Policy on Geometric Design of Highways and Streets (Green Book), current revision. For residential streets, no sag vertical curve shall be used if the algebraic difference between the two intersecting grades does not exceed 2 percent. For collector streets, sag vertical curve length shall be determined by the "comfort equation" contained in the referenced AASHTO publication..

404.7 Design speed shall be 25 mph on all residential and collector streets and 30 mph on arterial streets except as modified by the Public Works Department.

404.8 For horizontal curves the minimum centerline radius on street alignment shall be 200 feet.

404.9 The minimum radius on returns at residential intersections and at intersections of a residential and arterial street shall be 30 feet. At intersections of arterial streets, the

minimum radius on returns shall be 40 feet. The minimum radius on the returns for industrial districts shall be 40 feet. A larger radius may be required for industrial districts if specified by the City.

- 404.10 The maximum grade of a residential street when intersecting an arterial shall be 2 percent for a minimum of 100 feet from the curb line of the arterial. No vertical curve shall begin any closer than 50 feet from the curb line of the arterial. The maximum grade of residential streets at intersections shall be 4 percent.
- 404.11 A proposed and existing profile shall be shown beyond the end of all dead end streets for a minimum of 200 feet to determine a satisfactory grade for future development.
- 404.12 Cross slope may be 2 percent or 3 percent ( $\frac{1}{4}$  inch or  $\frac{3}{8}$  inch per foot); however, crown will be flattened off so that crown never exceeds curb height.
- 404.13 Where proposed development is adjacent to an existing arterial street not constructed to the approved width and pavement dimensions of the currently adopted Land Use Plan and accepted specifications, the City shall be provided with a report detailing the existing condition of the roadway. Information to be provided, at a minimum, will include the type of pavement, thickness of pavement, estimated age of the pavement, type of subgrade, and California Bearing Ratio (CBR) for the subgrade material. The proposed design shall be approved by the Public Works Department.

#### 405 INTERSECTION DESIGN

##### 405.1 General

- A. Streets shall intersect one another at right angles ( $90^\circ$ ) unless topography and other design factors require a waiver by the Public Works Department.
- B. Proposed residential areas shall not use 4 leg intersections within the development unless approved by the City Planner.
- C. Grades at collector/arterial intersections and 50 feet back of radius point shall not exceed 3 percent.
- D. For residential and collector streets the portion of the street from the gutter line of the street being intersected to the P.C. (point of curvature) of the curb return (typically 30 feet) shall have a maximum longitudinal grade of 2 percent. This will allow the crosswalk to meet the requirements of the Americans with Disabilities Act, which has a maximum sidewalk cross slope of 2 percent.

##### 405.2 Sight Distance Triangle (Vision Triangle)

- A. The intersection sight distance provisions contained in ‘A Policy on Geometric Design of Highways and Streets’ (the AASHTO Green Book (latest edition) referenced in Section 404.6) are adopted as the presumptive standard applicable to

all intersections within the City provided, however, that the City Engineer or designee may, where consistent with public safety, specify greater or lesser intersection sight distances. Unless otherwise required by the Director of Public Works or his/her designee, all intersections shall be designed, constructed and maintained in accordance with such sight distance provision. Additionally, no landscaping, fence, utility equipment, wall or other structure in excess of thirty-six inches in height above the roadway shall be constructed or maintained in the area identified as the sight triangle, nor shall any parking be allowed within the area of the sight triangle.

B. Streets shall not be designed with intersections on the inside of horizontal curves or at any location in general where sight distance will be inadequate for drivers to tell if they can safely enter the traffic flow or cross the street. The minimum distance from an intersection to a curve shall be the applicable minimum sight distance listed below. The Director of Public Works or his/her designee may make exceptions for especially difficult design circumstances only if visibility easements to provide adequate sight distance are established. In lieu of visibility easements, additional street right-of-way may be dedicated. Minimum intersection design sight distance standards, as specified in the AASHTO “Green Book” shall be as follows:

Design Speed (MPH)	Minimum Sight Distance (Feet) *
25	280
30	355
35	415
40	470
45	530
50	590
55	645
60	705

\* Distance measured from an entering driver’s eye position to the position of the closest approaching vehicle’s far front corner.

1. The entering driver’s eye position shall be assumed 3 feet to the right of the entering street’s centerline, 3.5 feet above the pavement surface, and 9 feet to the nearest pedestrian crosswalk line (marked or unmarked) on the street being entered.

2. The position of the closest approaching vehicle's far front corner shall be assumed 3 feet from the edge of the nearest approaching vehicle lane and 4.25 feet above the pavement surface for each direction of travel.

C. Where stop control is not used, the corner sight distance for residential streets shall be a minimum of 200 feet (300 feet recommended).

D. To maintain the minimum sight distance, restrictions on height of embankment, locations of buildings, and screening fences may be necessary. Landscaping in the sight distance triangle shall be low-growing, and shall not be higher than 3 feet above the level of the intersecting street pavements. Tree overhangs shall be trimmed and maintained to a line at least 14 feet above the curb level of the intersections.

#### 405.3 Right-Of-Way

A. Intersections containing primary arterials/secondary arterials as classified by the INCOG Major Streets and Highways Plan and the Sapulpa Comprehensive Plan shall provide a width of 120 feet of public right-of-way for a distance of 200 feet from the intersecting right-of-way. Said right-of-way shall then have a 150 foot transition from the 120 foot width to a 100 foot standard width.

B. Variations to this right-of-way requirement may be granted in accordance with the procedure for plat variations contained in the Subdivision Regulations of the City of Sapulpa, Oklahoma.

### 406 TRAFFIC IMPACT OF DEVELOPMENTS

#### 406.1 General

A. When a development will have a significant impact on the traffic pattern (100 vehicles per hour increase, or more) of the adjacent streets, driveways, and intersections, the developer shall provide a traffic impact analysis. The developer shall provide additional traffic lanes and right-of-way width to the streets or other improvements to mitigate the impact of the development. The City Engineer shall determine the exact type and quantity of construction required. Each development will be evaluated based on the traffic into and out of the development, the traffic load on the arterial, and current and planned configuration of the arterial, as shown in the City's Comprehensive Plan and the trip generation rates for the proposed development, including future phases.

#### 406.2 Geometric Design Criteria

A. Intersection design (storage, tapers, grades, etc.) shall be based on National Cooperative Highway Research Report 279, INTERSECTION

CHANNELIZATION DESIGN GUIDE, Transportation Research Board, National Research Council, latest edition.

406.3 Outside Lane

A. An outside lane shall be required when:

1. The development is within 1,000 feet of an arterial type intersection.
2. The arterial will be at or above 130 percent of level C capacity with the addition of the traffic from the development.

406.4 Deceleration Lane

A. A deceleration lane is a right turn into a development that has a lane width of not less than 13 feet wide for a distance of not less than 100 feet plus corner radius, measured from the center line of the road on which the right turn is to be executed, and a 30 to 1 taper back to the existing arterial street width.

B. A deceleration lane is required when:

1. The number of vehicles making a right turn from the arterial is 100 vehicles per hour (VPH) or more during the peak period.
2. Topography makes the deceleration lane necessary for safety.
3. Un-signalized capacity analysis indicates the need for it.

407 TYPICAL SECTIONS

407.1 Typical sections shall be drawn at the same horizontal and vertical scale.

407.2 Typical sections shall show dimensions, type of materials, layer details, reserve topsoil, temporary and permanent erosion control, compacted thickness, etc.

407.3 All typical sections or notes that are necessary to clearly reflect the design shall be included.

407.4 The Developer shall have geotechnical engineering performed by a qualified geotechnical laboratory for all areas to be paved. Resulting soil tests and a recommended pavement section will be submitted to the Public Works Department for review. Minimum CBR of compacted and/or stabilized subgrade shall be 8.0. If desired, subgrade may be built of an accepted borrow material.

407.5 Pavement thickness shall be designed according to Section 416; however, industrial and commercial pavement sections shall have a minimum thickness of 8 inches asphaltic concrete or 7 inches Portland cement concrete over a minimum of 6 inches of stabilized aggregate base and a geo-synthetic fabric meeting ASTM D4595 for tensile strength and

ASTM D4491 for flow rate. Residential pavement sections shall have a minimum thickness of 6 inches asphaltic concrete or 6 inches Portland cement concrete with a geo-synthetic fabric as stated above.

- 407.6 Portland cement concrete streets shall have an integrally placed curb of the same mix design as for street paving. The curb shall be a minimum of 6 inches wide at the top and curb face shall be a minimum of 6 inches in height exclusive of bottom fillet.
- 407.7 Joints in Portland cement concrete shall be located in accordance with ODOT Standard Specifications for Construction. A joint layout plan shall be included with the construction plans and submitted to the Public Works Department for review and consideration.
- 407.8 Joints in Portland cement concrete paving, curbs and gutters shall be constructed in accordance with ODOT Standards unless otherwise directed by the Public Works Department. Joints shall be filled with an approved silicone sealant.
- 407.9 Asphaltic concrete streets shall have a Portland cement concrete curb and gutter. The curb shall not be less than 6 inches wide at the top with a 6 inch face in height exclusive of bottom fillet and the gutter shall be a minimum of 18 inches in width.
- 407.10 All curb sections shall be barrier type curb. Mountable type curbs will not be allowed unless accepted for specific sites by the City Engineer.
- 407.11 The Minimum sub-base preparation requirement shall be 6 inches of Class A Aggregate Base over an approved geo-synthetic fabric mentioned above and a stable, sub-grade processed and compacted in accordance with ODOT Subgrade Method B.
- 407.12 Asphalt Concrete shall be Superpave Types S 3, 4 & 5 per the latest edition of the ODOT “Standard Specifications for Highway Construction.”
- 407.13 All concrete shall be in accordance with Sections 509 and 701, of the latest edition of the ODOT “Standard Specifications for Highway Construction.”

Class	Description	Concrete Uses
AA	4000 PSI, 7 SACK or 658 LB CEMENT	Bridge Floors, Approach Slabs, Reinforced Concrete Piles, Drilled Shaft Foundations, Parapet Walls, Concrete Rail, and Handrails.
A	3000 PSI, 6 SACK or 564 LB CEMENT	Pavements, Alleys, Sidewalk and Driveway Approaches, Roadway Culverts, and all Reinforced Concrete not requiring either Class AA or S Concrete.
S	3000 PSI, 6 SACK or 564 LB CEMENT	Pier Caps, Columns, Abutments, Retaining Walls, Bridge Box Culverts, and all Reinforced

Class	Description	Concrete Uses
		Concrete not requiring Class AA Concrete.
C	2400 PSI, 4.2 SACK or 395 LB CEMENT	Soil Erosion Control Structures.

407.14 Where Residential Estate (RE) zoning has been allowed the typical roadway section may be as stated above.

408 CROSS SECTIONS

408.1 Cross sections will be required as a part of the construction plans. Additional cross-sections will be required at the location of driveways.

408.2 All cross sections for street rights-of-way shall be drawn to scale showing existing ground and proposed construction from building line to building line.

408.3 Typical cross sections shall be shown for each street if the slope to the property line exceeds 2 percent.

408.4 Each section shall be stationed clearly.

408.5 The beginning and ending points of a project shall be stationed and cross sections for both the stations shall be drawn.

408.6 Typical interval between cross sections shall be 50 feet. Additional cross sections shall be included at driveways or as required.

408.7 Sufficient spot elevations and grading information shall be shown to demonstrate that water is not ponded behind curbs or in ditches.

408.8 Scale for cross sections shall not be less than:

	Horizontal	Vertical
Channels	1:100 (1" = 10')	1:50 (1" = 5')
Streets	1:50 (1" = 5')	1:50 (1" = 5')

409 STRUCTURES AND SPECIFIC DETAILS

409.1 All special structures will be detailed or the appropriate standard details shall be provided with the plans.

409.2 Special structures shall be drawn to scale unless noted otherwise.

409.3 Sufficient details, dimensions, coordinates, stationing and offset or related notes shall be provided for all structures.

- 409.4 All structures subject to vehicular traffic shall be designed for H-20 loading.
- 409.5 All bridge design shall meet the requirements in the latest edition of Standard Specifications for Highway Bridges prepared by AASHTO. Bridges shall be designed according to Load Resistance and Factor Design (LRFD) specifications.
- 410 SIDEWALKS
- 410.1 All sidewalk layouts and designs shall be reviewed by the Public Works Department. Sidewalk layouts and designs for the central business district and other commercial and industrial areas shall be furnished by the Public Works Department.
- 410.2 Unless otherwise specified by the Public Works Department, all sidewalk widths shall be 4 feet wide on local and collector streets and 5 feet wide on arterial streets. When a sidewalk is constructed adjacent to the street curb and gutter, it shall be constructed 1 foot wider. Sidewalks parallel to arterial roads with designated bike paths shall be 8 feet wide.
- 410.3 Sidewalks shall be required on both sides of local, collector, and arterial streets. All sidewalks must be constructed before the final plat is accepted and filed on record.
- 410.4 All sidewalks shall consist of concrete (ODOT Class A, 6 sack, 3000 psi, water/cement ratio of 0.48, 1 inch to 3 inch slump). Sidewalks shall include pedestrian bridges across creeks and streams where applicable.
- 410.5 The finished thickness of Portland cement concrete sidewalks shall not be less than 4 inches and the width shall be not less than 4 feet. Immediately after finishing operations, curing shall be accomplished by an approved method such as cotton mats, wet burlap bags, membrane curing compounds, or other methods accepted by the City Engineer.
- 410.6 In general, sidewalks shall be constructed within the dedicated right-of-way at a distance no less than one foot from the abutting property lines, and except at intersections or as approved by the City, shall be no less than 3 feet from the outside curb line of the street pavements.
- 410.7 Sidewalks must provide access for the safe and convenient movement across curbs of physically handicapped persons, including those persons in wheelchairs. Wheelchair ramps shall be constructed in accordance with the ODOT Standard Specifications and Standard Details and in conformance with the Americans with Disabilities Act (ADA).
- 410.8 To accommodate wheelchair passing space, sidewalks less than 5 feet wide shall have at least 5 feet by 5 feet passing spaces located at intervals not to exceed 200 feet. Driveways may be utilized as appropriate, provided that the cross-slope of the driveway on each side of the sidewalk does not exceed 2 percent (50:1).
- 410.9 Transverse crack control joints shall be placed at intervals not to exceed 5 feet. Joints shall be tooled or sawed to a depth of 1 inch.

- 410.10 Expansion joints shall be placed at curbs, driveways, or abutting structures.
- 410.11 Where sidewalks intersect drainage flumes, the sidewalks shall span the flume if the flume is the principal drainage between the lots, and the sidewalks may slope into the flume if the flume is constructed to act as an overflow. Where sidewalks cross driveways, the sidewalk thickness shall match the driveway thickness.
- 410.12 Detectable warnings shall be required on the end of curb ramps and shall consist of raised truncated domes with a diameter of nominal (0.9 in) 23 mm, a height of nominal (0.2 inches) 5 mm and a center-to-center spacing of nominal (2.35 inches) 60 mm, shall be the full width of the ramp walking surface, (24 inches) 600 mm length from the end of ramp and shall contrast visually with adjoining surfaces, either light-on-dark, or dark-on-light. The material used to provide contrast should contrast by at least 70 percent. Contrast in percent is determined by:

$$\text{Contrast} = [(B1 - B2)/B1] \times 100$$

where B1 = light reflectance value (LRV) of the lighter area and B2 = light reflectance value (LRV) of the darker area. Note that in any application both white and black are never absolute; thus, B1 never equals 100 and B2 is always greater than zero. The Public Works Department shall review for approval detectable warning material and its method of installation.

#### 411 DRIVEWAY APPROACH STANDARDS

##### 411.1 General

- A. A driveway approach sketch shall be submitted with the driveway permit application for review by the Public Works Department.
- B. A variance from the driveway approach standards described in this section and contained in the City's Standard Specifications and Construction Drawings may be granted upon review by the Public Works Department.
- C. A driveway approach installation and/or maintenance not meeting the requirements of the driveway approach standards may be corrected by the City if deemed necessary by the Public Works Department, at the expense of the property owner and after notice to the property owner to correct the problem.
- D. Specifications and Standards for all materials used in constructing a driveway approach shall be in accordance with the ODOT Standard Specifications for Construction.
- E. All subgrade shall be compacted to 95 percent standard proctor density within plus or minus two percent of the optimum moisture content before any sub-base or paving material shall be placed. At the intersection of public roads, driveways shall be located so that the dimension measured along the edge of the travel way "C" is

greater than the frontage boundary line, and the tangent projection of the nearest edge of the driveway is greater than 100 feet (for commercial and industrial driveways) or 30 feet (for residential driveways). (Refer to the ODOT Standard Specification and Standards for Construction).

F. 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 does, in fact, constitute a thoroughfare accessible to the public, shall be constructed to specifications required for local streets.

G. Approach types:

1. Type I: Driveway approach on street located in agricultural or residential estate zoning.
2. Type II: Driveway approach on street or areas other than agricultural or residential estate zoning (urban areas).

H. All concrete driveway approaches shall use Class A (ODOT Standard Specifications) concrete and be a minimum of 6 inches thick. All commercial driveways shall be concrete and may be thicker than 6 inches if recommended by the geotechnical report or required by the Public Works Department.

I. The expansion joint at the right-of-way line may be redwood or cedar, if asphaltic expansion joint material is used at the building (garage if the building is a residential home).

J. Residential lots with access either to a collector or local street shall not have driveway access to an arterial street. A residential lot at the corner of a local and collector street shall not have driveway access to the collector without the approval of the Public Works Department.

K. Every driveway approach shall be connected to a parking pad/drive of the same width or larger than the approach and a minimum of 20 feet deep beyond the Right-of-Way (ROW) Line (limited by Zoning Ordinance concerning paving coverage of yard, drainage impact on surrounding properties, utility easement accessibility, collector access or Historic District Impact).

L. In areas designated as a Historic District, the minimum driveway width shall be 8 feet and the maximum 10 feet.

#### 411.2 Approach Grades

A. Minimum approach width is 10 feet.

B. Grades suggested for driveway conditions are as follows:

Condition	Approach Grade	Maximum Desirable	Grade Change Maximum
High Volume Driveway	6%	0%	3%
Low Volume Driveway on Arterial or Collector Streets	6%	3%	6%
Low Volume Driveway on Local Street	10%	6%	12%

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

412 SPECIAL CONDITIONS

A. Residential Driveway Approaches without Curb (Type I)

- 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.
- The driveway approach shall be constructed using materials listed in the following chart:

Minimum Material Standards

Existing Street	Required Driveway Approach	
	Material	Thickness
Concrete	Concrete	6"
Asphalt	Type S5 Asphalt	6"*
Chip Seal	Type S5 Asphalt	6"
Crushed Rock	1.5" Crushed Rock	6"
Earth	1.5" Crushed Rock	6"

\* 8" if commercial

- Drainage pipe may be constructed of reinforced concrete or other approved pipe material with soil tight joints. The minimum pipe diameter shall be 18 inches or equivalent. Cover shall meet the manufacturer's

specifications. Minimal cover will require a heavier grade of pipe. Corrugated steel pipe shall only be used if a special exception is granted.

4. 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 a shallow ditch, 12 inch depth or less.

B. Type II Driveway Approaches (streets or alleys located in areas other than agricultural or residential estates)

1. All driveway approaches shall consist of concrete (ODOT Class A, 6 sack, 3000 psi, water/cement ratio of 0.48, 1 inch to 3 inch Slump), 6 inch minimum thickness. For driveway thickness of 8 inches or greater, dowels are required at contraction joints and at joint connection with the street per Section 2304.4.A.4. All concrete paving shall have 5 percent to 7 percent air entrainment by volume.

2. At the right-of-way line, the drive shall be .25 foot above the top of the existing curb.

3. Connections to the existing curb will meet and match the old curb.

4. Between driveways, construct a minimum 10 foot width pedestrian safety island at and parallel to the property line.

5. Where the existing pavement is asphalt or concrete with a separate concrete curb and gutter, remove both curb and gutter, then construct driveway and gutter as one unit.

6. Immediately after finishing operations, curing shall be accomplished by wet burlap bags, membrane curing compounds, or other methods accepted by the Public Works Department.

7. Sawed contraction joints shall be made as soon as the concrete has set firmly enough to support the concrete saw without cracking. The joints shall be filled with an approved silicone sealant and backer rod or other material accepted by the Public Works Department.

8. All exposed edges shall be tooled to no less than ¼ inch radius (curb backs and slabs).

9. 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.

C. Temporary End-of-Pavement Sections

1. A gravel turn-around area shall be provided at the temporary end of any street length in excess of 150 feet. The gravel turn-around will consist of either a gravel circle or a T shaped turnaround. The radius of the turn-around will be a minimum of 38 feet, and the gravel thickness will be a minimum of 6 inches.
2. Where a temporary end of street is less than 150 feet in length, one of the following shall be installed at the end of the pavement section: either a 12 inch wide concrete header curb, or an additional 5 feet of asphaltic pavement. In both cases, this end of pavement material shall be removed prior to extending the pavement section.

413 SIGNAGE

- 413.1 Street and traffic control sign plans shall be prepared by the developer for approval of the Public Works Department.
- 413.2 The developer shall be responsible for street name and other traffic control signage in all subdivisions, both public and private. All signs shall meet or exceed the requirements outlined in the Manual on Uniform Traffic Control Devices, latest edition.
- 413.3 Subdivision signs shall be installed prior to the filing of the final plat.
- 413.4 A Work Zone Traffic Control Plan shall be provided to the Public Works Department for review before any work is done on existing streets.

414 STRIPING

- 414.1 Plans for striping of streets requiring striping shall be reviewed by the City Engineer.
- 414.2 Striping shall be in accordance with the following schedule:

Vehicles per Day	Striping Material
Over 4,000	Thermoplastic, full thickness
2,000 - 4,000	Thermoplastic, half thickness
Under 2,000	Paint

415 EASEMENT AND RIGHT-OF-WAY

- 415.1 Easements and rights-of-way shall be clearly dimensioned on the plans. For curved roadways, additional right-of-way may be required to maintain adequate sight distance.
- 415.2 All overland restricted drainage easements will be shown detailed on the “Plans” and “Final Plat” as well as described in the conditions and restrictions of the plat.
- 415.3 An unimproved drainage way left in a natural state shall be dedicated to the public, either by title or easement, and platted with a minimum width equal to the floodplain. Dedicated drainage way shall be provided with adequate vehicular ingress and egress for maintenance purposes. If said drainage way width is less than 150 feet the minimum width required will be the floodplain plus an additional width of 15 feet on each side of the floodplain. Said dedication may have an ownership reversion provision.
- 415.4 The City may accept dedication of the entire floodplain area for an unimproved channel.
- 415.5 Adequate restrictive easements for dedicated right-of-way must be provided for access and maintenance of the drainage facilities.
- 415.6 The minimum width for all storm sewer easements shall be the outside diameter of pipe plus 10 feet, and the pipe shall be laid in the center of easement.

416 PAVING DESIGN

416.1 AASHTO Method

- A. Street pavements shall be designed on the basis of Guide for the Design of Pavement Structure, (AASHTO), latest edition and current amendments.
- B. Computations shall be performed on an up-to-date version of Pavement Analysis Software, developed by the American Concrete Pavement Association.

416.2 Design Parameters

A. Traffic Volumes

Street Class	ADT	No. Lots
Residential	300-700	50-120
Residential Collector	2,000-6,000	350-1025

- B. Arterial traffic volumes shall be based on the current Comprehensive Plan.

C. Truck Traffic Volumes

D. Truck traffic for various axle loads, taking into account truck traffic during construction, shall be estimated as follows:

Truck Traffic for Residential and Residential Collector Streets

(1) Axle Load (K)	(2) Construction (Per Lot)	(3) Occasional (Per Lot Per Year)	(4) Regular (Per Year)
Tandem:			
18/23/23	36	0.503	104
Single:			
12/22	42	0.123	348
10/18	38	2.68	1456

Note:

1. Traffic volumes are total vehicles per year.
2. Values for each truck category, for input to the paving design software are calculated as follows:

$$\text{Trucks per year} = [\text{Col. (2)} * \text{No. Lots} / \text{Design Period}] + [\text{Col. 3} * \text{No. Lots}] + \text{Col. (4)}$$

E. Design Period: The street pavements shall be designed for a period of 20 years.

F. Reliability Factor:

Street Class	Reliability Factor
Residential	65
Collector	85
Arterial	90

G. Drainage Coefficient: Except as accepted by the Public Works Department for specific conditions, supported by geotechnical testing, coefficient of drainage shall be 1.05.

H. Geotechnical Data: California Bearing Ratio (CBR) or subgrade modulus (k), may be used in the design of roadway pavement. The following table contains approximate range of values. These values are to be considered as a guideline and not necessarily used for design.



B. Street lights shall be installed by the franchised vendor providing the electrical service and shall be shown on the preliminary plat.

C. Four basic objectives shall be considered in providing street lighting: aesthetics, traffic safety, security, and intersection identification. The objectives to be considered are directly related to the function of the street to be lighted.

1. For major thoroughfares, the primary objectives are aesthetics and traffic safety.
2. For minor streets and local collectors, the primary objectives are security and intersection identification.

D. Light poles shall be located a minimum of 5 feet back of curb or future curb, including left and right turn lanes.

E. The City of Sapulpa will not assume maintenance and operation costs of street lights installed as a part of the original subdivision for security purposes, should status change occur (i.e. annexation).

F. The City will approve the plan developed by the electrical provider showing the location of street lights in all new subdivisions upon receiving an official “preliminary” plat of the subdivision for review.

#### 417.2 Scheduling

A. Street lighting shall be chronologically integrated with development.

B. Street lighting shall not be installed until all required offsite improvements such as water mains, sanitary sewer mains, paving, and drainage structures are completed and accepted by the City, to avoid conflicts with other Contractors and workmen. However, it shall be installed prior to extensive development to avoid interference with private landscaping. A good rule to follow is to order street lighting at the same time that street name signs are ordered. Close coordination with the developer is required for lights to be installed in time to avoid interference with private landscaping.

#### 417.3 Location and Design

A. Generally, street lighting shall be installed in all zones except A-1, A-2, and R-E, as development occurs. However, street lighting may be considered in A-1, A-2, and R-E zones if they are bordered or traversed by a major thoroughfare, and if that major thoroughfare has been improved to current City standards.

B. The following guidelines shall be followed in providing lighting on minor streets and local collectors:

1. One 4,000 lumen street light at each street or alley intersection.
2. One 4,000 lumen street light at each end of each cul-de-sac or other permanently dead ended street.
3. One 4,000 lumen street light at the approximate midpoint of curvilinear streets that prohibit visual contact between intersections.
4. One 4,000 lumen street light midway between intersections that are spaced 700 feet or more apart.

C. The spacing and sizing of thoroughfare lighting shall be in accordance with the criteria of Roadway Lighting Handbook, U.S. Department of Transportation, Federal Highway Administration, latest edition.

417.4 Approvals

A. Requests for street lighting shall be submitted to the office of the Public Works Department.

B. Lighting for minor streets and local collectors shall be reviewed by the Public Works Department and forwarded to the franchised vendor on forms provided by the vendor. Lighting for minor streets and collectors which are not as specified herein shall require the review of the Public Works Department.

C. Proposals for thoroughfare lighting shall be submitted in letter form to the franchised vendor by the Public Works Department, with final allowance to proceed with installation by the Director of Public Works.

D. The Public Works Department will document in writing reasons for denying a request for lighting.

418 CUT BACK PARKING ON PUBLIC RIGHT-OF-WAY

418.1 New cut back parking areas will be allowed only on roadways carrying less than an average of 1,000 vehicles per day. Where allowed, sufficient maneuvering space for safe backing must be provided. The minimum width of the parking area, measured perpendicularly from the edge of the travel lane, shall be as follows:

Parking Angle	Minimum Width
0 Degrees (Parallel)	21 Feet
30 Degrees	27 Feet
45 Degrees	33 Feet

60 Degrees	39 Feet
90 Degrees (Perpendicular)	43 Feet

418.2 Cut back parking areas shall be paved in accordance with the applicable adopted City paving standards. Curbs shall be constructed to prevent parked vehicles from encroaching into unpaved areas or sidewalks.

419 ARTERIAL ACCESS

419.1 Direct access to arterial roadways must be avoided.

419.2 Adequate sight distances will be required at every driveway. Any movement for which inadequate sight distance is available will not be permitted.

419.3 Each development area will be permitted to have one access driveway, either on the parcel or as part of joint access. Where side streets abut the parcel, the access will be provided from the side street. Additional driveways may be needed and provided under the following conditions:

1. If the daily traffic volume using the driveway exceeds 2,000 vehicles per day.
2. If traffic using one driveway exceeds the capacity of a single stop controlled intersection during one peak street traffic hour or the peak site traffic hour.
3. If a competent traffic analysis shows that traffic conditions warrant additional driveways.

419.4 In all cases, minimum spacing and clearances shall be provided.

419.5 Driveways along arterial roadways must satisfy the following minimum spacing requirements:

Posted Speed	Small Generator	Medium Generator	Large Generator
	0 to 100 peak hour trips	101 to 200 peak hour trips	201 and more peak hour trips
< 40 MPH	220 Feet	330 Feet	550 Feet
> 40 MPH	330 Feet	440 Feet	660 Feet

Distances are from centerline to centerline of driveway

419.6 The corner clearance for driveways next to public road intersections shall meet the following criteria:

Speeds < 40 MPH		Speeds > 40 MPH	
Signal Control	Stop Control	Signal Control	Stop Control
175 Feet *	100 Feet	350 Feet*	200 Feet

\* The Director of Public Works or his/her designee may, where consistent with public safety, specify greater distances in order to keep driveways away from queuing areas and thus assure adequate traffic flow through the intersection.

419.7 Design speed shall be 25 miles per hour on all residential streets and 30 miles per hour on all collector streets.

419.8 For horizontal curves the minimum centerline radius on street alignment shall be 125 feet.

419.9 The minimum radius on returns at residential intersections shall be 25 feet. At intersections of a residential and arterial street, the minimum radius on returns shall be 30 feet. At intersections of arterial streets, the minimum radius on returns shall be 40 feet. The minimum radius on the returns for industrial districts shall be 40 feet.

419.10 The maximum grade of a residential street when intersecting an arterial shall be 2 percent for a minimum of 100 feet from the curb line of the arterial. No vertical curve shall begin any closer than 50 feet from the curb line of the arterial. The maximum grade of residential streets at intersections shall be 4 percent.

419.11 A proposed and existing profile shall be shown beyond the end of all dead end streets for a minimum of 200 feet to determine a satisfactory grade for future development.

419.12 Cross slope may be ¼ inch or 3/8 inch per foot; however, crown will be flattened off so that crown never exceeds curb height.

419.13 Proposed streets shall intersect one another as nearly at right angles as topography and other limiting design factors permit.

419.14 Proposed developments of residential areas shall keep to a minimum the use of four way intersections.

420 TYPICAL SECTIONS

420.1 Typical sections shall be drawn at the same horizontal and vertical scale.

420.2 Typical sections shall show dimensions, type of materials, layer details, reserve topsoil, temporary and permanent erosion control, compacted thickness, etc.

420.3 All typical sections or notes that are necessary to clearly reflect the design shall be included.

421 CROSS SECTIONS

421.1 Cross sections will be required as a part of the construction plans and are considered necessary to reflect more clearly the intent of the design.

421.2 All cross sections for street rights-of-way shall be drawn to scale showing existing ground and proposed construction from building line to building line.

421.3 Typical cross sections shall be shown for each street if the slope to the property line exceeds one quarter inch per foot.

421.4 Each section shall be stationed clearly.

421.5 The beginning and ending points of a project shall be stationed and cross sections for both the stations shall be drawn.

421.6 Maximum distance between cross section stations shall be 100 feet.

421.7 Sufficient information shall be furnished to show that water is not ponded behind curbs or in ditches.

421.8 Scale for cross sections shall not be less than:

A. Channels      1" = 10' Horizontal                      1" = 5' Vertical

B. Streets        1" = 5' Horizontal                                      1" = 5' Vertical

422 STRUCTURES AND SPECIFIC DETAILS

422.1 All special structures will be detailed.

422.2 Special structures shall be drawn to scale unless noted otherwise.

422.3 Sufficient details, dimensions and related notes shall be provided for all structures.

422.4 All structures subject to vehicular traffic shall be designed for H-20 loading.

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

423 EASEMENT AND RIGHT-OF-WAY

423.1 Easements and rights-of-way shall be clearly dimensioned on the plans.

423.2 All overland restricted drainage easements will be shown detailed on the "Plans" and "Final Plat", as well as described in the conditions and restrictions of the plat.

423.3 An unimproved drainage way left in a natural state shall be dedicated to the public, either by title or easement, and platted with a minimum width equal to the floodplain width required to pass the regulatory flood. Dedicated drainage way shall be provided with adequate vehicular ingress and egress for maintenance purposes. If said drainage

way width is less than 150 feet the minimum width required will be the floodplain plus an additional width of 15 feet on each side of the floodplain. Said dedication may have an ownership reversion provision.

- 423.4 The City may accept dedication of the entire floodplain area for an unimproved channel.
- 423.5 Adequate restrictive easements for dedicated right-of-way must be provided for access and maintenance.
- 423.6 The minimum width for all storm sewer easements shall be the outside diameter of pipe plus 10 feet, and the pipe shall be laid in the center of easement.

#### 424 LIGHTING

- 424.1 Installation of street lights by the Developer, as approved by the Public Works Department, will be for the purpose of traffic safety only.
- 424.2 The City of Sapulpa will not assume maintenance and operation costs of street lights installed as a part of the original subdivision for security purposes, should status change occur (i.e. annexation).
- 424.3 The City of Sapulpa will approve the plan developed by OG&E showing the location of street lights in all new subdivisions upon receiving an official "preliminary" plat of the subdivision for review.

## DIVISION 500 STORMWATER DRAINAGE CRITERIA

### 500 POLICIES

- 500.1 The peak flows from development shall be controlled by on-site detention, or by regional detention identified in the adopted City master drainage plans, further described in the following policies:
- A. The stormwater drainage system for all developments shall be designed to pass the stormwater runoff received from upstream and from the subject property during a 1% (100-year) frequency rainstorm.
  - B. In this Manual, the 1% (100-year) frequency rainstorm is the “regulatory 1% (100-year) storm”.
  - C. All development shall be constructed such that it will not increase the frequency of flooding or the depth of inundation of structures during the 100% (1-year), 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), and 1% (100-year) flood events.
  - D. Peak flows shall not be increased at any location, upstream or downstream of any development for the 100% (1-year), 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), and 1% (100-year) flood events unless approved by the City Engineer and there is adequate conveyance so that no properties are damaged.
- 500.2 If a tract of land under development has a floodplain area within its boundary, then a hydraulic (backwater) analysis of the existing and proposed drainage system shall be provided to show any impact the proposed development has on the floodplain area and elevation.
- 500.3 At the discretion of the Public Works Department, the regulation or mitigation of peak flows to allowable levels shall be achieved by on-site detention, regional detention or improved conveyance to compensate for increased flows from the development.
- 500.4 Fee-in-lieu of on-site detention, if approved by the Public Works Director, may be paid when a regional detention facility has been master planned and funded OR when it can be demonstrated that the development will not aggravate the flooding of downstream facilities. May require both a separate resolution and fee guidelines.
- 500.5 Compensation shall be provided for filling or development which diminishes the flood storage capacity of any regulatory flood plain area by providing compensatory storage or other method as determined by the Public Works Department.
- 500.6 In order to compare the effects of the project, existing conditions shall be computed and compared to the “with project” conditions at the point of discharge from the project and

at points downstream as specified by the Public Works Department to ensure that there is no increase in the discharges.

- 500.7 The design of any development shall provide for the maximum use of open channels and natural streams for drainage areas of 40 acres or more, and detention or retention storage to control runoff rates. Natural drainage channels and techniques shall be given priority consideration in preparation of stormwater drainage system designs and shall be designed or improved as an integral part of the landscape of the area in accordance with the following guidelines:
- A. Drainage channel improvements shall be developed and designed to preserve and protect trees and other worthy botanical and geological features to the maximum extent practicable. Vegetation shall be preserved when feasible. Riparian habitat shall be maintained when feasible, during improvements.
  - B. Wherever channel improvements are required to accommodate storm runoff in a specified manner, the designs shall provide maximum practical utilization of turf, sodding, and natural ground surface protection techniques in order to protect the environment by reducing erosion potential.
  - C. Water quality control measures shall be incorporated into stormwater management designs, subject to approval of the Public Works Department. Additionally, impacts on receiving water quality shall be assessed for all flood management projects.
  - D. Open channels are required when delineated in the approved master drainage plan.
  - E. The Public Works Department may require open channels for other drainage ways for just cause.
  - F. Stormwater pumping shall not be used as a primary method of conveyance.
- 500.8 Storm sewers shall be utilized in all development up to a drainage area of 40 acres. Storm sewers may be required for larger drainage areas where there are no viable alternatives to fit the site or geographic conditions or to meet the requirements of this Manual at the discretion of the Public Works Department. Storm sewers may be used to alleviate existing drainage problems and when required in the approved Master Drainage Plans, subject to the approval of the Public Works Department.
- 500.9 Developers shall complete construction of stormwater facilities to control runoff and erosion prior to issuance of any building permits.
- 500.10 A Maintenance Bond or Irrevocable Letter of Credit shall be posted in an amount equal to 100 percent of the determined amount of construction costs for a two year period.

500.11 When projects will be funded (in whole or in part) by the State of Oklahoma or Federal agencies, the more stringent criteria will apply to the project.

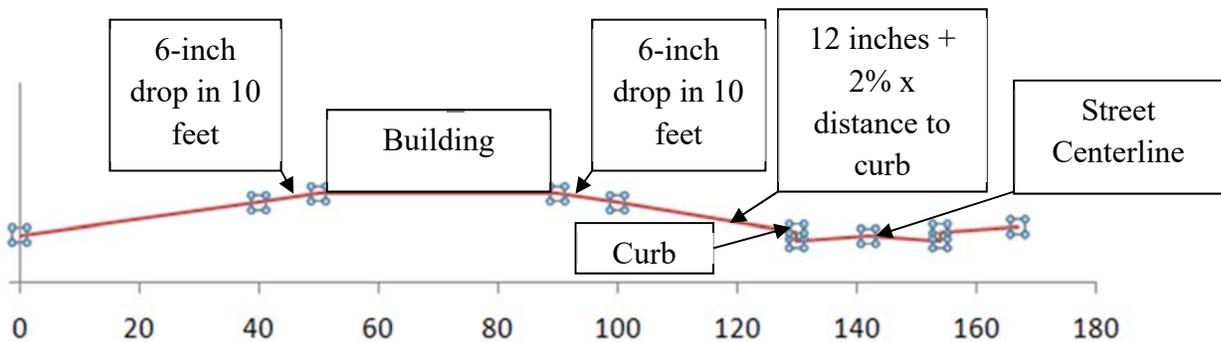
501 LOT DRAINAGE

501.1 Surface drainage shall be diverted to a public storm sewer conveyance or other approved point of collection that does not create a hazard. No more than 2 lots or ½ acre shall be allowed to drain onto an adjacent lot unless it drains into a public stormwater drainage system component.

501.2 Lots shall be graded to drain surface water away from foundation walls, as follows:

A. The grade shall fall a minimum of 6 inches within the first 10 feet.

B. The top of any exterior foundation shall extend above the elevation of the street gutter at point of discharge or the inlet of an approved drainage device a minimum of 12 inches plus 2 percent times the distance from the gutter to the building as shown below.



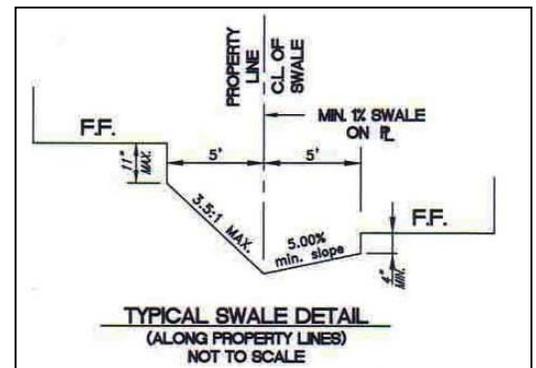
501.3 Where lot lines, walls, slopes or other physical barriers prohibit 6 inches of fall within 10 feet, the following applies:

A. Drains or swales shall be constructed to ensure drainage away from the structure.

B. Impervious surfaces within 10 feet of the building foundation shall be sloped a minimum of 2 percent away from the building.

C. Between buildings, the sketch to the right shows the minimum requirements for drainage.

501.4 Crawlspace shall not be used for mechanical and electrical equipment or storage purposes of any kind lower than the following:



- A. An elevation of one foot above the lowest curb (in a curb and gutter section) or street elevation (in an open paving section) adjacent to the lot; or
- B. An elevation one foot above the lowest ground elevation adjacent to the lot.

501.5 In a curb and gutter roadway section where buildings are located below the grade of the street, the following applies:

- A. There shall be a horizontal distance between the toe of the slope and the building equal to the horizontal component of the slope. This area shall be used to divert water around the building.
- B. If a wall is used to separate the curb elevation from the elevation in front of the building, the horizontal distance between the wall and the building shall be equal to or greater than the difference in elevation between the curb elevation and the building finished floor.
- C. The drive shall be shaped so that the high point between the gutter and downhill portion of the driveway slope is at or above the highest adjacent curb elevation.

501.6 The elevation of the front of buildings adjacent to the street will not be allowed below roadway elevations in an open section.

501.7 Operation and Maintenance of Stormwater Detention Facilities:

- A. The City of Sapulpa requires that maintenance access be provided to all storm drainage facilities for operational and maintenance purposes through acceptance of the project by the City. After acceptance, permanent access shall be protected by a dedicated right-of-way or easement. The right-of-way or easement shall be shown on final plats or final development plans and shall clearly state that the purpose is for stormwater management facilities.
- B. Drainage facilities provided by the developer shall be fully and properly maintained from construction through final acceptance of the development improvements by the City of Sapulpa.
- C. It shall be the responsibility of all property owners to maintain private drainage facilities with a tributary watershed area of less than 40 acres as follows:
  - 1. Mow and provide maintenance of drainage channels and their slopes for that portion of the channel lying within their property limits.
  - 2. Keep clear all drainage channels within the boundaries of their properties in accordance with the requirements of this Manual.
  - 3. Prevent any and all drainage interferences, obstructions, blockages, or other adverse effects upon drainage into, through, or out of the property.

4. Control the erosion of the drainage channels and the deposition of materials into the drainage channels from the property.

D. Private stormwater detention facilities shall be maintained as follows:

1. Remedial activities to be provided include erosion control, sediment removal and minor reconstruction of side slopes, areas subject to turbulence, and detention pond outlet works.
2. Mowing shall be provided once a month during the 7-month growing season.

## 502 EASEMENTS

502.1 Easements will be required for all stormwater management facilities not in public rights-of-way; including:

- A. Storm sewers
- B. Channels
- C. Storage areas
- D. Other hydraulic structures
- E. All portions of the public stormwater drainage system that cross more than 2 lots or 2 properties

502.2 Easements shall:

- A. Allow no restriction of the drainage purposes.
- B. Clearly identify that the purpose includes operation and maintenance of stormwater management facilities.
- C. Be shown on all plats, including widths and specific purposes (i.e.: storm sewer, maintenance access, channel, etc.).

502.3 The widths of easements are determined by:

- A. The size of the storm sewer, its depth, and the equipment needed to remove, replace or repair the sewer.
- B. The width of the easement for channels, storage areas and other structures is generally determined by the size of the facility and the equipment needed for maintenance, typically covering the entire facility plus 20 feet for maintenance access.

502.4 Drainage easements (see Table below) shall be shown on the Final Plats and Final Development Plan and shall state that the City has the right of access on the easements which shall be kept clear of obstructions to the flow and/or maintenance access.

Required Operations, Maintenance Easements & Outlot Areas  
(Not Within A Public Right Of Way)

Drainage Facility	Minimum Easement/Outlot Area Width			
<b>Storm Sewers</b>				
<i>Pipe Diameter</i>	<i>Width of Easement for Trench Depth to Pipe Invert (Feet) of:</i>			
<i>Inches</i>	<i>5</i>	<i>10</i>	<i>15</i>	<i>20</i>
18"	15	15	20	30
24"	15	15	25	35
30"	15	15	25	35
36"	(1)	15	25	35
42"	(1)	15	25	35
48"	(1)	15	25	35
54"	(1)	15	25	35
60"	(1)	20	30	35
>60" (2)	(1)	30	30	30
	Notes: (1) Area of minimum cover, depending on structural requirements and easement location. (2) For pipe diameters greater than 60 inches, repairs can be made internally and the ROW width is not dependent of excavation for repairs.			
<b>Storm Sewer Overflow, Where Required</b>	As required to contain surface overflow in an overland drainage easement. Refer to Section 5.8.10.			
<b>Open Channel</b>	Top width plus 20 feet; five feet on one side and 15 feet on the side with the maintenance access road.			
<b>Post-development 1% (100-year) Regulatory Floodplain</b>	Area sufficient to contain the regulatory 1% (100-year) post-development floodplain.			
<b>Open Space Detention Facilities</b>	As required to access and contain storage volume and associated facilities plus 20 feet of maintenance access around the perimeter.			
<b>Parking Lot and Underground Detention Facilities</b>	As required to access and contain storage volume and associated facilities.			

502.5 An outlot shall be platted containing the regulatory 1% (100-year) floodplain.

503 REVISIONS TO FLOODPLAIN MAPS

503.1 Changes to the boundaries of a flood plain, floodway, flood insurance zone, flood elevation, flood depth and other information shown on the officially adopted flood plain

maps must be approved by the Federal Emergency Management Agency (FEMA) through the Conditional Letter of Map Revision (CLOMR) and/or Letter of Map Revision (LOMR) process.

- 503.2 The Floodplain Administrator (FPA) will not approve a Letter of Map Revision based on Fill (LOMR-F) in the City of Sapulpa without supporting documentation verifying compliance with City ordinances. The placement of fill in the floodplain shall require hydraulic studies to determine the upstream and downstream effect.
- 503.3 A CLOMR is required to be obtained from FEMA before a project can be built if the project includes any work within the designated floodway, or if the project would require any change in the effective hydraulic model, the delineated 1% (100-year) floodplain, or the effective flood profiles.
- 503.4 A LOMR is required as a follow-up to the CLOMR, if any work has been completed within the designated floodway, or if the project requires any change in the effective hydraulic model, the delineated 1% (100-year) floodplain, or the effective flood profiles. No occupancy permits will be approved until the LOMR is approved by the City for submittal to FEMA.
- 503.5 The new floodplain boundaries must be submitted to the City in GIS format in order to update the City's floodplain mapping.

#### 504 ACCEPTANCE OF EXISTING STORMWATER DRAINAGE FACILITIES

- 504.1 The City of Sapulpa will consider acceptance of existing stormwater drainage facilities not constructed under these criteria for ownership and maintenance without modification to the system using the following guidelines:
  - A. The system must be capable of conveying the regulatory 1% (100-year) storm flow using the criteria presented in this Manual.
  - B. The system must be reasonably maintainable with legal access to all facilities using the standards for access presented in these criteria.
  - C. Facilities submitted as part of previously approved plats, but not building permits, will be considered for acceptance.
  - D. Channels must meet the minimum standards of:
    - 1. Maximum side slopes of 3:1
    - 2. Maximum regulatory 1% (100-year) storm design flow velocity as set forth in these criteria with suitable vegetation and other erosion control facilities

3. The regulatory 1% (100-year) storm flow must be contained within the channel banks

E. Storm sewer systems must meet the minimum standards of:

1. Manholes at changes in pipe sizes and vertical alignment.
2. The requirements for manholes at changes in horizontal alignment will be considered on a case by case basis.
3. Manholes or other appropriate maintenance access must not be spaced farther apart than 500 feet.
4. The sewer must be structurally sound and not subject to imminent failure or have leaking joints.

505 TECHNICAL REQUIREMENTS

505.1 Rainfall:

A. Total rainfall depths for 100% (1-year) through 0.2% (500-year) storms with storm durations of 5-minutes to 24-hours have been developed for the City of Sapulpa and are presented in the table below. These rainfall depth-duration data will be used in all HEC-HMS and HEC-1 models to calculate existing and future development discharges for frequency storms.

Duration	Total Rainfall Depths for Sapulpa, Oklahoma In Inches							
	Frequency (Return Period)							
	100% (1-year)	50% (2-year)	20% (5-year)	10% (10- year)	4% (25- year)	2% (50- year)	1% (100- year)	0.2% (500- year)
5-minute	0.428	0.495	0.612	0.715	0.867	0.991	1.12	1.46
10-minute	0.626	0.725	0.896	1.05	1.27	1.45	1.64	2.13
15-minute	0.764	0.884	1.09	1.28	1.55	1.77	2.00	2.60
30-minute	1.08	1.25	1.55	1.81	2.21	2.53	2.87	3.75
60-minute	1.42	1.66	2.08	2.45	3.00	3.45	3.92	5.13
2-hour	1.76	2.07	2.61	3.08	3.79	4.36	4.97	6.52
3-hour	2.00	2.36	2.98	3.53	4.34	5.00	5.71	7.51
6-hour	2.43	2.85	3.59	4.25	5.23	6.04	6.90	9.12
12-hour	2.89	3.35	4.17	4.90	6.02	6.95	7.94	10.50
24-hour	3.35	3.87	4.80	5.65	6.91	7.96	9.09	12.00

Source: NOAA Atlas 14 Volume 8 Version 2

B. The rainfall depth duration data presented in the table above are point rainfall depths. As watershed area increases, it is unlikely that the rainfall will be evenly distributed over the entire watershed. Therefore, a storm area equal to the area of the entire watershed shall be used.

C. All hydrologic studies shall use a storm duration of 24 hours.

D. A balanced rainfall distribution shall be used. The maximum intensity duration shall be set to 5 minutes and positioned at the 50 percent location of the storm.

505.2 Runoff

A. All stormwater runoff shall be subject to review and approval by the Public Works Department with regard to analysis, design and construction of drainage way facilities. The appropriate public authority shall have the right of maintenance or to cause to be maintained the drainage way system for its intended purposes. If a stormwater master drainage plan is adopted for the area under consideration, then the provisions of the plan shall be followed.

B. Use of the Rational Method:

1. The use of the Rational Method is limited to watersheds with a time of concentration of less than 4 minutes for the entire watershed draining to the point of discharge from the project, and is generally used for inlet calculations only.
2. Additionally, the Wright-McLaughlin Method for adjustment of the larger storm frequencies is required, as described in the ODOT Drainage Design Manual (February 2014 or as amended).

A brief description of the Rational Method is shown below:

C. 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
- C<sub>f</sub> = Wright-McLaughlin modifier as shown below:
  - 1.0 for 10-year or less recurrence interval (10% storm)
  - 1.1 for 25-year (4% storm)
  - 1.2 for 50-year (2% storm)
  - 1.25 for 100-year (1% storm)
- C = Runoff coefficient, dimensionless
- T<sub>c</sub> = Time of concentration of the watershed
- I = Rainfall intensity for a duration equal to the time of concentration, inches/hour

A = Watershed area, acres

D. Values for “C”, the runoff coefficient, I, the rainfall intensity, shall be obtained from the ODOT Drainage Design Manual (November 2014 or as amended), Figure 7.6-A through 7.6-F.

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

$$t_c = T_o + T_f$$

Where:

$t_c$  = time of concentration (minutes)

$T_o$  = initial, inlet, or overland flow time (minutes)

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

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

Overland flow time  $t_i$  varies with surface slope, surface cover and distance of surface flow and is estimated using Equation 7.6(3) from the ODOT Drainage Design Manual (November 2014 or as amended), as shown below:

$$T_o = \frac{k(L_o^{0.37})}{S_o^{0.20}}$$

Where:

$T_o$  = Time of concentration for overland flow, minutes

$L_o$  = Length of overland flow path, ft

$S_o$  = Slope of the overland flow path, ft

$k$  = Dimensionless coefficient, a factor of the retardation of the conveyance of the water through the drainage area (overland) and is depending on the overland ground cover

Values of  $k$  for various overland ground covers are:

Surface Type	k
Concrete, Asphalt	0.372
Commercial	0.445
Residential	0.511
Rocky, Bare Soil	0.604
Cultivated	0.775

Surface Type	k
Woodland, Thin Grass	0.942
Average Pasture	1.040
Tall Grass	1.130

The maximum length of overland flow is 500 feet. At that point the flow will be considered gutter flow, pipe flow or channel flow. The time of concentration for channel flow may be computed by Equation 7.6(4) from the ODOT Drainage Design Manual (November 2014 or as amended), as shown below:

$$T_f = \frac{k'(L_f^{0.77})}{S_f^{0.385}}$$

Where:

$T_f$	=	Time of concentration for channel flow, minutes
$L_f$	=	Channel length, ft
$S_f$	=	Channel slope, ft/ft
$k'$	=	Dimensionless coefficient

Values of  $k'$  for various channel conditions are:

Channel Type	$k'$
Straight, clean stream	0.00592
Average stream, few obstruction	0.00835
Meandering stream with pools	0.0102
V-ditch	0.01252

G. The rainfall intensity is the average rainfall rate in inches per hour for the period of maximum rainfall of a given frequency having duration equal to the time of concentration. As described in the ODOT Drainage Design Manual (February 2014), the following equation shall be used in the Sapulpa area (Zone 4)<sup>1</sup> to calculate the average rainfall intensity:

<sup>1</sup> ODOT ROADWAY DRAINAGE MANUAL, February 2014, Figure 7.6-P – IDF CURVE COEFFICIENTS for  $I = a/(t_c + b)^c$

For the:	0.2% (500-Year) storm,	$I = 126 / (t_c + 13)^{0.76}$
	1% (100-Year) storm,	$I = 91 / (t_c + 12)^{0.75}$
	2% (50-Year) storm,	$I = 77 / (t_c + 11)^{0.74}$
	4% (25-Year) storm,	$I = 70 / (t_c + 10)^{0.74}$
	10% (10-Year) storm,	$I = 58 / (t_c + 10)^{0.74}$
	20% (5-Year) storm,	$I = 47 / (t_c + 9)^{0.73}$
	50% (2-Year) storm,	$I = 43 / (t_c + 9)^{0.76}$

Where  $t_c$  = time of concentration, minutes

H. All stormwater drainage facilities for which the time of concentration is 4 minutes or greater shall be designed using the SCS (NRCS) Method, using the rainfall pattern approved for this unit hydrograph method. The user is referred to Section 4, Hydrology, National Engineering Handbook, Soil Conservation Service, Washington, D.C., July 1966, for specific details on SCS Unit Hydrographs.

I. Floodplain storage must be taken into account for drainage basins of 40 acres or larger by routing of sub basin hydrographs.

J. For all hydrologic studies submitted to the City of Sapulpa which involve routing of sub basin hydrographs, the following routing methods shall be used as indicated:

1. Kinematic Wave is approved where the flow is completely contained in the channel or in a storm sewer for the 1% (100-year) storm.
2. The Storage-Discharge (Modified Puls) method is approved for areas of overbank flow and for reservoir routing.
3. The Lag method is used when the 1% (100-year) storm is completely contained in a storm sewer flowing full.

### 505.3 Hydraulics of Open Channels

A. Trapezoidal channels shall be designed with a hard lined low flow channel, such as concrete.

1. The low flow channel shall branch off to pick up any storm sewers discharging into the channel.
2. The top of the sides of the low flow channel shall be a minimum of 6 inches lower than the adjacent main channel bottom. This is to insure that the drainage runs over and into the low flow channel and does not erode around it.
3. The minimum cross slope on the bottom of the trapezoidal channel shall be 2 percent.

4. The easement for the trapezoidal channel shall include 10 feet additional width along each side of the top of the bank for an access road.

B. Roughness coefficients for drainage design will be as listed in tables 5-5 and 5-6, figure 5-5, pages 109 through 123, of "Open Channel Hydraulics" by Ven Te Chow (published by McGraw-Hill Book Company, 1959, or latest edition).

C. The minimum velocity in any drainage system shall be 2.5 feet per second, for all events of 20% (5 year) frequency and greater. The maximum velocity in an unlined ditch shall be 6 feet per second.

D. The centerline radius of a curve on an improved open channel shall be a minimum of 3 times the top width at the design flow or 100 feet, whichever is greater. All improved channels shall be provided with a minimum of one foot of freeboard above normal depth of the runoff from a 100 year frequency rainstorm.

E. At all bends in improved channels, the amount of freeboard shall be increased by the following conditions:

1. The increased freeboard height shall be maintained a minimum of one channel width upstream and downstream of the bend. Channel curves should be super-elevated to prevent overtopping the channel on the curves.

F. Borrow ditches, when allowed, shall not exceed 4 feet in depth. Culverts shall be sized to handle the 5 year or larger storm (minimum 15 inch diameter). The side slopes on the bank next to the road shall be 4 feet horizontal to 1 foot vertical, or flatter. The side slope on the opposite bank shall be maintainable.

#### 505.4 Hydraulics of Bridges

A. New bridges shall be constructed with adequate capacity to pass the 1% (100-year) storm with one foot of freeboard from the water surface to the low chord. A backwater analysis shall be required to illustrate compliance with this requirement.

#### 505.5 Hydraulics of Culverts

The following standards shall apply except as modified by this Manual:

A. "ODOT, Office of Design, Section 6, Policies and Procedures".

B. "Standard Specifications for Highway Construction", ODOT.

C. FHWA publication: Hydraulic Design of Highway Culverts.

D. FEMA Requirements: All bridges that cross FEMA studied streams shall follow the FEMA and Floodplain Administrator's submission and review requirements.

E. Zero Rise: There shall be no adverse impact (zero rise in water surface elevation) for the design discharge and the existing conditions 100-year discharge upstream or downstream of the bridge.

F. Culvert Hydraulic Design Program: HEC-RAS is the preferred hydraulic design program for culverts.

G. Design Discharge: The design discharge for all culverts shall be the 1% (100-year) discharge.

H. Freeboard: The vertical clearance of the lowest low chord of the culvert above the 1% (100-year) water surface elevation shall be 1 foot in those locations where full flow or headwater on the culvert would flood upstream properties.

I. Headwater: For all other culverts, the maximum headwater to culvert diameter (or rise) ratio shall be 1.5 for the 1% (100-year) storm.

J. Backwater, or the rise in the 1% (100-year) flood water surface due to the restrictions created by the construction of the culvert, shall be 1 foot or less. No increase in water surface elevation is allowed that will increase the floodplain outside of the limits of the channel or on private property.

K. Velocity:

1. The minimum velocity in the culvert shall be 3 feet per second for any studied flow rate to assure a self-cleaning condition.
2. The maximum velocity in the culvert shall be 20 feet per second.
3. The velocity at the outlet of the culvert will require channel protection or an energy dissipater according to the design guidelines applicable for the downstream channel type.

L. The hydraulic design calculations for all culverts must be prepared and certified by a licensed Oklahoma Professional Engineer using the hydraulic modeling program HEC-RAS or HEC-2 (or other program approved by the Public Works Department).

M. The radius of curve for a long box structure shall be a minimum of 3 times the maximum width of the box structure, but not less than 50 feet.

N. Inlet and Outlet Configurations:

1. Culverts are to be designed with erosion protection at the inlet and outlet areas.

2. The headwalls or end sections are to be located a sufficient distance from the edge of the shoulder or back of walk to allow for a maximum slope of 3H:1V to the back of the structure.

O. Construction Materials: All culverts within the City shall be constructed of reinforced concrete. Reinforced Concrete Box (RCB) culverts or Reinforced Concrete Pipe (RCP) culverts with soil tight joints are acceptable.

P. Driveway culverts shall be sized to pass the 1% (100-year) design flow.

Q. The minimum size culvert shall be an 18" RCP (or equivalent).

#### 505.6 Technical Requirements: Street and Overland Stormwater Drainage

A. The roadway and overland stormwater drainage systems shall be designed to receive and pass the runoff from a 1% (100-year) frequency rainstorm. The entire flow shall be confined within the said stormwater drainage system.

B. A storm sewer shall be required for drainage basins smaller than 40 acres. For larger drainage basins, an open channel may be used.

C. The street and storm sewer system shall be designed to pass the 1% (100-year) storm within the right of way. Inlets shall be designed to pass a minimum of the 10% (10-year).

D. The flow from a 10% (10-year) storm shall not exceed any of the following criteria:

1. curb height,
2. the crown of the street, or
3. the depth required to inundate the outside lane.

E. For non-residential streets, the first inlet shall be located no more than 400 feet from the high point in the street profile or at the point where the outside lane would be inundated, whichever is less.

F. Cross-over Flow:

1. In the upstream sections of a drainage basin, above which the 10% storm flow is lower than the depth where the outside lane would be inundated, cross flow is allowed at intersections only.
2. Otherwise, no cross-over flow is allowed. Inlets shall be located at intersections to collect the flow from crossing the intersection. Inlets at

intersections shall be located so they do not encroach upon the curb return. No drainage structure shall be permitted at a wheelchair ramp.

G. Hydraulic design procedures may be obtained from the following sources:

1. The current state-of-the-practice for designing non-recessed storm inlets is presented in the FHWA publication “Urban Drainage Design Manual,” Second Edition.
2. Guidelines for design of recessed concrete inlets are presented in the FHWA publication “Hydraulic Characteristics of Recessed Curb Inlets and Bridge Drains.”
3. The guidelines for design of recessed metal curb openings without grates are based on the Kansas City Engineer of Transportation (KDOT) publication “K-TRAN Research Project KU-98-3, Hydraulic Performance of Set-Back Curb Inlets.”

H. Grated Inlets:

1. Grated inlets without a curb opening are not permitted within City of Sapulpa streets. Hydraulic information is provided for analysis of existing conditions.
2. The vane grate (in combination with a curb opening) is the only grate approved by the City of Sapulpa within the street pavement.
3. 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, since the curb opening portion is reserved to collect debris.

I. Recessed Curb Inlets:

1. Inlets without grates, having sufficient hydraulic capacity to function similarly to a grated inlet may be considered providing safety bars protect the opening and that no danger is posed to the public. Inlets may be from four feet to eight feet in length. An access manhole in the inlet will be required.

J. Alternative Inlet Structures:

1. Inlets manufactured from PVC may be considered providing the hydraulic capacity is sufficient and the grate will support H-20 truck loading. The vane grate requirement shall apply.

K. Paved ditches or flumes, commonly called beaver slides, shall not be allowed in lieu of inlets.

L. The overland flow portion of the collector system shall be confined to dedicated rights-of-way, or restricted drainage easements to assure that stormwater can pass through the development without inundating the lowest level of any building, dwelling, or structure. Restricted drainage easements shall be shown on the plat.

M. The overflow portion of the flow in a sump area shall be designed for 100% blockage of the sump area. This overflow routed shall be identified as an overland drainage easement with language prohibiting blockage of flow.

N. Runoff from areas greater than  $\frac{1}{2}$  acre outside the roadway shall be collected before it reaches the roadway. Parking lots shall have internal drainage systems so as to reduce concentrated flow into streets. This item does not apply to single family residential lots.

O. Drainage areas, runoff from 10% (10-year) and 1% (100-year) frequency rainstorms, time of concentration, and inlet design for each inlet shall be summarized and tabulated on the plans. This summary table shall also be a part of the drainage calculations.

P. The flows and velocities for each pipe and open channel shall be summarized and tabulated as above on the plans as well as in the drainage calculations.

Q. No pipe shall be installed downstream having a diameter smaller than the pipe from which it is receiving water.

R. All pipe shall meet one of the following requirements:

1. Concrete pipe may be used in sizes 18-inches through 96-inches meeting ASTM C-76 Class III, Class IV or Class V with an approved joint gasket or band. Mastic seal shall not be used. Pipe joints shall be able to resist an internal pressure of 15 pounds per square inch (PSI).
2. Corrugated metal pipes shall not be used in roadways, through dams or on public projects unless specifically approved for use.
3. Polypropylene Pipe (PP) meeting ASTM F2736, ASTM F2881 and AASHTO M330 may be used in sizes from 18-inches to 60-inches.

4. Smooth walled polyethylene (HDPE) pipe may be utilized, in sizes from 18-inches to 30 inches, in storm drainage systems in approved locations, outside roadway pavement and outside earthen embankments.

S. Junctions between different pipe sizes shall be made with the top inside of the downstream pipe no higher than the top inside of the upstream pipe.

T. A manhole or junction box shall be required at all changes of grade, changes in alignment, and junctions between two or more different size pipe.

U. The horizontal distance between pipes being placed in the same trench shall be a minimum of two feet or one third the diameter of the larger pipe, whichever is greater. This would include multiple pipe crossings for culvert purposes.

V. The minimum storm sewer pipe size shall be 15 inches. Use of smaller pipes, shall require prior approval by the Public Works Department.

W. A minimum of 6 inch covers shall be provided over pipes and box culverts to the bottom of the subgrade in paved areas except when the box culverts are built with the top at grade.

X. All storm sewers shall be shown in profile, showing flow line, size, type and grade. Profiles shall show the natural and proposed ground line at the center line of the storm sewer. Stationing shall be continuous through manholes, along the main (longest) line, to the top of the system. Branch lines shall be stationed, from their connection with the main line. Lines shall be stationed in the profile drawing from left to right increasing upstream.

Y. All cast in place structures shall have approved water stops in all control joints.

Z. New box culverts and bridges shall have adequate capacity to pass the 1% (100 year) fully urbanized flows with one foot of free board under the low chord. A backwater analysis shall be provided to illustrate compliance with this requirement.

AA. Pipes discharging at a velocity greater than 6 feet per second into drainage ways and detention facilities shall be provided with an outlet structure and a method for dissipating energy or revetment to preventing erosion.

BB. Channel velocities greater than 6 feet per second will require an approved non erosive material lining the channel.

CC. When storm sewers are constructed in fill areas, all materials in fill areas shall be compacted to a 95 percent standard proctor density at plus or minus 2 percent of optimum moisture content prior to the trenching and laying of the pipe.

DD. Maximum spacing between manholes or junction boxes shall not exceed 400 feet for pipes of 18 inches and 500 feet for pipes greater than 18 inches.

EE. All junction boxes and manholes shall be built with one standard manhole ring and cover at grade.

FF. A manhole or junction box shall be constructed at the P.C. or P.T. of all curves in large, long culverts.

506 STORAGE REQUIREMENTS

506.1 For all stormwater detention facilities, the releases shall not exceed the pre-development runoff conditions for the 100% (1-year), 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), and 1% (100-year), 24 hour storms, and must be conveyed to a public stormwater conveyance system with no negative impact downstream.

506.2 The provisions of the stormwater detention plan shall adhere to any stormwater master drainage plan that is adopted in the area under consideration.

506.3 The intent of the stormwater detention requirements shall be identified at the preliminary plat stage of the project review. The 1% (100 year) frequency rainstorm floodplain areas and stormwater detention site locations shall be shown on the preliminary plat to illustrate how these areas will be managed during and after construction.

506.4 Detention facilities should be located in areas which require a minimum of maintenance.

506.5 All detention storage volume shall be located above the BFE in FEMA mapped areas, or above the 1% (100-year) floodplains as mapped by the City for regulatory floodplains.

506.6 Additional detention storage, in excess of the required storage for a drainage area, shall not be acceptable to satisfy the detention requirements for a tract of land downstream of the detention facility.

506.7 All stormwater detention facilities shall be located at the downstream end of the development to insure that “flash” runoff from uncontrolled areas does not contribute to adverse conditions offsite.

506.8 If a tract of land being developed is located in more than one drainage area, then grading work to divert flows from one drainage area to another will not be permitted. Compensatory storage will not be permitted in one drainage area for that required in another.

506.9 Detention facilities shall not be used for compensatory storage and shall not encroach into any floodplain area.

506.10 All dikes and spillways on detention facilities shall have typical cross sections shown on the plans. Dams shall be constructed from suitable non-erodible material in lifts not to exceed 8 inches, loose measure, compacted to 95 percent Standard Proctor Density at plus or minus 2 percent optimum moisture content. Spillways shall not be located within the fill zone of a dam. Dams shall be constructed in accordance with FEMA design standards in particular, “Conduits through Earthen Dams”, 2005.

- 506.11 Side slopes on dams or detention facilities shall not be steeper than 3:1(Horizontal: Vertical). Steeper side slope may be allowed should the site conditions necessitate; however, methods for proper erosion control must be established and illustrated, and the procedures for maintaining these steeper side slopes must be established and shown on the plan.
- 506.12 Detention facilities shall be provided with a low flow channel from the inlet to the outlet structure to transmit low flows and the low flow channel shall be approved by the City. The low flow channel shall be concrete lined and of sufficient width and geometry to allow for proper maintenance. The maintenance procedure shall be shown on the plans. Wet ponds or ponds that retain water shall have a primary spillway that controls the water level and is able to pass the 10 percent storm event. Ponds must have a method of draining most of the water from the facility without breaching the dam. The control for the drain shall be made accessible in all conditions without the use of a boat. Wet ponds must have wave protection on the dam that extends 3 feet above and 3 feet below the normal water surface.
- 506.13 Easements for the storm sewers and detention ponds shall appear on the plat and shall designate the parties responsible for maintenance.
- 506.14 An access road at least 20 feet wide shall be provided to any detention area. Access may be provided by frontage on a dedicated public street or by an access easement from a dedicated public street to the detention area. The access road shall have a maximum grade of 10 percent. The access road shall be paved, 12 feet wide, from the top of the bank to the bottom of the detention pond and in the bottom of the detention pond to locations of high maintenance. Pavement may be asphalt, concrete or articulating blocks.
- 506.15 An operations and maintenance guide shall be prepared to illustrate the proper use and care of the detention facility, and by whom, when and how. The guide shall include text and diagrams.
- 506.16 Any dam or berm constructed shall be designed and constructed under the supervision of a Registered Professional Engineer.
- 506.17 Spillways on detention facility dams shall be constructed to pass the 500 year flood event with a minimum of 1 foot of freeboard on the earth dam structure. The area downstream from auxiliary spillways shall be restricted
- 506.18 All detention facilities shall meet the Oklahoma Water Resources Board's (OWRB) requirements. The design of detention facilities that have a certain storage volume and/or dam height are subject to regulation by the OWRB. The classification criteria and design requirements are available for download at the OWRB website on the Rules and Regulations page: <http://www.owrb.ok.gov/util/rules/rules.php>.

506.19 Freeboard Requirements: All detention facilities shall be designed to meet OWRB requirements or the requirements set forth in this Manual, whichever is stricter. Freeboard requirements are shown in the table below:

<b>Freeboard Requirements for Stormwater Detention Facilities</b>			
<b>Embankment or Excavated Pond</b>	1% (100-year) water surface elevation depth	1% (100-year) water surface elevation	0.2% (500-year) water surface elevation
<b>Embankment or Excavated</b>	< 18 inches	Contained within a dedicated Stormwater detention easement	
<b>Embankment</b>	18 inches to 6 feet	Contained within the detention facility with one foot of freeboard to the top of the embankment*	
<b>Embankment</b>	> 6 feet		Contained within the detention facility with one foot of freeboard to the top of the embankment*
<b>Excavated</b>	>18 inches	Contained within the detention facility with one foot of freeboard to the top of the embankment*	

\*unless more stringent OWRB dam safety requirements control, as outlined in Title 785:25-3-3 of the Oklahoma Administrative Code, found at [http://www.oar.state.ok.us/viewhtml/785\\_25-3-3.htm](http://www.oar.state.ok.us/viewhtml/785_25-3-3.htm).

506.20 General Design Criteria: all calculations and plans for detention facilities shall be presented to the City for review and approval. Information submitted shall include:

- A. Inflow and outflow hydrographs
- B. A comparison of the pre-project and with-project peak discharges at the point(s) of discharge from the development and at points downstream as required by the Public Works Department
- C. Elevation-Storage-Discharge relationships
- D. Discharge rating curves for each component of the outflow structure

- E. Tailwater rating curves at the outlet (tailwater shall be considered when designing the outlet structure)
- F. Erosion protection measures at the outlets and spillway
- G. Embankment design in accordance with OWRB guidelines, including slope protection in case of overtopping, slope stability, and maintenance access
- H. Multiple use plans (parks, playgrounds, sports fields, etc.)
- I. Trash rack design

506.21 On-Site Stormwater Detention

- A. On-site detention facilities shall show to be effective in controlling the peak discharges from the development immediately downstream of the development.
- B. The volume of on-site detention required is calculated by comparing the total runoff volume, in acre-feet, of the existing condition 1% (100-year) flood with the volume of the proposed conditions 1% (100-year) flood. The comparison is made using the existing conditions and proposed conditions hydrologic models (HEC-HMS or HEC-1).
- C. On-site detention facilities shall be designed so that there is no increase in the peak discharge from any point of the development during the 100% (1-year), 50% (2-year), 20% (5-year), 10% (10-year), 4% (25-year), 2% (50-year), and 1% (100-year) flood events. This applies at the point(s) of discharge from the development as well as at points downstream, as required by the City Engineer.
- D. The erosive effects of the increased runoff volume from the on-site detention facility shall be mitigated by armoring the stream bank downstream.
- E. Mitigation for other water quality impacts of the urban runoff leaving the on-site detention facility shall be provided.

506.22 Design Standards for Open Space Detention

- A. All earth slopes and areas subject to erosion, such as, adjacent to trickle channels, inlet structures, and outlet structures, shall be slab sodded with Bermuda sod or protected with other erosion control measures. All other earth surfaces, within the area designated for detention pond site, shall have an established growth of Bermuda grass or other approved species. All grass covered areas shall be fertilized, to current recommendations, watered and in an established growing condition prior to completion and approval of the detention pond.
- B. Detention facilities shall be environmentally sound and compatible with the area (neighborhood). Where feasible, multiple uses for the facilities should be established.

C. The maintenance responsibility for onsite detention facilities shall depend upon the zoning. If the area is zoned for single family residential, including duplexes, the maintenance responsibility shall belong to the City. If the area is otherwise zoned, the maintenance responsibility shall belong to the private sector. A written agreement between the development and the City defining the maintenance, responsibility shall be made prior to the development's acceptance by the City.

506.23 Design Standards for Parking Lot Detention

A. Parking Lot detention may be used on properties that do not receive offsite water.

B. The maximum depth in the detention pond shall be 12 inches, occurring during the 1% (100-year) storm.

C. The total flooded area during the 100-year storm shall not exceed 25 percent of the property.

D. The unit volume curves included herein may be used to design the outlet if a two-stage weir is used.

E. The 20% (5-year) storm must completely fill the bottom 6 inches up to the first weir.

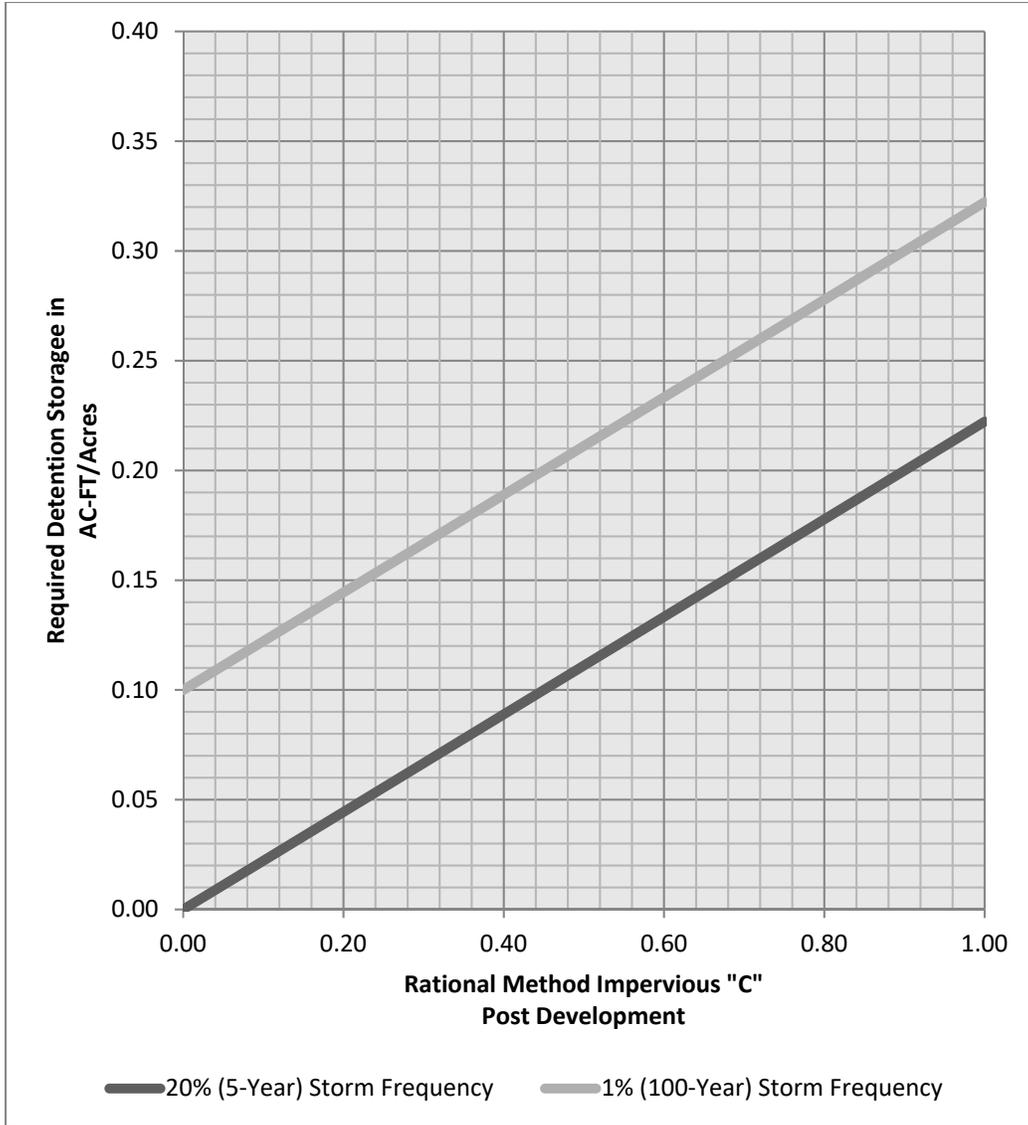
F. The 1% (100-year) volume must fill the entire 12-inch depth of water.

G. There must be a 6-inch drop off from the outlet elevation to the ground immediately downstream.

H. If a pipe and weir outlet is used, the same criteria apply, with the weir set at the 10% (5-year) elevation.

I. If a pipe outlet is used, a City-approved trash rack must be placed upstream.

506.24 The figures below summarize the storage requirements.



Pre-Developed 1% (100-Year) Rational Method "C"	Outflow Rate for Drainage CFS/AC <sup>2</sup>	
	20% (5-Year)	1% (100-Year)
0.1	0.0	0.6
0.2	0.1	1.3
0.3	0.2	2.0
0.4	0.6	2.9
0.5	1.8	4.9
0.6	3.6	7.5

<sup>2</sup> Reference: City of Tulsa Stormwater Management Criteria Manual, Updated 1993

## 507 DRAINAGE PLANS AND STUDIES

## 507.1 Requirement for Professional Engineer licensure

All final drainage studies shall be formulated under the direct supervision of a registered professional engineer licensed by the State of Oklahoma. Studies submitted for final acceptance shall be accompanied by payment of a fee in accordance with the schedule approved by the City Council and bear the signature and seal of the submitting engineer and, additionally, the following statement shall immediately precede the signature and seal of the submitting engineer:

*"I hereby certify that I am familiar with the adopted ordinances and regulations of the City of Sapulpa governing drainage facilities; that this final drainage study has been prepared under my direct engineering supervision; and that the above and foregoing final drainage study complies with all governing ordinances and the adopted drainage standards of the City of Sapulpa pertaining to drainage facilities to the best of my knowledge, information and belief."*

## 507.2 Certification Statement:

All final drainage plans shall be formulated under the direct supervision of a registered professional engineer licensed by the State of Oklahoma. Plans submitted for final acceptance shall bear the signature and seal of the submitting engineer and, additionally, the following statement shall immediately precede the signature and seal of the submitting engineer:

*"I hereby certify that I am familiar with the adopted ordinances and regulations of the City of Sapulpa governing drainage facilities; that the final drainage plan has been prepared under my direct engineering supervision; and that the above and foregoing final drainage plan complies with all governing ordinances and the adopted drainage standards of the City of Sapulpa pertaining to drainage facilities to the best of my knowledge, information and belief."*

## 507.3 Owner's Statement:

Following the signature and seal of the submitting engineer, the drainage plan shall bear the name, address, phone number, and signature of the owner which shall be subscribed below the following statement:

*"I (We) hereby certify that the accepted drainage plan will be implemented as designed and "as-built" drawings prepared of the completed drainage facilities under the general supervision of a professional engineer licensed by the State of Oklahoma. I (We) further certify that I am (we are) aware of my (our) responsibilities as the owner(s) of record for this piece of property, and that I (we) may be held personally (corporately) liable for any violations on this property resulting from the failure to comply with the provisions of the adopted ordinances*

*and regulations of the City of Sapulpa governing drainage facilities. Said provisions include, but are not limited to, responsibilities for proper construction, construction procedures and maintenance of the drainage facilities upon completion.”*

507.4 Property Owned by a Corporation:

A. In the case of property owned by a corporation, the statement shall use the parenthetical language and the owner’s information shall also include the title of the authorized person signing the owner’s certification and a notarized corporate seal.

508 SUBMITTAL REQUIREMENTS

508.1 The submittal requirements for drainage reports and plans are set forth in this section.

A. Drainage Report:

1. The Drainage and Detention Report will identify and define solutions to the problems which may occur on site and off site as a result of the development. In addition, those problems that exist on site prior to development must be addressed during design.
2. All reports shall be typed on 8 1/2" x 11" paper and bound together. The drawings, figures, plates, and tables shall be bound with the report or included in a folder/pocket at the back of the report.
3. The report shall include a cover letter presenting the preliminary design for review and the report shall be prepared by or supervised by an engineer licensed in Oklahoma.
4. Cover letter shall provide a Summary Statement containing the following:

B. Goals and Policies

C. Discuss how the proposed drainage plan meets the Stormwater Management goals and adheres to the floodplain policy(ies) of this Chapter.

D. Discuss any deviation of the proposed drainage plan from the above goals and policies.

E. Drainage System Components

F. Discuss the overall concept of the proposed system.

G. Discuss the interaction of the major drainage and the proposed system.

H. Criteria

- I. Discuss any proposed deviation from the Chapter and methodology, as set forth in the standards, for consideration by the City for approval, if appropriate.
- J. Discuss the design criteria for the storm drainage design of the proposed system.

- 1. The report shall contain a certification sheet signed by engineer licensed in Oklahoma. The following statement shall appear:

*"I hereby certify that this report (plan) for the preliminary drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance with the provisions of the City code of Sapulpa for the owners thereof."*

\_\_\_\_\_  
Licensed Professional Engineer  
State of Oklahoma No. \_\_\_\_\_  
(Affix Seal)

- 2. The report shall be formatted in accordance with the following outline and contain all of the applicable information listed:

- K. General Location and Description
- L. Name and address of Legal Owner
- M. Vicinity Sketch
- N. Legal description of property
- O. Boundary line survey
- P. Township, range, section, 1/4 section
- Q. Local streets within and adjacent to the subdivision
- R. Major drainage ways and facilities
- S. Names of surrounding developments
- T. Description of Property
- U. Area in acres
- V. Ground cover (type of trees, shrubs, vegetation)
- W. Major drainage ways and floodplains
- X. Soil Types and Hydrologic Soil Groups
- Y. Drainage Basins and Sub-Basins
- Z. Major Basin Description

AA. Reference to major drainage way planning studies such as Stormwater Master Plan, flood damage prevention ordinance, and flood insurance rate maps

BB. Major basin drainage characteristics

CC. Identification of all drainage system components within 50 feet of the property boundary

DD. Overall drainage area boundary and drainage sub-area boundaries

EE. Sub-Basin Description

FF. Historic drainage patterns of the property in question

GG. Off-site drainage flow patterns and their impact on the proposed development

HH. Drainage Design Criteria

II. Regulations:

1. Discussion of the optional criteria selected or the deviation from the Chapter, if any
2. Development Criteria Reference and Constraints
3. Previous drainage studies (i.e., project master plans) for the site in question that influence or are influenced by the drainage design and how the plan will affect drainage design for the site
4. Discussion of the drainage impact of site constraints such as streets, utilities, railways, existing structures, and development of site plan

JJ. Hydrological Criteria:

- Design rainfall
- Hydrologic analysis for runoff and on-site or regional stormwater detention facilities as required
- Hydrologic analysis for compensatory storage requirements for any alterations of the floodplain
- Runoff calculation method
- Hydrologic analysis for runoff to insure conveyance
- Detention discharge and storage calculation method
- Design storm recurrence intervals

KK. Hydraulic Criteria:

- Routing of off-site drainage flow through the development
- Location of watercourse and the appropriate hydraulic analysis for any alteration of a watercourse
- Hydraulic analysis for runoff to insure conveyance
- Hydraulic analysis for compensatory storage requirements for any alterations of the floodplain
- References for calculation of facility capacity
- Detention outlet type
- Grade control structure criteria used

LL. Drainage Facility Design

MM. General Discussion of:

- Proposed and typical drainage patterns
- Compliance with off-site runoff considerations
- The content of tables, charts, figures, plates, or drawings presented in the report
- Anticipated and proposed drainage patterns

NN. Specific Discussion of:

- Drainage problems encountered and solutions at specific design points
- Detention storage and outlet design
- Photographs of downstream channel condition
- Maintenance access and aspects of the design
- Proposed maintenance agreement
- Easements and/or ROW dedications required

OO. Impact on Area of Special Flood Hazard

PP. Location of watercourse and the appropriate hydraulic analysis for any alteration of a watercourse

QQ. Hydraulic and Hydrologic analysis for run-off to insure conveyance

RR. Hydraulic and Hydrologic analysis for compensatory storage requirements for any alterations of the floodplain

SS. Hydraulic and Hydrologic analysis for run-off and on-site or regional stormwater detention facilities, if required

TT. Floodplain boundaries with elevations to 1988 NAVD

UU. Estimate of the quantity of excavation and fill with drawings indicating each separate excavation or fill (cross sections may be required)

VV. All appropriate FEMA submittal data to achieve a LOMR

WW. No Rise certification for offsite properties

XX. Conclusions

- Compliance with the City Code of Sapulpa
- Stormwater Master Plan
- Best Management Practices Plan provided and implemented
- Drainage Concept
- Effectiveness of drainage design to control damage from storm runoff
- Influence of proposed development on the Stormwater Master Plan recommendation(s)

YY. References

- Reference all criteria and technical information used

ZZ. Appendices

- Hydrologic Computations
- Land use assumptions regarding adjacent properties
- Path(s) chosen for computation of time-of-concentration
- Stormwater runoff at specific design points onsite and offsite
- Historic and fully developed runoff computations at specific design points
- Hydrographs at critical design points if applicable
- Hydraulic Computations
- Culvert capacities
- Storm sewer capacity
- Street capacity
- Storm inlet capacity including inlet control rating at connection to

storm sewer

- Open channel design
- Check and/or channel drop design
- Detention area/volume capacity and outlet capacity calculations
- COMPLETED DRAINAGE AND DETENTION CHECK LIST ASSURING THAT ALL ITEMS HAVE BEEN ADDRESSED

AAA. Drawings:

1. Sheet-1 General Location Map: A map shall be provided in sufficient detail to identify drainage flows entering and leaving the development and general drainage patterns. The map should be at a scale of 1" = 200' to 1" = 400' and show the path of all drainage from the upper end of any off-site basins to the defined major drainage ways. The map shall identify any major construction (i.e., developments, irrigation ditches, existing detention facilities, culverts, main storm sewers), along the entire path of drainage. The size of the drawings shall be 8 ½" x 11", 11" x 17", or 22" x 34".
2. Sheet-2 Floodplain Information: A copy of the regulatory floodplain map showing the location of the subject property shall be included with the report.
3. Sheet-3 Drainage Plan: Map(s) of the proposed development at a scale of 1" = 20' to 1" = 200' on a 22" x 34" drawing shall be included. The plan shall show the following:
  - Existing and proposed contours at 2 foot maximum intervals. In terrain where the slope is relatively flat, spot elevations and drainage arrows must be shown.
  - Property lines and easements with purposes noted: Name, address and telephone number of legal owner of property; vicinity sketch
  - Streets, roads and highways adjacent to the property
  - Existing drainage facilities and structures, natural or man-made, including, roadside ditches, drainage ways, gutter flow directions, and culverts. All pertinent information such as material, size, shape, slope, and location shall also be included.
  - Overall drainage area boundary and drainage sub-area boundaries

- Proposed type of street flow (i.e., vertical or combination curb and gutter), roadside ditch, gutter flow directions, and cross pans. Include street classifications.
- Proposed storm sewers and open drainage ways, including inlets, manholes, culverts, retaining walls, erosion control measures, and other appurtenances
- Proposed outfall point for runoff from the developed area and facilities to convey flows to the final outfall point without damage to downstream properties
- Routing and accumulation of flows at various critical points for the minor storm runoff
- Path(s) chosen for computation of time-of-concentration
- Details of detention storage facilities and outlet works
- Location and elevations of all defined floodplains affecting the property
- Location and elevations of all existing and proposed utilities affected by or affecting the drainage design
- Routing of off-site drainage flow through the development

509 MAINTENANCE BOND

- 509.1 A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 100.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a one-year period.

## DIVISION 600 SOIL EROSION AND SEDIMENTATION CONTROL

### 600 GENERAL

The Consultant shall design and the Contractor install and maintain erosion and sediment controls that minimize the discharge of pollutants from earth-disturbing activities. To meet this requirement, soil erosion mitigation methods must comply with the requirements in this Manual and ODEQ standards.

### 601 AREA OF DISTURBANCE

The area of disturbance must minimize the amount of soil exposed during construction activities.

### 602 DESIGN REQUIREMENTS

602.1 The following factors must be accounted for in the design of stormwater controls:

- A. The expected amount, frequency, intensity, and duration of precipitation
- B. The range of soil particle sizes expected to be present on the site
- C. The nature of stormwater runoff and run-on at the site, including factors such as expected flow from impervious surfaces, slopes, and site drainage features

602.2 If any stormwater flow will be channelized at the site, measure must be taken to control both peak flow rates and total stormwater volume to minimize erosion at outlets and to minimize downstream channel and stream bank erosion

602.3 Discharges from the site shall be directed to vegetated areas of the site to increase sediment removal and maximize stormwater infiltration, including any natural buffers, unless infeasible. Velocity dissipation devices should be used, if necessary, to prevent erosion when directing stormwater to vegetated areas.

### 603 PROTECTION OF SURFACE WATER: NATURAL BUFFERS AND EQUIVALENT SEDIMENT CONTROLS

603.1 In order to minimize sediment discharges, if any waters of the State are located on or immediately adjacent to the site, a minimum of 50 feet of natural buffer zone must be maintained, as measured from the top of the bank to disturbed portions of the site, from any named or unnamed receiving streams, creeks, rivers, lakes or other water bodies, unless 100 feet of natural buffer is required by ODEQ.

603.2 There are exceptions from this requirement for water crossings, limited water access, and stream restoration authorized under a CWA Section 404 permit. Where no natural buffer exists due to preexisting development disturbances (e.g., structures, impervious surfaces) that occurred prior to the initiation of planning for the current development of

the site, compliance with the requirements in this section is not required unless portions of the preexisting development will be removed.

- 603.3 Where it is possible, an undisturbed natural buffer shall be provided and maintained. The Contractor shall implement erosion and sediment controls that achieve the sediment load reduction equivalent of a 100-foot or 50-foot undisturbed natural buffer.
- 603.4 Additionally, this requirement is not intended to interfere with any other ordinance, regulation, statute or other provision of law.

#### 604 INSTALLATION OF PERIMETER CONTROLS

- 604.1 Installation Requirements: The Contractor shall install sediment controls along those perimeter areas of the site that will receive stormwater from earth-disturbing activities. For linear projects with rights-of-way that restrict or prevent the use of such perimeter controls, the Contractor must maximize the use of these controls where practicable and document in the SWP3 why it is impracticable in other areas of the project.
- 604.2 Maintenance Requirements: The Contractor shall remove sediment before it has accumulated to  $\frac{1}{2}$  of the above-ground height of any perimeter control.

#### 605 MINIMIZE SEDIMENT TRACK-OUT

The Contractor shall minimize the track-out of sediment onto off-site streets, other paved areas, and sidewalks from vehicles exiting the site of construction. Requirements are as follows:

- A. Vehicle use shall be restricted to properly designated exit points.
- B. Appropriate stabilization techniques shall be used at all points that exit onto paved roads so that sediment removal occurs prior to vehicle exit.
- C. Where necessary, additional controls to remove sediment from vehicle tires prior to exit shall be used.
- D. Where sediment has been tracked-out from the site onto the surface of off-site streets, other paved areas, and sidewalks, the deposited sediment shall be removed by the end of the same work day in which the track out occurs or by the end of the next work day if track-out occurs on a non-work day. The Contractor shall remove the track-out by sweeping, shoveling, or vacuuming these surfaces, or by using other similarly effective means of sediment removal. Hosing down the site or sweeping tracked out sediment into any stormwater conveyance (unless it is connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or surface water is not acceptable for removal.

#### 606 CONTROL DISCHARGES FROM STOCKPILED SEDIMENT OR SOIL

For any stockpiles or land clearing debris composed, in whole or in part, of sediment or soil, compliance with the following requirements is required:

- A. Piles outside of any natural buffers established under Section 603 and physically separated from other stormwater controls implemented in accordance with DIVISION 600 must be located.
- B. The piles must be protected from contact with stormwater (including run-on) using a temporary perimeter sediment barrier.
- C. Where practicable, cover or appropriate temporary stabilization shall be provided to avoid direct contact with precipitation or to minimize sediment discharge.
- D. Soil or sediment accumulated on pavement or other impervious surfaces shall not be hosed down or swept into any stormwater conveyance (unless connected to a sediment basin, sediment trap, or similarly effective control), storm drain inlet, or surface water.
- E. To the greatest extent possible wind soil piles should be contained and securely protected.

#### 607 MINIMIZE DUST

In order to avoid pollutants from being discharged into surface waters, to the extent feasible, the Contractor shall minimize the generation of dust through the appropriate application of water or other dust suppression techniques.

#### 608 MINIMIZE THE DISTURBANCE OF STEEP SLOPES

The Contractor shall minimize the disturbance of steep slopes (i.e., slopes of 40 percent or greater). If it is not feasible to avoid disturbance of steep slopes, the following should be observed:

- A. Concentrated or channelized flows of stormwater shall be diverted away from and around areas of disturbance on steep slopes.
- B. Specialized erosion and sediment controls should be used for steep slopes, such as temporary and permanent seeding with soil binders, erosion control blankets, surface roughening, reducing the continuous slope length with terracing or diversions, gradient terraces, interceptor dikes and swales, grass-lined channels, pipe slope drains, subsurface drains, level spreaders, check dams, seep berms, and triangular silt dikes.
- C. Stabilization practices designed to be used on steep slopes are required. The Contractor is to comply with the stabilization requirements as required in Division 600 of this Manual.

#### 609 PRESERVE TOPSOIL

The Contractor shall preserve native topsoil on the site. Top soil should be stockpiled and reused in areas that will be stabilized with vegetation later.

610 MINIMIZE SOIL COMPACTION

In areas of the site where final vegetative stabilization will occur or where infiltration practices are to be installed, the Contractor shall:

- A. Restrict vehicle and equipment use in these locations to avoid soil compaction; or
- B. Use soil conditioning techniques. Prior to seeding or planting areas of exposed soil that have been compacted, techniques that condition the soils to support vegetative growth should be used, if necessary.

611 PROTECT STORM DRAIN INLETS

Regarding any discharge to any storm drain inlet carrying stormwater flow from a construction site directly to surface stream (if it is not first directed to a sediment basin, sediment trap, or similarly effective control), the Contractor must comply with the following requirements:

- A. Inlet protection measures that remove sediment from the site discharge prior to entry into the storm drain inlet must be installed.
- B. The protection measures shall be cleaned, removed, and/or replaced as sediment accumulates, the filter becomes clogged, and/or performance is compromised. Where there is evidence of sediment accumulation adjacent to the inlet protection measure, the Contractor must remove the deposited sediment by the end of the same work day in which it is found or by the end of the following work day if removal by the same work day is not feasible.

612 CONSTRUCTED STORMWATER CONVEYANCE CHANNELS

Channels shall be designed to avoid un-stabilized areas on the site and to reduce erosion, to the greatest extent possible. Erosion of channels and their embankments, outlets, adjacent stream banks, slopes, and downstream waters during discharge conditions shall be minimized through the use of erosion controls and velocity dissipation devices within and along the length of any constructed stormwater conveyance channel, and at any outlet to provide a non-erosive flow velocity.

613 SEDIMENT BASINS

When sediment basins are used, the following shall be complied with:

- A. Design requirements: Storage for either the calculated volume of runoff from a 2-year, 24-hour storm, or 3,600 cubic feet per acre drained, shall be provided.
- B. When discharging from the sediment basin, outlet structures that withdraw water from the surface shall be utilized in order to minimize the discharge of pollutants, to the greatest extent possible.

C. Erosion of the sediment basin shall be prevented using stabilization controls (e.g., erosion control blankets), and the inlet/outlet using erosion controls and velocity dissipation devices.

D. Sediment basins shall be situated outside of surface waters and any natural buffers established under Parts 603.

#### 614 DEWATERING PRACTICES

In no case will discharging of groundwater or accumulated stormwater that is removed from excavations, trenches, foundations, vaults, or other similar points of accumulation associated with a construction activity be allowed, unless such waters are first effectively managed by appropriate controls. Uncontaminated dewatering water may be discharged without being routed to a control. The following requirements for dewatering activities shall apply:

A. Visible floating solids or foam may not be discharged.

B. An oil-water separator or suitable filtration device (such as a cartridge filter) that is designed to remove oil, grease, or other products must be used if dewatering wastewater is found to contain floating solids or foam.

C. To the extent feasible, vegetated, upland areas of the site shall be utilized to infiltrate dewatering water before discharge. In no case will surface waters be considered part of the treatment area.

D. At all points where dewatering water is discharged, compliance with the velocity dissipation requirements of Part 612 is required.

E. Backwash water must be either hauled away for disposal or returned to the beginning of the treatment process.

F. The filter media used in dewatering devices must be replaced and cleaned when the pressure differential equals or exceeds the manufacturer's specifications.

#### 615 STABILIZATION REQUIREMENTS

The Contractor is required to stabilize exposed portions of the construction site. The following sections outline the deadlines for initiating and completing stabilization and the criteria for stabilization.

##### 615.1 Deadlines for Initiating and Completing Stabilization

A. Deadline to initiate stabilization: The Contractor shall initiate stabilization measures immediately whenever earth-disturbing activities have permanently or temporarily ceased on any portion of the site and will not resume for a period exceeding 14 calendar days.

The term "immediately" is used to define the deadline for initiating stabilization measures. In the context of this provision, "immediately" means as soon as practicable,

but no later than the end of the next work day, following the day when the earth-disturbing activities have temporarily or permanently ceased.

B. Deadline to complete stabilization activities: As soon as practicable, but no later than 14 calendar days after the initiation of soil stabilization measures consistent with Part 615.1.A the following are to be completed:

1. a. For vegetative stabilization, all activities necessary to initially seed or plant the area to be stabilized.
2. b. For non-vegetative stabilization, the installation or application of all such non-vegetative measures.

C. Any discharge to an impaired water, or Outstanding Resource Water (ORW), or Aquatic Resource of Concern (ARC), the stabilization activities specified in Part 615.1.B. must be completed within 7 calendar days after the temporary or permanent cessation of earth-disturbing activities.

#### 615.2 Criteria for Stabilization.

To be considered adequately stabilized, the following criteria shall be met depending on the type of cover being using, either vegetative or non-vegetative.

A. Vegetative Stabilization. For both temporary and final stabilization of an exposed vegetative portion of the site, compliance with one of the following criteria is required:

1. An established uniform perennial vegetative cover must be provided (e.g., evenly distributed without large bare areas), which covers 70 percent or more of the density of coverage that was provided by vegetation prior to commencing earth-disturbing activities. When background vegetation covered less than 100 percent of the ground prior to commencing earth-disturbing activities, the 70 percent coverage criteria is adjusted as in the following example: if vegetation covered 50 percent of the ground prior to construction, then the requirement would be to provide a total vegetative cover at final stabilization of 70 percent of 50 percent ( $0.70 \times 0.50 = 0.35$ ), or 35 percent of the site.
2. Immediately after seeding or planting the area to be vegetative stabilized, to the extent necessary to prevent erosion on the seeded or planted area, non-vegetative erosion controls that provide cover (e.g., mulch, rolled erosion control products) must be selected, designed and installed to the area while vegetation is becoming established.

B. When non-vegetative controls (e.g., hydromulch, erosion control blankets, riprap, geotextiles, and gabions) are being used to stabilize exposed portions of the site, or using such controls to temporarily protect areas that are being vegetative stabilized, effective non-vegetative cover must be provided to stabilize any such exposed portions of the site.

SECTION II. STANDARD SPECIFICATIONS  
FOR THE CITY OF SAPULPA AND  
SAPULPA MUNICIPAL AUTHORITY  
July 2014

## PURPOSE, INTENT, AND INTERPRETATION OF SPECIFICATIONS

The purpose of these Specifications is to establish, as appropriate, target, minimum and/or maximum standards for acceptance and payment for and products furnished by the Contractor. While certain interim requirements may be imposed, it is the intent of these Specifications that the Contractor be fully and exclusively responsible for producing an acceptable end product. The Oklahoma Department of Transportation (ODOT) Standard Specification for highway construction shall be included herein by reference. The ODOT Standard Details, latest edition, shall apply for all types of construction unless another detail is otherwise substituted, or approved by the Public Works Department.

In exercising this responsibility, the Contractor will be given control of the production processes to the greatest degree possible. However, delegation of control should not be interpreted as limiting the authority of the City to suspend the Contractor's operations when deemed necessary to prevent an unacceptable product or danger to the general public. City of Sapulpa personnel, except where specifically provided for herein, will make inspections for the City to document that an acceptable product is being produced.

Interpretation of these Specifications will be done in such a manner as to allow the Contractor to control his/her project to the greatest degree possible in producing an end result product which is in all respects acceptable. These Specifications should not, however, be interpreted in any manner which allows a Contractor to produce an unacceptable product or endanger the health, safety or welfare of the general public. An acceptable end result product is the essence of the Contract. Only projects in substantial conformance with the approved plans and specifications will be accepted by the City of Sapulpa. Acceptance and determination of adjustment in payment for products deviating from specified standards are entirely the City's responsibility.

## DIVISION 1100 GENERAL SPECIFICATIONS

### 1100 SCOPE AND LOCATION

1100.1 The location of the project is in or near the City of Sapulpa, Oklahoma. The character and exact location of the project are shown on the Drawings on file in the office of the Public Works Department. Said Drawings clearly show the general work involved, but are not intended to show all details of the work.

1100.2 The site and/or rights-of-way upon which the work is to be performed is shown on the Drawings. The Contractor agrees that the site or rights-of-way provided is adequate for the performance of the work. If any additional working area is required, the Contractor shall, at his/her expense, make arrangements for such working area. The City will not be liable for additional compensation as a result of any delay in obtaining rights-of-way.

### 1101 SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND DRAWINGS

1101.1 The Drawings are not intended to be scaled for dimensions, and if dimensions not shown on the Drawings are required, the Contractor shall request them from the Engineer. Where existing utility lines or other sub-surface obstructions are shown on the Drawings, the same have been located as nearly as practicable from information furnished by the owners of such, and from such surface indications as may exist at the work site. Such obstructions are shown for the purpose of advising the Contractor that they may interfere with the work to be done hereunder, but not for the purpose of indicating that the work can be performed without such interference.

1101.2 Where exploratory drilling is indicated to have been performed on the plans, boring logs will be available for review at the office of the Engineer. The logs will be furnished for informational purposes only, and are not to be construed as a true representation of actual subsurface conditions.

1101.3 Should anything be omitted from the Specifications and Drawings which is necessary to provide a clear understanding of the work, or should it appear various instructions are in conflict, the Contractor shall request written instructions from the Engineer before proceeding with the construction affected by such omissions or discrepancies.

### 1102 LINES AND GRADES

1102.1 All work done under this Contract shall be done to the lines, grades, and elevations shown on the Drawings. Vertical and horizontal controls shall be furnished by the Engineer. The Contractor shall provide detailed construction staking, all batter boards, forms, straight edges, and other materials for lines, levels, and measurements.

## 1103 PROTECTION OF PROPERTY

- 1103.1 The protection of City, State and Government monuments, street signs, and other City property is of prime importance, and if the same be damaged, destroyed, or removed, they shall be repaired, replaced or paid for by the Contractor. Disturbance to this property must first be approved by the appropriate agency.
- 1103.2 No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor.
- 1103.3 At places where the Contractor's operations are adjacent to, or crossing, the plat or railway, telegraph, telephone, electric, and gas companies, or water, sanitary sewers, and storm sewers, damage to which might result in expense, loss or inconvenience, work shall not be commenced until all arrangements necessary for the protection thereof have been made. The Contractor shall review the records of the County Clerk for recorded utilities and notify the Notification Center of Oklahoma One-Call System, Inc. of any excavation or demolition prior to the commencement of such work. Notification shall be made no sooner than 10 days nor later than 48 hours prior to start of work, excluding Saturdays, Sundays and legal holidays.
- 1103.4 The City has attempted to locate all storm sewers, culverts, buried telephone or electrical conduits, sanitary sewers, water mains, and gas mains that might interfere with the construction of this project. The Contractor shall cooperate with the owners of any underground or overhead utility lines in their removal and rearrangement operations so that these operations may progress in a reasonable manner and duplication or rearrangement work may be reduced to a minimum, and that services rendered by those parties will not be unnecessarily interrupted. The revision and crossings of the various types of lines shall be made as follows:
- A. Storm sewers and culverts may be removed at the time of crossing or may be adequately braced and held in position while the pipe is placed beneath them. If the storm sewer or culvert is removed, it shall be replaced with pipe of the same type and size as that removed, and it shall be re-joined to the undisturbed line with a joint satisfactory to the Engineer. Backfill over the main, up to and around the storm sewer, shall be thoroughly compacted in order that no settlement will occur. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines, other than those shown on the Drawing, are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossing or revision under the "Extra Work" clause of the Contract.
  - B. All overhead and buried telephone and electrical conduits, and gas mains to be revised or crossed by the construction of this project shall be protected in accordance

with the directions of the utility company owning the conduits and/or mains. The Contractor shall notify the companies and obtain their permission before making any crossing or revisions. The revision and crossing shown on the Drawing shall be at the expense of the Contractor. In the event lines other than these shown on the Drawing are encountered and fall within the standard trench limit and, in the opinion of the Engineer, revision of the line is necessary for the construction of the project, the Contractor will be reimbursed for the extra cost of the crossings or revision under the "Extra Work" clause of the Contract. Any overhead cables or buried cables or conduits or gas mains damaged by the Contractor shall be repaired at his/her expense to the satisfaction of the Engineer and of the Owner.

C. The Contractor shall not remove any water or sanitary sewer lines except as directed by the Engineer or as required by the Drawings and Specifications, and shall adequately brace and protect them from any damage during construction. Any existing water main or sewer main or lateral damaged by the Contractor's operation will be repaired by the Contractor's forces. The Contractor shall notify the City immediately after damaging any pipe. The repairs will be made at the Contractor's expense.

- 1103.5 The location of utility service lines serving individual properties may or may not be shown on the Drawings, but the Contractor shall assume that such service lines exist whether or not they are shown on the Drawings, and it shall be the responsibility of the Contractor to make any necessary changes in the line and/or grade of such services, or to secure the necessary changes therein to be made by the particular utility company involved or other owner thereof, or by an agent or individual Contractor approved by such revisions whether performed by Contractor, the utility company, or other owner, or an approved Contractor. In the event of interruption of a utility service as a result of accidental breakage, Contractor shall promptly notify the Engineer and the owner of the utility, and shall repair or cause the same to be repaired, in the same manner as necessary changes above provided for, and the Contractor shall do all things necessary to see to the restoration of services as promptly as may be reasonably done. All sanitary sewer service lines damaged shall be replaced with cast iron or ductile pipe, regardless of type or kind damaged.
- 1103.6 In the event the Contractor in any way fails to comply with the requirements of protecting, repairing, and restoring of any utility or utility service, the Engineer may, upon 48 hours written notice, proceed to protect, repair, rebuild or otherwise restore such utility or utility service as may be deemed necessary, and the cost thereof will be deducted from any money due or which may become due the Contractor pursuant to the terms of his/her contract.

## 1104 CONNECTIONS

- 1104.1 All connections to existing water mains shall be made by the Contractor, unless noted otherwise. The Contractor shall perform his/her work so that these connections may be readily made. All transfer of building service line connections from the existing to the new main shall be made by the Contractor after the main has been backfilled, tested, and chlorinated, but before any sidewalks, driveways, curbs, and/or paved roadways, are replaced.
- 1104.2 The Contractor shall not make any unauthorized connections to a sewer, nor shall he permit any such connections to be made. If the Contractor is properly authorized by the Engineer to make connections by installing wyes in the sewer under construction, such installation shall conform to the regulation of the City.

## 1105 REFERENCES TO OTHER SPECIFICATIONS

- 1105.1 Where a standard American Society for Testing Materials (ASTM), American Concrete Institute (ACI), American Standards Association (ASA), American Water Works Association (AWWA), or other agency designation is specified for a material, that designation shall be the current edition, either tentative, or adopted. If a referenced specification is in disagreement with these specifications, the City of Sapulpa specifications shall govern.

## 1106 PROTECTION OF MATERIALS

- 1106.1 All materials delivered to the site of the work shall be adequately housed and protected against deterioration according to the standard accepted procedures. The Contractor shall keep his/her storage yards in good order, pile his/her materials neatly, and protect them from damage.

## 1107 TESTING

- 1107.1 Materials: All materials required to be tested shall be tested by a laboratory of good reputation, previously approved by the City. No material shall be accepted for construction unless it bears the approval of the laboratory. Reports of tests shall be forwarded to the City. Before final acceptance of the project, all parts shall be tested and shall be found in good and proper condition, or shall be placed in such condition. The cost of all testing shall be paid by the Contractor.
- 1107.2 Flushing of Sanitary Sewers: Flushing of sewer lines will be performed by the City, but the Contractor shall lend such assistance as may be required. The Contractor shall within 30 days of completion, at his/her expense perform a mandrel test and a video inspection of the sewer and provide the resulting report to the City Engineer. Any damage or problems detected by these tests shall result in the sewer being declared not acceptable. The Contractor shall immediately correct the damage or failures in a manner acceptable to the Engineer.

1107.3 Testing and Chlorinating Water Mains: Testing and chlorinating of water mains will be performed by the Contractor, but the City shall lend such assistance as may be required. Water mains shall be tested in accordance with the Standard Specifications for “Installation of Cast Iron Water Mains”, AWWA Designation C-600. The pressure test of 150 psi shall be for a thirty minute duration. If the line passes the test without significant pressure drop, a leakage test shall be made at the normal operating pressures under which the line is to operate for two hours duration. Before being placed in service, all mains shall be chlorinated in accordance with a “Procedure for Disinfecting Water Mains”, AWWA Designation C-601. Where temporary plugs are required for pressure testing, the Contractor shall furnish and install the plug and temporary blocking, and remove after testing is complete. The cost shall be included in the unit price bid for pipe. No additional payment will be made.

#### 1108 “OR EQUAL” CLAUSE

1108.1 When a material is specified or shown on the Drawings by brand or manufacturer’s name, any other material that will adequately perform the same function, in the opinion of the Engineer and/or the City, may be accepted for use.

#### 1109 DEWATERING

1109.1 The Contractor shall provide all necessary pumps, drains, dams, well points, and other means for removing water from, or preventing water from entering the trench or other excavation until the project is completed. Sufficient pumps or other works shall be made available at all times to hold the water at a safe level. Water from the excavation shall be properly disposed of so that no damage or interference results to public health, public or private property, completed or uncompleted work, other projects, or streets.

#### 1110 SAFETY

1110.1 Excavations: The Contractor shall adequately shore, or sheet, and brace the excavation, or shall slope the sides of the trench in accordance with State of Oklahoma Department of Labor requirements.

1110.2 Explosives: In handling explosives used during the Construction of the project, the Contractor shall adhere to all federal and State Laws and City Ordinances regulating the purchase, transportation, storage, handling, and use of such explosives. No blasting shall be done without the approval and presence of the Inspector. All equipment, tools, and materials used shall be of the correct type and in good condition for the operation. The Contractor shall take all necessary precautions to avoid damage to property resulting from the transportation, storage, handling and use of explosives. Before blasting, the Contractor shall cover the area to be blasted with steel mesh mat or other suitable material, reinforced with timbers of sufficient weight so that rock and debris will be confined to the excavation. Any blasting within 10 feet of a water, sewer, gas, or pipe line shall be done with very light charges, and utmost care should be taken to avoid

disturbance to these lines. All location for blasting shall be subject to approval of the Engineer.

- 1110.3 Work Zone Traffic Control: When the Contractor is performing any type of construction or excavation work, or is stockpiling or storing any materials or equipment upon or adjacent to any street, alley, sidewalk, public ground, or other location that is likely to be subject to pedestrian or vehicular traffic, he shall furnish, erect, and maintain substantial guard rails, barriers, signs and lights around the project to protect pedestrians, animals, and vehicles from injury or damage. Barricades shall be painted white or yellow and equipped with flashing lights. Reflectorized paint may be used in lieu of the foregoing. Flashing lights shall be placed so that warning is given from any direction. There shall be maximum distance of 20 feet between barricades. Barricades signage shall be removed only at direction of the Contractor's representatives or the inspector. The Contractor shall provide sufficient proper signage and flagman for warning during blasting operations. All signs and traffic control devices shall be installed in accordance with the manual on Uniform Traffic Control Devices (MUTCD), current edition.
- 1110.4 Power Lines: No person, materials, or equipment shall come within 10 feet of any power line carrying more than 440 volts unless the electric power service has been first discontinued.
- 1110.5 Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory firefighting means at the location of work.
- 1110.6 Interference with Traffic: The Contractor shall construct and maintain adequate and safe bridges or crosswalks over excavations, where required. When a roadway or sidewalk is not closed, the Contractor shall provide a safe substitute route for any portion obstructed by his/her operations. If a roadway or sidewalk is closed to traffic, the Contractor shall provide and mark detours. As directed by the Engineer, construction across roadways or sidewalks may be done by open excavation and bridging, tunneling, or boring.
- 1110.7 Condition of Equipment and Materials: All equipment, tools, appliances, and materials used in connection with the project shall be handled and operated only when they are in safe operating condition and in accordance with a standard safety procedure.
- 1111 REMOVAL OF REJECTED MATERIALS AND STRUCTURES
- 1111.1 The Contractor shall remove from the site of the work without delay, all rejected and condemned materials or structures of any kind brought to or incorporated in the work and upon his/her failure to do so, or to make satisfactory progress in so doing, within 48 hours after the service of a written notice from the Engineer ordering such removal, the condemned material or structures may be removed by the City and the cost of such removal to be taken out of the money that may be due or may become due the Contractor on account of or by virtue of this contract. No such rejected or condemned material shall

again be offered for use by the Contractor under this or any other contract under this project.

1112 TRAFFIC CONTROL DEVICES

1112.1 The Contractor shall furnish and place traffic control devices in accordance with the standard drawings and as directed by the Engineer. All traffic control devices shall be installed in accordance with the Manual of Uniform Traffic Control Devices (MUTCD).

1113 CLEAN-UP

1113.1 Immediately upon installation of any portion of the work, the Contractor shall restore all fills, topsoil, and utilities to their location and condition prior to construction.

1113.2 Immediately upon installation of any block in length of the work herein contemplated, the Contractor shall remove all materials, tools, debris, excess excavated material, and equipment; and restore the site in a manner satisfactory to the Engineer.

1113.3 Clean-up and restoration of service line transfers shall be made immediately following each transfer installation.

1114 STREET WASH DOWN

1114.1 The Contractor shall wash down streets to control dust and clean the streets in the area of construction. The Contractor shall obtain a hydrant meter from the Customer Service Department and shall pay all required fees for obtaining and using the meter. Refer to Section 600 of the Design Criteria.

1115 PLACING WORK IN SERVICE

1115.1 If desired by the City, portions of the work may be placed in service when completed and the Contractor shall give prior access to the work for this purpose, but such use and operation shall not constitute an acceptance of the work.

## DIVISION 2200 WATER & SEWER MATERIAL SPECIFICATIONS

### 2200 SUBMITTALS

- 2200.1 The Contractor shall submit to the Engineer, six (6) copies of material submittals for all material he proposes to use. Construction shall not begin until the submittals have been approved by the Engineer.
- 2200.2 Submittals for pipe shall consist of notarized certifications that the pipe was manufactured and tested in accordance with the applicable specifications. The certifications shall indicate the pipe diameter, the pressure rating, and the batch number from which the pipe was manufactured. For pipelines 16 inches and larger and for restrained joint pipe, a detailed laying schedule prepared by the manufacture shall be submitted, along with the detailed design calculations.
- 2200.3 Submittals for material other than pipe shall consist of manufacture's product literature or shop drawings, indicating dimensions and material specification. Submittals shall include reference to compliance with AWWA, ASTM, NSF, and other applicable standards.

### 2201 CONCRETE

#### 2201.1 Cement

A. All cement used in the work shall be a well-known brand of true Portland Cement and shall conform to the Standard Specifications for Portland Cement, ANSI/ASTM Designation C150. Unless otherwise permitted, the Contractor shall use only one brand of cement in the work and under no condition shall he use more than one brand of cement in the same structure. Cement which for any reason has become partially set or contains lumps or cakes will be rejected and shall be removed from the site of the work.

B. The acceptance or rejection of cement shall rest with the Engineer and any cement failing to meet the requirements specified herein may be rejected at his/her direction. All rejected cement shall be plainly marked for identification, shall be immediately removed from the work site and shall not again be offered for inspection. Cement kept in storage for several months may be subject to repeated tests, if required.

C. The cement shall be delivered in strong cloth or paper bags. No cement shall be used and no cement shall be inspected unless delivered in the original package with the brand and name of the manufacturer plainly marked thereon. Each bag of cement shall contain approximately 94 pounds of cement, net weight, and 4 bags

shall be the equivalent of the barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

D. The Contractor shall provide, at the site of the work, a suitable weathertight building, or buildings, having a tight floor properly blocked or raised from the ground, for the storage of cement. The building shall be large enough to permit keeping on hand a supply of cement in quantity sufficient to prevent delays or interruptions to the work which might be due to the lack of cement. The cement shall be stored in such manner to permit easy access for the proper inspection and identification of each shipment. Cement in bags shall not be piled to a height in excess of 7 feet. Suitable accurate scales shall be provided to the job, the Contractor will not be permitted to remove any of the cement to any other job or dispose of any of this cement in any way without the consent of the Engineer.

E. At the beginning of operations and at all other times while cement is required, the Contractor shall have, at the site of the work an ample supply of acceptable cement and shall carefully guard against possible shortage on account of rejection, irregular deliveries, or any other cause.

2201.2 Water

A. All water used in mixing mortar or concrete shall be free from acid, alkali, oil, salt, vegetable, or other matter in sufficient quantity to be injurious to the finished product, and shall be from an approved source.

2201.3 Aggregate

A. Fine aggregate for concrete shall be clean, hard, durable, uncoated grains of Arkansas River sand or other sand acceptable to the Engineer. It shall be free from injurious amounts of dust clay balls, soft or flaky particles, shale, alkali, organic matter, loam, or other deleterious substances. It shall not contain more than 3 percent by weight of material which can be removed by standard decantation tests. If the color of the supernatant liquid is darker than that of the reference standard color solution when subjected to the Standard Test for Organic Impurities in Sands for Concrete ANSI/ASTM C40, the fine aggregate shall be rejected unless it passes the Standard Test for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar ANSI/ASTM C87.

B. Fine aggregate shall be graded approximately within the limits shown in the following table. If not enough fines are available in the natural sands, limestone dust, or other approved, fines shall be added:

Percent Passing Standard Square Mesh Screens			
No. 4	No. 20	No. 50	No. 100
95-100	45-80	10-30	5-10

C. Course aggregate shall consist of the best available crushed limestone or other approved material. River gravel or other material with smooth surfaces shall not be used without specific written approval of the Engineer. Coarse aggregate shall be clean, tough, sound, durable rock and shall not contain harmful quantities of foreign materials and must be satisfactory to the Engineer.

D. Coarse aggregate shall be graded approximately within the limits shown in the following table:

Percent Passing Standard Square Mesh Screens				
<u>Aggregate Max Size</u>	<b>2- ½"</b>	<b>2"</b>	<b>1-½"</b>	<b>1"</b>
2"	100	95-100	60-95	50-83
1-½"		100	95-100	
¾"				100
<u>Aggregate Max Size</u>	<b>¾"</b>	<b>½"</b>	<b>3/8"</b>	<b>No. 4</b>
2"	40-70	20-40		0-5
1-½"	40-70		10-30	0-5
¾"	95-100		40-75	0-5

E. Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSI/ASTM C33, except as to graduation. The maximum size aggregate to be used in structures 6 inches thick and under shall be ¾ inch; in structures from 6 inches to 10 inches thick, the maximum size of aggregate shall be 1 and ½ inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

F. In case the concrete resulting from the mixture of the aggregates is not of a workable character or does not make the proper finished surface, the Engineer may require a different grading in order to secure the desired results, or they may allow the use of inert admixtures to correct deficiencies, upon proper showing that such use will not materially lower the strength or increase the permeability of the concrete.

2201.4 Steel Reinforcement

A. All reinforcing steel shall be deformed bars and shall conform to the requirements of the Standard Specifications for Billet Steel Bars for Concrete Reinforcement, ANSI/ASTM A615, for intermediate or hard grades. All steel shall be manufactured in the United States.

B. The Engineer reserves the right to require a test of three specimens of each size of bar from each carload received on the work. These tests shall be made by a

laboratory or testing firm approved by the Engineer and the cost of such testing shall be included in the price bid for steel reinforcement.

#### 2201.5 Strength and Proportion

A. The concrete shall have a compressive strength of no less than 3000 pounds per square inch, unless otherwise specified in the plans, as determined from test cylinders at 28 days, made, cured, and broken, as hereinafter specified.

B. The Concrete shall be mixed in the approximate proportion of 1:2-½: 4-¼ and shall contain no less than 5 sacks of cement per cubic yard of finished concrete. With the approval of the Engineer, admixtures may be added in order to increase workability.

#### 2201.6 Testing of Concrete

A. During the progress of the work, a reasonable number of compression tests shall be made when and if required by the Engineer. Each test shall consist of no less than 3 test cylinders. At least 1 test shall be made for each 100 cubic yards of concrete placed. The test cylinders shall be made and stored in accordance with the Standard Method of Making and Curing Concrete Test Specimens in the Field, ANSI/ASTM C31, and shall be tested in accordance with the requirements related to making compression tests and concrete test specimens as given in the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ANSI/ASTM C39.

B. All test specimens shall be kept as near to the point of sampling as possible and yet receive the same protection from the elements as is given to the portions of the structure being built. Specimens shall be protected from injury. They shall be sent to a testing laboratory approved by the Engineer not more than 7 days prior to the time of the test, and while in the laboratory shall be kept in the ordinary air at a temperature of approximately 70 degrees Fahrenheit until tested.

C. The Contractor shall furnish the Engineer certified reports on these tests and shall pay all the expense of making the tests and of furnishing the concrete for preparing and testing the cylinders.

#### 2201.7 Responsibility of Contractor for Strength

A. It is the intent of these specifications that 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.

B. Should the average strengths shown by test cylinders fall below the strengths required, the Engineer will 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

concrete of insufficient strength has been placed and the Contractor, at his/her cost, shall remove and replace such concrete with concrete meeting these specifications.

#### 2201.8 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.

#### 2201.9 Mixing

A. The concrete shall be mixed in an approved batch machine or mixer. The ingredients shall be accurately measured by weight, unless measurement by volume is permitted by the Engineer, before being placed in the mixer. Measuring boxes or other approved measuring apparatus shall be such that the proportions can be accurately determined. The quantity of water to be added, which will vary with the degree of dryness of the material and with the weather conditions, shall be accurately measured for each batch of concrete. Means shall be provided by which a measured quantity of water can be introduced at any stage of the process. The mixing shall be done in a thorough and satisfactory manner and shall continue until every particle of aggregate is completely covered with mortar. The mixing time for each batch shall not be less than one minute after the materials are in the mixer. The entire contents of the drum shall be discharged before recharging. Retempering of concrete which has partly hardened will not be permitted.

#### 2201.10 Consistency

A. All reinforced concrete which is required to be spaded or puddled in forms or around reinforcing steel shall be of such consistency that: all aggregate will float uniformly throughout the mass without settling or segregation; when dropped directly from the discharge chute of the mixer, it will flatten out at the center of the pile but will stand up at the edges, the pile spreading from internal expansion and not by flowing; it will flow sluggishly when tamped or spaded; it can be readily puddled into corner and angles of forms and around reinforcing steel, it can be readily spaced to the bottom of the pour or to a depth of several feet any time within 30 minutes after placing.

B. 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 not the segregation or accumulation of laitance.

C. If, through accident, intention, or error in mixing, any concrete shall, in the opinion of the Engineer, vary materially from the consistency specified, such concrete shall not be incorporated in the work but shall be discharged as waste material.

#### 2201.11 Placing Concrete

A. Before beginning a run of concrete, surfaces of the forms, reinforcing steel, and concrete previously placed shall be thoroughly cleaned of hardened concrete or foreign materials. Forms shall be thoroughly wetted or oiled.

B. Concrete shall be placed in the forms immediately after mixing. It shall be so deposited that the aggregates are not separated. Dropping the concrete any considerable distance, generally in excess of 5 feet, depositing large quantities at any point and running or working it along the forms, or any other practice tending to cause segregation of the ingredients, will not be allowed. It shall be compacted by vibration or continuous tamping, spading, or slicing. Care shall be taken to fill every part of the forms, to work the coarser aggregate back from the face and to force the concrete under and around the reinforcement without displacing it. All concrete shall be thoroughly vibrated, except where specifically accepted in the specifications. The concrete shall be deposited in continuous horizontal layers and, whenever practicable, concrete in structures shall be deposited continuously for each monolithic section of the work. Chutes and tremies used for conveying concrete shall be mortar-tight.

C. Work shall be arranged in order that each part of the work shall be poured as a unit, if this is possible. Where necessary to stop pouring concrete, the work shall be brought up in level courses and against a vertical stop board.

D. The placing of concrete under water, where permitted, must be done by special approved methods.

#### 2201.12 Placing in Cold Weather

A. No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below 35 degrees Fahrenheit.

B. If concreting in freezing weather is permitted by the Engineer, care shall be taken to prevent the use of any frozen material. In addition to adequate provisions for protecting the concrete against chilling or freezing, the Contractor shall be required to heat the water and aggregate in order that when deposited in the forms, the concrete will have a temperature of no less than 50 degrees Fahrenheit, nor more than 80 degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature for a minimum of 72 hours after it has been placed and a

temperature above 32 degrees Fahrenheit for a period of 2 additional days. The work shall be done entirely at the Contractor's risk.

C. No chemicals or other foreign matter shall be added to the concrete for the purpose of preventing freezing.

#### 2201.13 Ready-Mixed Concrete

A. Ready-mixed concrete may be used on the work, with the approval of the Engineer, when the Contractor can demonstrate that the concrete can be furnished in accordance with the specification hereinabove and that delivery can be made at such rate as will insure the continuity of any pour. Standard Specifications for Ready-Mix concrete, ANSI/ASTM C94, when not in conflict with the specifications herein, shall control the furnishing of the ready-mix concrete.

B. All mixer trucks shall be equipped with water meters. Additional water shall be added at the job site only with the specific approval of the Engineer.

#### 2201.14 Construction Joints

A. Construction joints shall be located as shown on the drawings and at other points as may be necessary during the construction, provided that the location and nature of the additional joints shall be approved by the Engineer. 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 1/3 of the area of the joints.

B. In resuming work, 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 1/2 inch of cement mortar, after which concreting may proceed. Mortar shall be placed in a manner in order not to splatter forms and reinforcing steel.

#### 2201.15 Finish of Concrete Surfaces

A. All surfaces exposed to view shall be free from conspicuous lines, affects or other irregularities caused by defects found in the forms. If for any reason this requirement is not met, or if there are any conspicuous honeycombs, the Engineer may require the correction of the defects by rubbing with carborundum bricks and water until a satisfactory finish is obtained.

B. Immediately after removing the forms, all wire or other exposed metal shall be cut back from the concrete surface, and the depressions thus made and all honeycombs rubbed smooth. If the Engineer deems any honeycomb or other defect concrete shall be cut out to a depth sufficient to expose the reinforcement and to afford a key for the concrete replacing that cut out.

#### 2201.16 Curing Concrete

A. Exposed surfaces of concrete shall be protected by approved methods from premature drying for a period of at least 7 days. Curing compounds, when approved by the Engineer, shall be applied according to the manufacturer's recommendations. In dry, hot weather, forms shall be removed as early as practicable and curing started immediately. The Engineer may require the frequent wetting of the concrete and the use of means to protect it from the direct rays of the sun.

#### 2201.17 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. Bends and splices shall be accurately and neatly done and shall conform to American Concrete Institute Manual of Standard practice for Detailing Reinforced Concrete Structures.

B. All reinforcing shall be placed in the exact position shown on the drawings and shall be held firmly in position by means of approved metal spacers and supports, by wiring to the forms, and by wiring the bars together at intersections with approved wire ties in order that the reinforcement will not be displaced during the depositing and compacting of the concrete. The placing and fastening of reinforcement in each section of the work shall be approved by the Engineer before any concrete is deposited in the section. Care shall be taken not to disturb the reinforcement after the concrete has taken its initial set.

#### 2201.18 Forms

A. Forms shall be so designed and constructed that they may be removed without injuring the concrete. The material to be used in the form 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 must be obtained. Undressed lumber may be used for backing or other unexposed surfaces, except inside faces of conduit.

B. The forms shall be built true to line and braced in a substantial and unyielding manner. They shall be mortar-tight, and if necessary to close cracks due to shrinkage, shall be thoroughly soaked in water. Forms for re-entrant angles shall be filleted, and for corners shall be chamfered. 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. The interior surfaces of the forms shall be adequately oiled with a non-staining mineral oil to insure the non-adhesion of mortar.

C. Form lumber which is to be used a second time shall be free from bulge or warp and shall be thoroughly cleaned. The forms shall be inspected immediately

preceding the placing of concrete. Any bulging or warping shall be remedied, and all direct, sawdust, shavings, or other debris within the forms shall be removed. No wood device of any kind used to separate forms will be permitted to remain in the finished work.

D. Temporary openings shall be placed at the bottom of the column and wall forms and at other points where necessary to facilitate cleaning and inspection immediately before depositing concrete.

#### 2201.19 Removal of Forms

A. Forms shall be removed in such a manner as to insure the complete safety of the structure. No forms shall be removed except with the express approval of the Engineer. In general, this approval will be based on the following:

1. 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 24 to 48 hours after placing, depending upon weather conditions.
2. Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within 24 to 48 hours after placing, depending upon weather conditions. No backfill shall be placed against walls, piers, or abutments, unless they are adequately supported or have reached the required strength.
3. Girder, beam, and joist 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.

### 2202 DUCTILE IRON PIPE, DUCTILE AND CAST IRON FITTINGS, AND VALVES

#### 2202.1 Pipe and Fittings

A. Where ductile iron pipe (DIP) 3 inches in diameter and larger is specified or required, it shall conform to, and be tested in accordance with, the current American national Standard Specification for Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids, ANSI/AWWA C151/A21.51. Ductile iron pipe less than 3 inches in diameter shall conform to the manufacturer's standards, either centrifugally or statically cast with a minimum thickness of 1.25 inches. The ductile iron (nodular cast iron) shall conform to the Standard Specification for Ductile Iron Castings, ANSI/ASTM 1536, with physical

properties of Grade 60-42-10. Length of Joints shall be either 18 or 20 feet. The minimum standard thickness of each pipe shall be as follows:

Pipe Size	Thickness Class
4" thru 8"	51
10" and larger	50

For 16 inch and larger Ductile Iron Pipe, the bell and spigot joints shall be electrically bonded, using a #4 AWG bare copper wire of adequate length to braze, using a #15 Cadweld cartridge, the copper wire to the bare metal at the bell and spigot. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

For 16-inch and larger Ductile Iron Pipe, junction box test stations shall be furnished and installed, EXCEPT, no magnesium anode banks shall be furnished or installed. Junction box test stations shall be installed in accordance with the stationing shown on the Schedule of Anode Spacing. Cost shall be included in the unit price bid per lineal foot of Ductile Iron Pipe.

B. Fittings for ductile iron pipe shall be cast or ductile iron. Cast iron and ductile iron fittings shall conform to the American national Standard for Gray-Iron and Ductile Iron Fittings, 3-inch through 48-inch, ANSI/AWWA C110; or the American National Standard for Ductile-Iron compact fittings, 3-inch through 12-inch, ANSI/AWWA C153, Compact Fittings, 3-inch through 12-inch, ANSI/AWWA C153, with the exception of solid sleeves. All solid sleeves shall conform to ANSI/AWWA C110 and shall be the longest length listed in the AWWA specifications (12-inch length for 3-inch through 12-inch sleeves, 15-inch length for 14-inch through 24-inch sleeves, and 24-inch length for 30-inch through 48-inch sleeves).

## 2202.2 Joints

A. Cast iron and ductile iron pipe and fittings shall be jointed with any of the end types as specified below, unless a particular end type is specified. Fittings shall have mechanical joints, unless otherwise specified. Flanged ends shall be used only where specifically noted on the drawings except that the valve connection end of all tapping sleeves shall be flanged.

B. Mechanical joints and push-on joints shall conform to and be tested in accordance with, the American National Standard for Rubber Gasket Joints for Ductile-Iron and Gray-Iron Pressure pipe and Fittings, ANSI/AWWA C111/A21.11.

C. Push On joints shall conform to ANSI/AWWA C111/A21.11. Either the Tyton or the Fastite joint types may be used.

D. Flange joints shall conform to the American National Standard for cast Iron Pipe Flanges and Flanged Fittings, ANSI B16.1.

E. Where ductile iron pipe is to be tapped, a split cast iron tapping sleeve of 150 psi working pressure shall be used. The sleeve body shall be cast iron conforming to ANSI/AWWA C110. The sleeve shall have mechanical joints conforming to ANSI/AWWA C111 on the run and a flange branch conforming to ANSI B16.1., Class 125. The ends gaskets shall be natural rubber or neoprene material conforming to ANSI/AWWA C111 on the run and a flange branch conforming to ANSI B16.1., Class 125. The gaskets shall conform to ANSI/AWWA C111.

F. Tapping sleeve manufactured by Mueller and American, or equal, are permitted.

G. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material as specified under ANSI/AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI/AWWA C207.

H. Where restrained joints are specified or required, they shall be a wedge action type mechanical restrained joint assembly equal to the Megalug Series 1100, manufactured by EBAA Iron, Inc. Set screw type retainer glands will not be permitted.

### 2202.3 Coating, Lining and Polyethylene Wrap

A. Cast iron and ductile iron pipe and fittings shall be bituminous coated outside and cement-mortar lined inside with seal coat in accordance with American National Standard for Cement Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water, NSF /ANSI 61, ANSI/AWWA C104/A21.4.

B. All cast iron and ductile iron pipe and fittings shall be encased with polyethylene tube made from virgin polyethylene resin conforming to ANSI/ASTM Specification D-1248. Thickness shall not be less than 8 mils (.008 inch). The material shall be chemically inert and moisture resistant to form an effective seal against penetration by water or vapor. Tensile strength shall be 1800 psi with elongation of 500 percent. The material shall be Polytube, or approved equal, as manufacture by Polytube Corporation, Birmingham, Alabama. Tape of polyethylene tube shall be plastic backed adhesive tape, Polykan #900, Scotchrap #50 or approved equal, 2 inches in width. The tube shall be of such length that a 1 foot overlap is provided at each joint of pipe.

C. Minimum flattened polyethylene tube widths for use with specific pipe sizes and joint types:

Nominal Pipe Diameter (Inches)	Flat Tube Width (Inches)
3	14
4	16
6	20
8	24
10	27
12	30
14	34
16	37
18	41
20	45
24	54
30	67
36	81
42	95
48	108
54	121

#### 2202.4 Gate Valves

A. Where gate valves are specified or required, they shall conform to, and be tested in accordance with, the AWWA Standard for Gate Valves, 3-inch through 48-inch, Nominal Pipe Size, for Water and Sewage Systems, ANSI/AWWA C500. Valves shall have double disk parallel seats, non-rising stem, vertical mounting “O” ring stem seal, counter clockwise opening, and ends to fit the pipe or fitting to which attached (push on mechanical, bell and spigot, or flanges).

B. Where resilient seated gate valves are specified or required for waterworks distribution service, they shall conform to and be tested in accordance with the AWWA Standard for Resilient Seated gate Valves, 3 inch through 12 inch nominal pipe size, Water and Sewer Systems, ANSI/AWWA C509. The valve shall be bubble tight from either direction at a rated design working pressure of 200 psi. The valve shall have a single disc gate with synthetic rubber seat bonded or mechanically attached to the opening, “O” ring stem seals, corrosion resistant interior coating acceptable for potable water; and end to fit the pipe or fitting to which is attached (mechanical, bell and spigot, or flanged).

C. Certified test reports in accordance with Section 6, AWWA C509 shall be submitted to the Engineer prior to installation.

D. Only the following makes will be permitted: American, Dresser, Mueller, Kennedy, and U.S. Pipe.

E. Where flanges are specified they shall be ANSI B16.1, Class 125, cast iron flanges.

#### 2202.5 Ball Valves

A. Ball valves shall conform to and be tested in accordance with the AWWA Standard for Ball Valves, ANSI/AWWA C507. Where ball valves are specified or required, they shall be: double-seated with natural or synthetic rubber, bronze, or monel metal seats; designed for 150 psi working pressure; flanged end; "O" ring rotor bearing seals; constructed of high-tensile strength cast iron; equipped with totally enclosed manual operators, with open closed indicator and hand wheel with standard AWWA 2 inch operating nut for one man operation at 150 psi unbalance across the valve. Where manual worm gear operators are specified or furnished, they shall be furnished with an AWWA Input Shaft Stop, designed and tested to withstand, without damage, all torques and forces in accordance with AWWA C507. Valves shall be tested by, and shall withstand without leak, a hydrostatic pressure of: (1) 250 psi on the valve body with rotor in the open position and; (2) 150 psi on the side of the valve with the opposite side open to atmosphere. Four (4) copies of the test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve.

B. Where flanges are specified they shall be ANSI B16.1, Class 125, cast iron flanges.

C. Only the following makes will be permitted: McNally, Henry Pratt, or Willamette Iron & Steele.

#### 2202.6 Butterfly Valves

A. Butterfly valves shall be of the tight-closing, rubber-seat type, shall have a rated pressure of 150 psi, and shall be bubble-tight at this pressure with flow in either direction. Butterfly valves shall be Pratt or approved equal. The valves shall conform to and be tested in accordance with the AWWA Standard for Rubber-Seated Butterfly Valves, ANSI/AWWA C504, Class 150B. The valve body shall be of the short-body flange type, constructed of cast iron conforming to either ASTM A126, Class B, or ANSI/ASTM A48, Class 40 or ductile iron ANSI/ASTM A48, Class 40, or ductile iron, ANSI/ASTM A536 Grade 65-45-12. Valve shafts shall be constructed of 18-8, Type 304 or 316 stainless steel, ANSI/ASTM A296, Grade CF8, or monel. Valve seats shall be body or disc mounted and shall be of natural or

synthetic rubber compound with mating seat surfaces of 18-8, conforming to ANSI/ASTM A436, Type 1, or bronze Grade A, D, or E. Valve bearings shall be corrosion resistant and self-lubricating.

B. Manual valve operators shall be totally enclosed, permanently lubricated, suitable for buried service, and equipped with fan opened-closed indicator, handwheel, and standard AWWA 2-inch operating nut for one-man operation at 150 psi, unbalanced across the valve. The handwheel shall be mounted in the horizontal position.

C. Interior and exterior surfaces of the valve, except seating surfaces, shall be thoroughly cleaned and painted with 2 coats of asphalt varnish conforming to Federal Specification TT-V-51C. For non-buried service, exterior surfaces shall be coated with 2 coats of zinc chromate. Hydrostatic and leakage tests shall be conducted in strict accordance with ANSI/AWWA C505. Four (4) certified copies of test results and manufacturer's drawings shall be submitted for approval prior to delivery of the valve.

D. Only the following makes will be permitted: Pratt only.

#### 2202.7 Air Relief Valves

A. Where air relief valves are specified or required, the valve shall be heavy-duty combination air release and vacuum type for 150 psi working pressure, tested to 300 psi, size shown on plans. Body, cover, and baffle shall be cast iron. All internal parts to be either highest quality stainless steel or bronze, and the inside of valve coated with rust inhibitor.

B. Only the following makes will be permitted: Val-Matic only.

#### 2202.8 Check Valves

A. Where check valves are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Swing-Check Valves for Ordinary Water Works Service, AWWA C508. They shall be horizontally mounted, single disc, swing type with a full diameter passage providing minimum pressure loss. Valves shall be of the non-slamming type designed for the future installation of outside lever and weight. Disc faces and seat rings shall be bronze. Ends shall fit the pipe or fitting to which attached (mechanical, bell and spigot, or flanged).

B. Only the following makes will be permitted: Mueller only.

#### 2202.9 Fire Hydrants

A. Where fire hydrants are specified, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA

C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 5 ¼ inch compression main valve; 6 inch inlet connection; or mechanical joint hub; 4½-foot bury length, or as specified on drawings; one 4-inch pumper nozzle with National Standard threads; one 4-inch pumper nozzle with City of Sapulpa threads (refer to standard detail for Fire Hydrants included on the drawings); “O” ring seal; drain valve; left (counter-clockwise opening) and National Standard pentagon operating nut. Do not paint.

B. Where fire hydrant extensions are specified or required, they shall be of proper design to accommodate the make of fire hydrant installed.

C. Only the following makes will be permitted: Mueller Centurion only.

#### 2202.10 Five-Way Fire Hydrant

A. Where five-way fire hydrants are specified or required, they shall conform to, and be tested in accordance with the AWWA Standard for Dry-Barrel Fire Hydrants, ANSI/AWWA C502. All hydrants shall have: breakable connection features and a breakable coupling on the stem immediately above the bury line which has a lower breaking point than the rest of the unit; 5-1/4-inch compression main valve; 8-inch inlet connection; bell, flange, or mechanical joint inlet; 4½-foot bury length; 4-inch pumper nozzles with City of Sapulpa (refer to Standard Details as shown on the Drawings); “O” ring seal; set ground line at the finished grade; and National Standard pentagon operating nut. Do not paint.

B. Where fire hydrant extensions are specified or required, they shall be of the proper design to accommodate the make of fire hydrant installed.

C. Only the following makes will be permitted: Mueller Improved only.

#### 2202.11 Control Valves

The only approved manufacturer for pressure regulating valves and altitude valves is the following: OCV Control Valves, 7400 East 42nd Place, Tulsa, Oklahoma.

#### 2202.12 Vaults

Valve vaults shall be constructed of cast in place or precast concrete. Concrete shall be class AA and reinforcing steel shall be grade 60. Vaults shall have a pit on one corner to allow all water to be pumped out. Cast in place vaults shall have water stops in all horizontal joints that prevent groundwater from leaking into the vault. Precast vaults shall meet or exceed ASTM C-478. All vaults shall be designed and approved by a professional engineer. Vaults shall be equipped with a rustproof locking manway lid equal to a Bilco type J or approved equal with a lift assist. Lids shall be leak resistant and fabricated from diamond plate galvanized steel, stainless steel or aluminum. Frames shall be galvanized steel angles embedded into the cast

in place or precast vault top. Vaults located in areas subject to vehicular traffic shall be designed for AASHTO H-20 wheel loading. No masonry structures will be approved.

## 2203 STEEL PIPE AND FITTINGS

### 2203.1 General

A. 203.1.1. Where steel pipe is specified or required, it shall conform to the AWWA Standard for Steel Water Pipe, 6-inches and larger, AWWA C200. No steel less than 33,000 psi specified minimum yield strength shall be permitted. All pipe shall be hydrostatically tested in accordance with AWWA C200. Mill Test Reports shall be furnished and the hydrostatic test pressure shown on shop fabrication drawings. AWWA Designation C200 shall govern the testing. Pipe length shall be not less than 35 feet per joint, except for specials, unless otherwise noted. There shall be no more than one longitudinal or girth seam per section. Nominal pipe diameter and steel thickness shall be as specified on the drawings. The diameter shown is the required inside diameter of cement-mortar lining. All pipe shall be manufactured by an established manufacturer who has had at least 3 years' experience in successfully building this type of pipe. Openings for air valves, main connections, and blow-off connections shall be provided with suitable reinforcements around the opening, welded to the body of the pipe in accordance with AWWA Manual M11. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material listed above as specified under AWWA C200. All bolts shall be carbon steel ANSI/ASTM A307, Grade A only, in accordance with ANSI/AWWA C207. For corrosion monitoring of steel pipe, junction box test stations shall be furnished and installed. Magnesium anode banks shall be furnished and installed where specified in the plans. Junction box test stations and anode banks shall be installed in accordance with the stationing as shown on the Schedule of Anode Spacing in the plans.

B. All steel pipe shall be manufacture with ends of true circular shape, free from indentations, projections, or roll marks for a distance of 8 inches from the end of the pipe. This shall be done by hydraulic expansion or some other method satisfactory to the Engineer. The outside diameter of the pipe shall be true enough in dimension to permit the passage for a distance of 8 inches from the end of the pipe to a ring gauge with a bore three-thirty seconds of an inch larger than the outside diameter of the pipe.

C. Where steel fittings or specials are specified or required, they shall conform to all of the steel pipe specification requirements and to the AWWA Standard for Dimensions for Steel Water Pipe Fittings AWWA C208. Where fittings and specials are fabricated from mill pipe, they shall be fabricated from pipe hydrostatically tested in accordance with AWWA C200 with mitered joints dye checked for welding flaws. Changes in line and grade shall be made by steel specials or in the joints. Joint deflection shall not exceed that as recommended by the manufacturer. Inside diameter of steel specials and fittings shall be the required inside diameter of cement-mortar lining.

D. Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of 6 inches each side of the cut and the pipe surface shall be cleaned and brushed to bright metal. After welding, the inside lining shall be replaced in accordance with AWWA C602.

E. The minimum thickness standard in inches for each size pipe shall be as follows:

Minimum Thickness – Inches For Grade of Steel			
Nominal Pipe Diameter	A-283 Gr. D	A-53 GR. B	A-139 Gr. C
	A-570 Gr. 33	A-135 Gr.B	A-139 Gr. b
		A-36	A-572 Gr. 42
36"	0.313	0.250	0.250
42"	0.313	0.281	0.250
48"	0.375	0.313	0.281
54"	0.438	0.375	0.313
60"	0.500	0.406	0.344
66"	0.500	0.438	0.375
72"	0.563	0.500	0.406

The design criteria for steel pipe thickness are based on 150 psi working pressure plus a 75 psi allowance for water hammer. Maximum depth of cover shall be 12 feet. Depth of cover in excess of 12 feet shall require special design.

2203.2 Joints

A. Steel Pipe and fittings shall have one of the following type joints: slop joint ends for field lap welding, single beveled ends for field butt welding, double beveled ends

for field butt welding, “O” ring bell and spigot joints, or plain ends for mechanically coupled field joints. Flange ends shall be used only when noted on the drawings.

B. Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water pipe Joints, AWWA C206. slop joints for field lap welding shall be sized to provide a tolerance of not less than 0.09 inches and not more than 0.41 inches difference in measurement between the outside circumference of the spigot end and the inside circumference of the bell end.

C. Mechanically coupled joints shall consist of Dresser Couplings, Style 38, or equal, or as specified on the drawings. The harness lugs, tie bolts, and nuts shall conform to AWWA M11 Steel Pipe Design and Installation, Par. 19.8.

D. Bell and Spigot joints with rubber gasket shall conform to the AWWA Standard for Steel water Pipe 6-Inches and Larger, AWWA C200 and the AWWA Steel Pipe Manual, M11. The gasket shall be a continuous “O” ring design of natural rubber or neoprene and shall be of suitable cross-section and size to assure a watertight joint. Acceptable bell and spigot joints for all steel pipe diameters and thickness shall be the “O” Ring-Bar Type, or the “O” Ring-Carnegie Section, or rolled grove type joint. Bell and spigot ends shall be properly sized by forcing over a sizing die or by expanding to stretch the steel beyond its elastic limit so that the difference in diameter between outside of spigot and inside of bell at normal engagement is not less than .03 inch and not more than 0.10 inch as measured on circumference with a diameter tape. Shop applied interior lining on the bell end of the pipe shall be held back a minimum distance of the spigot engagement plus or minus ½ inch. Interior lining for the spigot shall be continuous to the end. Field replacement of the interior joint linings shall be in accordance with Section 2203.4. of these specifications for cement-mortar using a #4 bare copper wire, 6 inch length #15 Cadweld cartridge brazed to bare metal at the bell and spigot or equal. Shop applied exterior coatings shall be held back in accordance with manufacturer’s specifications. Field replacement of exterior coatings at the joints shall be in accordance with the AWWA Standard for Cold-Applied Tape Coatings for Special Sections, Connections, and Fittings, for Steel Water Pipelines, AWWA C209, or AWWA C203 Coal-Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, or AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe, 4” and Larger, Shop Applied.

E. Where steel pipe is to be tapped, a split tapping saddle of 150 psi working pressure shall be used. The saddle body shall be heavy welded ANSI/ASTM A36, or ANSI/ASTM A285, Gr. C steel with flange conforming to ANSI/AWWA C207, Class D. The gasket shall be natural rubber or neoprene design in a continuous ring of suitable cross-section, and sized to assure a watertight joint. The interior and exterior surfaces of the saddle body shall be shop coated with a fusion bonded

epoxy. The exterior coating or wrap on steel pipe shall be removed to bare metal beneath the entire area to be covered by the sleeve.

F. The following makes of saddles will be permitted: Superior Style 822, Baker Series 428, Rockwell 622, or equal.

G. Flanged joints shall conform to the AWWA Standard for Steel Pipe flanges, AWWA C207, Class D.

### 2203.3 Exterior Coating

A. The exterior coating on steel pipe and fittings shall be in accordance with Coal Tar Protective Coatings and Linings for Steel Water Pipelines, Enamel and Tape, Hot Applied, AWWA C203; or Tape Coating Systems for the Exterior of Water Pipelines AWWA C214 or cement-mortar coatings in accordance with AWWA C205, Cement-Mortar Protective Lining and Coating For Steel Water Pipe, 4" and Larger, Shop Applied. Where tape coatings are used, the total thickness shall be no less than 80 mils. Where coal tar enamel is used, the pipe shall be primed, coated with coal tar enamel, fibrous glass mat, bonded asbestos felt wrapper, and either whitewash coating or a final wrap of Kraft paper applied. Where cement-mortar coating is used, the thickness shall be not less than  $\frac{3}{4}$  inch and reinforced with spiral-wire, wire fabric, or ribbon mesh reinforcement in accordance with AWWA C205, Sec. 2.1. All above ground piping shall be cleaned, primed, and painted with an enamel, as shown in the plans. The total dry film thickness shall be 6 mils.

B. If field welding is used, the pipe joints shall be furnished with the outside coating held back, in accordance with standard joint detailed drawings. The coating and any touch up work shall be done under the direction of the coating manufacturer, and as approved by the Engineer.

### 2203.4 Interior Lining

A. The interior lining shall be installed in the field in accordance with AWWA C602, Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place; or shop applied in accordance with AWWA C205, Cement Mortar Protective Lining and Coating for Steel Water Pipe, 4 inch and larger, shop applied. The lining shall be  $\frac{3}{8}$  inch thick for diameters through 36 inches, and  $\frac{1}{2}$  inch thick for 42 inches and larger, whether shop or in place lines. Tolerances shall be in accordance with the applicable AWWA standards. Coal tar enamel and coal tar epoxy interior linings will not be permitted.

B. In a place cement-mortar lining is used, the Contractor shall furnish all materials, labor, equipment, prepare the interior surface, and machine place the mortar lining in the pipe. The lining at valves, specials, and bends may be hand sprayed or troweled, or hand applied as required. The lining shall be maintained in a moist condition

while curing. The Contractor shall be responsible for any extended curing time until acceptance by the Engineer. No additional payment shall be made for any extended curing period.

#### 2203.5 Strutting and Bracing

A. Strutting and bracing shall be provided on all specials, fittings, and straight pipe, where shop lines or coated with cement mortar, so as to limit the pipe deflection to 2 percent maximum of inside diameter. A minimum three strutting braces shall be installed in each standard pipe joint. For pipe 54 inch and larger in diameter, the strutting shoes at each bearing point shall be a minimum of 4 feet long, parallel to the longitudinal pipe axis. The strutting shall remain in place until all compacting and backfilling has been completed. Where in place cement mortar lining is to be installed, sufficient strutting braces, subject to the approval of the engineer, shall be installed at the shop to insure against pipe deformation.

### 2204 REINFORCED CONCRETE PIPE AND FITTINGS

#### 2204.1 Reinforced Concrete Pipe and Fittings for Water Lines

A. Where reinforced concrete pipe (RCP) and fittings are specified or required for water lines, they shall be designed, manufactured, and tested in accordance with the AWWA standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids, AWWA C303. All pipe shall be manufactured by an established manufacturer who has had at least three years' experience in successfully building this type of pipe. All specials and fittings shall be built to the details furnished by the manufacturer and approved by the Engineer. Each special and each length of straight pipe shall be plainly marked to indicate the head for which the pipe is designed and to indicate where the pipe will be used by reference to the layout drawings. All closure fittings shall be furnished with an 18-inch flanged access manway with an 18-inch steel blind flange. 6-inch screw type hand hole fittings will not be permitted.

B. RCP and fittings for water lines shall be designed for the following conditions (minimum): Normal operating pressure equal to 150 psi, plus 50% for surge pressure plus earth load resulting from actual backfill depth, but not less than 8 feet plus external live load equal to AASHTO HS 20 loading. The thickness of the mortar coating shall provide a minimum cover of 1 inch over the reinforcing steel.

C. Reinforced concrete pipe and fittings for water lines shall be jointed according to AWWA Standard for Prestressed Concrete Pressure Pipe, Steel Cylinder Type, for Water and Other Liquids, ANSI/AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids,

ANSI/AWWA C301, or Reinforced Concrete Pressure Pipe, Steel Cylinder Type, Pretensioned, for Water and Other Liquids, AWWA C303.

D. Where concrete pressure pipe ANSI/AWWA C301, Steel Cylinder Prestressed Concrete or Pretensioned Concrete Pressure Pipe, AWWA C303 is to be tapped, the tapping saddle shall be fabricated in accordance with the American Water Works Association Manual M-9, and as recommended by manufacturers of Concrete Pressure Pipe. Saddle shall provide grout gaskets and grout opening to enable filling the wall space between saddle and pipe wall with grout, to assure complete protection of the steel pipe wall. The saddle shall also provide gland assembly, including gasket and flange, to insure a tight seal.

E. Tapping saddles as manufactured by Gifford-Hill American Interpace Corporation, or equal, are permitted.

F. Openings of the sizes shown on the drawings shall be furnished with steel blind flanges of proper strength to withstand the working pressure of the line where no other provision is made for closing the openings. Blind flanges shall be fabricated from material as specified under AWWA C200. All bolts shall be carbon steel ASTM A307, Grade A only, in accordance with ANSI/ASSW C207.

## 2205 POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE

- 2205.1 Where a polyvinyl chloride (PVC) pipe 4 inches in diameter through 12 inches in diameter is specified or required, it shall conform to and be tested in accordance with AWWA C900, "AWWA Standard for Polyvinyl Chloride (PVC) Pressure Pipe, 4 in. through 12 in., for Water" as herein modified. PVC water pipe shall be approved by the Underwriters Laboratory and bear the seal of approval ("NSF" mark) of the National Sanitation Foundation (NSF) Testing pipe shall be restricted from use under or adjacent to arterial streets.
- 2205.2 PVC pipe shall conform to pressure Class 150 or 200 (equivalent to Standard Dimension Ratio 14 or 18) as directed by the City Engineer and shall have an outside diameter (OD) equal to the OD of equivalent size ductile iron pipe.
- 2205.3 PVC pipe shall have integral wall-thickened bell ends and shall be jointed using one piece elastomeric gaskets. Solvent cement jointing shall not be permitted.
- 2205.4 Fittings for PVC pipe shall be polyethylene wrapped ductile or cast iron conforming to section 202 of these specifications. The use of PVC fittings shall not be permitted.
- 2205.5 Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with the AWWA C900, and that it meets the approval of the "NSF".

2206 HIGH DENSITY POLYETHYLENE (HDPE) PIPE, WATER SERVICE

2206.1 Where a high density polyethylene (HDPE) pipe 4 inches in diameter through 12 inches in diameter is specified or required, it shall conform to and be tested in accordance with AWWA C906, HDPE pipe shall conform to pressure Class DR-11, pressure class 200 for PE 4710.

2206.2 HDPE pipe shall have butt fused joints and fittings in accordance with ASTM F2206 and shall be adaptable to ductile iron pipe fittings.

2206.3 Fittings for HDPE pipe shall conform to ASTM F 2206.

2207 POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

2207.1 Where polyvinyl chloride (PVC) pipe 8 inches in diameter through 12 inches in diameter, fittings and in-line tees are specified or required for sewer service, it shall conform to and be tested in accordance with ASTM D3034 "Type PPSM Polyvinyl Chloride Sewer Pipe and Fittings" for Standard Dimension Ratio (SDR) of 35. The outlet connection in-line tee fittings shall be Schedule 40.

2207.2 The PVC sewer pipe shall be supplied in 12.5 feet, or 20 feet laying lengths as specified.

2207.3 Where it is necessary to connect PVC sewer pipe to ductile iron pipe an AWWA C110 long body solid sleeve shall be used with a special gasket for the PVC pipe. Flexible couplings will not be permitted.

2207.4 Where PVC Sewer pipe is being installed, the fittings for the service line and the in-line tees for future service connections shall be manufactured and specifically designed for Schedule 40 PVC service lines.

2208 CASTINGS

2208.1 Casting for valve boxes, valve vaults, manholes, lampholes, and other appurtenances shall conform to, and be tested in accordance with the specifications for Gray Cast Iron, ANSI/ASTM A48, Class 30. Design shall be according to the attached Standard Details. Frames and covers that are to be located within dedicated public right-of-way, or any other location subject to vehicular traffic, shall have all bearing surfaces machined so that fitting parts will not rattle or rack under traffic. All castings shall be subject to a hammer test before installation.

2208.2 Where sealed lids are specified or required for sanitary sewer manholes, they shall be Neenah R1755-E, or equal.

2209 CONDUIT

2209.1 Where conduit (also known as tunnel liner or pipe sleeve) is specified or required, it shall conform to, and be tested in accordance with one of the following:

Type of Conduit	Specification
Reinforced Concrete Culvert, Storm and Sewer Pipe	ANSI/ASTM C76; Class IV
Corrugated Galvanized Metal Pipe for Railroad Crossings	AASHTO M36; 12-gauge
Corrugated Galvanized Metal Pipe for Street Crossings	AASHTO M36; 14-gauge
Corrugated Galvanized Metal Pipe Liner Plate	AASHTO M36; 12-gauge
Steel Pipe, 6-inches and larger thickness	AWWA C200; 3/8 inch wall thickness

2210 VAULT, PITS AND MANHOLES

- 2210.1 All structures shall be constructed with cast in place Class A concrete and reinforcing steel. Precast concrete structures are acceptable providing they are watertight. Refer to section 2202.12.
- 2210.2 Precast manholes shall conform to, and be tested in accordance with the specifications for Precast Reinforced Concrete Manhole Sections, ANSI/ASTM C478, flat slab top type.

2211 SAND FOR CUSHION OR BACKFILL

- 2211.1 Sand shall be graded from fine to coarse, free from objectionable material, and contain no more than 10 percent clay or loam by weight. 100 per cent shall pass a 3/4 inch screen, and 95 per cent shall pass a number 4 screen.

2212 CRUSHED STONE FOR SURFACING, BASE, COURSE, AND STABILIZATION

- 2212.1 Crushed stone shall consist of clean, tough, durable fragments, free from an excess of soft disintegrated particles. The stone and placement shall conform to the ODOT specifications for base courses. Sampling shall be in accordance with the Standard Method of Sampling Aggregates, ANSI/ASTM D75.
- 2212.2 Sieve analysis shall be performed in accordance with the method of Sieve Analysis, ANSI/ASTM C136. Graduation to be used at each location will be specified by the Engineer.

Surfacing and Base Course

Percent Passing		
Sieve Size	Type A	Type B
3"		100

1-1/2"	100	40-100
3/4"	40-100	30-75
3/8"	30-75	25-60
No. 4	25-60	20-50
No. 10	20-43	15-35
No. 40	8-26	7-22
No. 200	4-12	3-10

## 2213 RIP RAP

- 2213.1 Quality of Materials: All stone for Rip Rap shall be limestone, or other hard stone of good quality that will not materially disintegrate under action of air or water. It shall weigh no less than 140 pounds per cubic foot as determined from the bulk specific gravity (saturated surface dry) of the sample in accordance with procedure in ANSI/ASTM Specifications of C127-68, "Test for Specific Gravity and Absorption of Course Aggregate". Slabs or slivers shall not be used. Rocks shall be of angular shape. Gypsum, anhydrite, chert, shale, soft furnished shall be such that will yield hard, massive, heavy durable stone, and shall be free from cracks, seams and other defects that would tend to unduly increase its destruction by natural causes. The Contractor shall furnish for the work, an approved stone of good quality. The successful bidder shall, within fifteen (15) days after receipt of notice to proceed, submit to the contracting officer for approval, three (3) samples weighing not less than 150 pounds each, of the tone he proposes to furnish. The samples shall be fairly representative of the whole quarry. If it is proposed to furnish stone from more than one quarry, samples as stated above shall be furnished from each quarry. The City will notify the Contractor of acceptance or rejection of the stone samples within ten (10) days after their submittal for approval. The submission of samples will not be required if the material is to be obtained from a source previously approved by the City from test and service records.
- 2213.2 Type "B": Type "B" rip rap material shall be quarry-run rock free from over burden spoil, and no piece shall weigh more than 500 pounds. At least 40 percent of any shipment shall consist of rocks weighing 100 pounds or more. Rock shall be graded so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids. Rock carrying dirt and fines less than 1/2-inch in maximum cross section, accumulated from stone layers or from blasting or loading operations will be accepted if such material does not exceed 10 percent by weight.
- 2213.3 Type "C": Type "C" rip rap material shall be quarry-run rock free from overburden spoil, and no piece shall weigh more than 1,000 pounds. A minimum of 40 percent of any shipment shall consist of rocks weighing 200 pounds or more. Rock shall be graded

so as to produce a reasonably well-graded mass with the minimum practicable percentage of voids.

DIVISION 2300 WATER & SEWER CONSTRUCTION  
SPECIFICATIONS

2300 RIGHT-OF-WAY CLEARING AND RESTORING

- 2300.1 Work under this item shall include the removal and reconstruction or replacement of all obstructions affected by the construction of the project, including, but not limited to fences, retaining walls, patios, trash burners, signs, mail boxes, out-buildings, landscaping, etc.
- 2300.2 Any such obstructions which are not to be reconstructed are so designated on the drawings and shall be removed and disposed of by the Contractor. Those to be replaced or reconstructed shall be restored to substantially the same condition as existed prior to the construction except as otherwise noted.
- 2300.3 Upon completion of work, all debris shall be removed and disposed of, and grade of the surface of the earth shall be restored as reasonably as may be done to the grade existing prior to construction. The site shall be restored to as neat, clean and orderly conditions and nearly as it was prior to construction except as otherwise noted.
- 2300.4 The Contractor shall photograph all concrete and asphalt driveway crossings, in the presence of an inspector, marking the location by street address on each photo. Photographs shall be filed with the Public Works Department prior to commencing work.
- 2300.5 Passable surfaces across or along the construction vicinity shall be maintained at all times with gravel, steel mat or plate, or temporary bituminous surfacing material where a sidewalk, driveway, parking lot, street or alley previously existed. Any paved area, composed of bituminous material other than asphaltic concrete, shall be cut, removed and replaced to at least the Standard trench width. Oiled surfaces shall be re-oiled. Gravel or macadamized surfaces shall be replaced with the same.
- 2300.6 If an obstruction is of public ownership, the Contractor shall notify the appropriate agency, and obtain any necessary permit or license 48 hours before beginning any operations affecting the obstruction. All work shall conform to the current standards and specifications of that agency, and shall be approved by the agency before completion of the project. At the Contractor's request, the Engineer will furnish information as to what licenses or permits are required.
- 2300.7 Payment: This item shall be made at the unit price bid per linear foot. Total footage shall be the total length of pipe, not including bores, fittings, or specials, as included in other items. No additional payment shall be made for alterations of utility mains, service lines, or appurtenances, unless specifically provided for elsewhere in the Contract Documents.

## 2301 EXCAVATION AND BACKFILL, UNCLASSIFIED

- 2301.1 The work under this item shall include all earth, shale, gravel, loose rock, solid rock, debris, junk and/or other material excavated or otherwise removed in the preparation of the trench; all work in connection with the excavation, removal and subsequent handling and disposal of such material, regardless of its type, character, or condition; subgrade preparation, all sheeting, piling, shoring, bracing, and dewatering of trenches; protection of adjacent property; backfilling; sand cushion; grade base stabilization; all specified backfill consolidation; and other work necessary or required.
- 2301.2 The trench shall be excavated so that the pipe can be laid to the alignment and grades shown on the drawings, or as directed by the Inspector. In dense or built-up areas or where unstable soils exist, the trench shall be excavated a maximum of 100 feet in advance of pipe laying. In open areas or where soil conditions permit, the trench excavation may be unlimited in advance of pipe laying, as approved by the Engineer. Opening of trenches in excess of the maximum requires specific approval of the Engineer. Trenches shall be dry when the trench bottom is prepared. The trench bottom shall be shaped so that even bearing is obtained from the barrel of the pipe with the bells unsupported. The standard trench width as shown on the attached Standard Detail shall not be exceeded at any elevation below a point 12 inches above the top of the pipe. If for any reason this portion of the trench exceeds the permitted width the Inspector shall determine cradle or encasement shall be installed. Any part of the bottom of the trench excavated more than 4 inches below the specified grade shall be corrected with approved material thoroughly compacted as directed by the Inspector. In the event suitable material is not available, sand shall be used. When rock is encountered and concrete cradle is required, it shall be excavated 4 inches below the bottom of the pipe and the trench refilled to grade with sand. When quicksand or other unstable earth is encountered, the Contractor shall excavate to sufficient depth to permit backfilling with crushed stone in order to provide a stable base for the pipe.
- 2301.3 Bedding of pipe shall be as shown on the attached Standard Details. Sand shall be placed in the trench simultaneously on both sides of the pipe to an elevation of 6 inches above the top of the pipe, being carefully worked and hand tamped around the pipe in order to consolidate the sand and assure excellent bedding. Backfill material shall not be placed in the trench covering the sand cushion without prior approval of the Inspector.
- 2301.4 When the type of backfill material is not indicated on the Drawings or specified, the backfill may be made with the excavated material, provided that such material, in opinion of the Inspector is suitable for backfilling. In the event that excavated material is not suitable, sand or other approved material shall be used. From 6 inches above the pipe to 18 inches above the pipe, the trench shall be backfilled by mechanical methods approved by the Inspector. Special care shall be used in placing this portion of the backfill to avoid damaging or moving the pipe. The remainder of the trench may be

backfilled by mechanical methods. Backfilling operation shall be completed within 100 feet or less of the finished line at all times, as directed by the Inspector.

- 2301.5 All trenches excavated across any sidewalk, driveway, parking lot or other paved area, across any traveled portion of unpaved streets or alleys, across any proposed roadways or proposed roadway fills, and as shown on the drawings shall be backfilled and compacted to the same density as the existing soil adjacent to the side of the trench, but shall not be less than 95 percent Standard Proctor Density, provided the excavated material consists of soil that can be readily compacted at the optimum moisture. If the excavated material consists of mostly clay or silt containing an excess of moisture, such excavated material shall be removed from the site of the work and the trench filled with sand or other material that will meet AASHTO M145 soil classification of A02, or better. Trenches excavated across existing street or alley paving shall be backfilled in accordance with the Standard Detail for Pavement Removal and Replacement. If the backfilling has been completed and the backfill material does not meet the requirements for compaction, all the material shall be removed and hauled from the job site and the trenches refilled with material as specified above. Failure of backfill shall be corrected immediately, as directed by the Engineer.
- 2301.6 Payment: Payment for this item shall be made at the unit price bid per cubic yard. Volume will be computed as follows: standard trench width as given in the Standard Detail included in the drawings; length of line as the actual horizontal measurement along the centerline of the ditch; depth of excavation as the actual depth of ditch from the original ground surface to the flow line of the pipe as shown in the construction notes. Average end-area method of computing volume will be used. No payment for excavation will be made for material excavated outside the neat lines of the standard trench width as given in the attached Standard Detail. No additional payment will be made for: sand cushion; backfilling; compaction of backfill; sand used for backfill under existing and/or proposed roadways, parking lots or as shown on the Drawings; removing and replacing top soils and obstruction, tunneling of trees, storm sewers or other obstructions; blasting; bracing and shoring; dewatering; pumping and draining; grade base stabilization removal of excess excavated material; or restoration of the site. It is mutually understood that subterranean water, quicksand, or other unstable earth may be encountered and the Contractor has taken such into consideration in making this bid. Where such is encountered, Contractor will be required to excavate to sufficient depth to permit backfilling with crushed stone in order to provide a stable base for the pipe. Extra payment will not be made because of such additional excavation or because it is necessary to excavate wider than the trench width as given in attached Standard Detail; or for crushed stone.

## 2302 CONCRETE CRADLE AND CONCRETE ENCASEMENT

- 2302.1 The work under this item shall include the installation of concrete encasement and reinforced concrete cradle as shown in the drawings or as directed by the Engineer, in accordance with the approved construction details. Care shall be taken to assure that placing of encasement does not deflect the pipe shape or move it from the proper grade or alignment.
- 2302.2 Sanitary sewers shall be encased when the depth of cut from the original ground elevations to the flow line of the pipe is four feet or less. Concrete encasement necessitated by trench widths greater than the standard trench width as recommended by the manufacturer or as directed by the Engineer. Concrete encasement shall not be used on PVC pipe.
- 2302.3 Concrete cradle shall be used when the ground water conditions indicate the possibility of hydrostatic lift of the pipe.
- 2302.4 Payment: payment for this item shall be made at the unit price bid per linear foot of the pipe specified in the Bid form, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes. The cost of reinforcing shall be included in the price bid for concrete cradle.

## 2303 PIPE, REINFORCED CONCRETE

- 2303.1 The work under this item shall include furnishing, hauling, placing and jointing of reinforced concrete pipe (RCP) in the trench in specific conformity with the lines and levels given.
- 2303.2 For water lines, the American national Standard for Installation of Gray and Ductile Cast-Iron Water Main and Appurtenances, AWWA C-600, shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail. Bedding for pretensioned concrete pipe shall be in accordance with Standard Bedding Detail for Pretensioned Concrete Pressure Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing the proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located before these drawings are prepared. The ends of the pipes to be jointed shall be cleaned immediately prior to joining and the rubber gasket thoroughly lubricated with vegetable soap before it is placed in position on the spigot end. Extreme care shall be taken in moving the spigot end of the pipe into the bell end of previously laid pipe. If the gasket is damaged or moved out of place, the new pipe shall be removed and a new gasket applied before rejoining. Any soap remaining on the exposed concrete surfaces inside or outside the pipe shall be completely removed. Fittings or specials included as pipe shall be blocked.

- 2303.3 For all lines, after the pipe had been jointed, a band at least five and one half inches wide shall be placed around the outside of the pipe at the joint. This band shall serve as a form for placing 1:1 cement mortar grout in the external recess formed by the face of the groove and the shoulder of the tongue. If a reinforced paper joint band is used, it shall be drawn up tight around the pipe and the backfill tamped against it up to the spring line before pouring the grout. If a cloth band is used, it shall be wired around the outside of the pipe, and the grout poured before backfilling. On all pipes, the joint space remaining on the inside of the pipe shall be filled with a strip mixture of 1:1 cement mortar which shall be troweled in place to produce a continuous, smooth, flush surface across the joint.
- 2303.4 Payment: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Bid form, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.
- 2304 PIPE, DUCTILE IRON
- 2304.1 The work under this item shall include furnishing, hauling, placing, and jointing of Ductile Iron pipe in the trench in specific conformity with the lines and levels given. All Ductile Iron pipe shall be wrapped with a loose fitting, and slop on polyethylene film. The polyethylene film shall be slopped over the end of the pipe length that has been raised above the ground at the trench side. After the joint on the pipe is made up, the one foot length shall be slipped over the joint to form an over or under lap of the adjacent polyethylene tube at his/her point. The loosely fitting film shall then be neatly folded over the top of the joint and held in place with tape. The loosely fitting tube extending along the pipe shall be drawn up snugly and folded along the top and held in place by using short pieces of plastic tape at intervals not to exceed 4 feet. Fittings, valves and corporation stops shall be wrapped with a section of polyethylene material split to form a flat sheet, using plastic tape to hold the material around the appurtenance. For all pipe, the American national Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation as applicable. The method of bedding shall be as shown on the attached Standard Detail for Thrust Blocks and Trench Conditions.
- 2304.2 For water lines, all fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail, with the size to be determined by the Engineer.
- 2304.3 Payment: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Bid form, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.

## 2305 PIPE, STEEL

- 2305.1 The work under this item shall include furnishing, hauling, placing, and jointing of steel pipe in the trench in specific conformity with the lines and levels given. For all lines, American National Standard for Installation of all lines, American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation, as applicable. The method of bedding shall be as shown on the attached Standard Bedding Detail for Steel Pipe. The Drawings show the plan and grade for the pipeline. The Contractor shall submit detailed drawings to the Engineer for approval, showing his/her proposed method of laying the pipe to these grades. All pipelines to be crossed shall be located before these drawings are prepared. Fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions.
- 2305.2 If joints are field-welded, they shall develop the full strength of the pipe. The Contractor shall file with the Engineer a description of the method of welding which he proposes to use, and the name of the individual or company in this particular line of work. Testing shall be in accordance with Section 3.3 of AWWA C206. If requested, coupons shall be cut across the field welds and tested by a testing company approved by the Engineer and at the Contractor's expense. The line may be welded continuously with provisions for slack in the line, or in sections to be lowered in the trench and connected by a position weld.
- 2305.3 If joints are to be mechanically coupled, sections up to 250 feet may be coupled and lowered carefully into the ditch. Electrical continuity shall be provided at all joints. Preparation for, protection of, and repair of pipe coating and lining, and coating of mechanical couplings shall conform to the applicable section of these specifications.
- 2305.4 Field replacement of the cement-mortar interior lining shall be in accordance with the AWWA Standard for Cement-Mortar Lining of Water Pipelines, 4-Inch and Larger, In Place, AWWA C602.
- 2305.5 Payment: Payment for this item shall be made at the unit price bid per linear foot of pipe of the type specified in the Bid form, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings used with drop manholes, for fittings or specials included as pipe, or for concrete blocking.

2306 POLYVINYL CHLORIDE (PVC) OR HIGH DENSITY POLYETHYLENE (HDPE)  
PIPE, WATER SERVICE

- 2306.1 When PVC OR HDPE pipe is delivered to the job site, it shall not be exposed to sunlight for more than 3 weeks. Pipe exposed to sunlight for more than 3 weeks shall be covered with an opaque protective covering. The pipe shall be left stacked and no more pipe than can be installed in one day shall be strung along the job site.

- 2306.2 When a length of PVC pipe is cut, the plain end shall be beveled to the same configuration as the factory beveled end. The end shall be beveled using a pipe beveling tool, portable sander, or abrasive disc. After beveling, stop marks shall be applied to the plain end at a distance from the end corresponding to the original stop marks.
- 2306.3 Both bell end and plain end of PVC pipe shall be thoroughly cleaned before connecting pipes.
- 2306.4 Elastomeric Gaskets shall be placed into bell with colored side of the gasket to the outside.
- 2306.5 Before connecting PVC pipes, the plain end shall be lubricated with an approved lubricant. The bell end of PVC pipe shall not be lubricated.
- 2306.6 When connecting, the plain end pipe shall be inserted into the bell end pipe and then pushed until stop marks on plain end are flush with end of bell.
- 2306.7 Payment: Payment for this item shall be made at the unit priced bid per linear foot of pipe of the type specified in the Bid form, and placed as shown on the Drawings. Total footage shall be the actual horizontal measurement along the centerline of the pipe. No additional payment shall be made for vertical pipe or fittings or specials included as pipe, or for concrete blocking.

#### 2307 LOCATOR WIRE AND DETECTABLE MARKING TAPE

- 2307.1 A Number 8 bare copper conductor wire for the purpose of locating PVC pipe shall be buried along the top of the pipe, and connected at each end to a fire hydrant by Cadweld Brazing just above the ground.
- 2307.2 Detectable Mylar marking tape for location of PVC or HDPE water pipe shall be required in areas as designated by the Engineer, more generally in commercial zones and open areas. Detectable Mylar marking tape shall be 2-inches wide, blue in color with a continuous black lettered imprinting stating "Caution: Water Line Below". Tape shall be equal to Lineguard Tape II tape as manufactured by Lineguard, Inc. of Wheaton, Illinois.
- 2307.3 Detectable Mylar tape shall be buried above PVC water lines at a depth of 10-inches below the surface.
- 2307.4 Payment: Payment for tape shall be included in the unit price bid for PVC pipe. No additional payment will be made.

#### 2308 TAPPING OF PVC PIPE FOR SERVICE CONNECTIONS

- 2308.1 Standard water service connections shall be made by using cast iron service clamps. The couplings shall be provided with factory installed brass bushings which conform to ASTM B62 and AWWA C800 for standard corporation stop threads. Bushings must match the corporation stops. Direct tapping of PVC water pipe will not be allowed.

## 2309 FITTINGS

- 2309.1 The work under this item shall include all of the requirements specified under the item of Pipe, in that “pipe” is understood to also mean “bends, tees, crosses, sleeves, outlet assemblies and other specified fittings.” Unless otherwise specified, outlet assemblies shall consist of a flanged outlet constructed into the wall of steel or concrete pipe. If cast iron or ductile iron pipe is used, the outlet shall consist of a tee with the outlet flanged. If a gate valve is shown on the Drawings to be attached to the outlet, the line side end shall be flanged and the opposite end shall be bell or mechanical joint according to the item for Valves. All bends, tees, crosses, outlet assemblies, and plugs shall be blocked with concrete as shown on the attached Standard Detail, except where the fittings have flanged, welded, or harnessed joints. The Inspector may, under certain conditions, delete the blocking. Concrete blocking shall be placed so that joints are accessible for repair.
- 2309.2 Payment: Payment for this item shall be made at the unit price bid per fitting, of the type specified in the Bid form, and placed as shown on the Drawings. Only fittings specifically noted in the Bid form are included in this item. No additional payment shall be made for excavation, backfilling, or concrete blocking.

## 2310 POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

- 2310.1 The work under this item shall include furnishing, hauling, placing, and joining PVC sewer pipe in the trench in specific conformity with the line and levels given, and meeting all the requirements of Section 208.

## 2310.2 Installation

A. Installation of the PVC sewer pipe shall be in accordance with ASTM D2321 “Underground Installation of Flexible Thermoplastic Sewer Pipe”. Backfill materials shall be placed in accordance with attached Standard Bedding Detail for Polyvinyl Chloride Flexible Sanitary Sewer Pipe. All crushed stone material shall be one and one-quarter to three-quarter inch Class A graded stone. Crusher run will not be acceptable. Limestone Screening may be used if compacted to 90 percent density at optimum moisture content. If there is a question regarding moisture content, the Contractor may, at his/her option, provide approved laboratory analysis to establish optimum moisture content. However, the Engineer’s decision will be final.

B. The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Drawings and/or as given in the field by the Inspector. Pipe shall be protected during handling against impact shocks and free fall. The laying of pipe in finished trenches shall be in the direction of flow. Pipe shall be laid continuously through new manholes if both inlet and outlet pipes are of the same size and in line. Upon completion of the manhole, the invert shall be shaped. The ends of adjoining pipes shall butt against each other for their entire circumference in such manner that there

is no shoulders of unevenness of batterboards and a “top line”. A top line shall be maintained over a span of 3 grade stakes when laying pipe. As each batterboard is erected, the top line shall be sighted to assure the accuracy of the grade stakes and the displacement of grade stakes shall be called to the attention of the Inspector for correction.

C. Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried.

D. A manhole water stop gasket and clamp assembly as approved by the Engineer shall be constructed at each point where a line enters or exists a manhole. The fluted gasket shall be placed around the pipe and secured with a stainless steel retainer ring. A standard “o”-ring coupling shall be placed around the manhole water stop assembly.

### 2310.3 Testing

A. After all backfill is in place, PVC sewer pipe shall be measured for vertical ring deflection using a deflection testing mandrel. The Contractor shall provide the mandrel and all necessary equipment to perform the deflection test. All testing and test conclusions shall be verified by the Engineer or his/her designated representative. The Contractor shall submit detailed dimensional drawings of the mandrel for approval by the Engineer. The mandrel shall be sized to limit the maximum ring deflection of the installed pipe to 5 percent of the average inside diameter, as defined by ASTM Designation D3034. All pipe exceeding the allowable deflection shall be replaced at no additional cost to the owner.

B. Flushing of PVC sewer lines will be performed by the City, but the Contractor will lend assistance as may be required. Any infiltration of flushing water or other leaks into the sewer shall not be acceptable, and the Contractor shall immediately correct the cause of the leak in a manner acceptable to the Engineer.

C. Where air testing of PVC pipe is specified, it shall be air tested in accordance with the City of Sapulpa Water and Sewer Department Standard Air Test Procedure. The air testing will be performed by the Contractor. Manholes shall be water tested by plugging all lines entering and exiting the manholes and then flooding the manhole to rim elevation. This test will be performed by the Contractor.

2310.4 Payment: Payment for this item shall be included in the unit price bid per linear foot of the pipe specified in the Bid form, and placed as shown on the Drawings.

### 2311 MANHOLE

2311.1 The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new standard or drop

manholes. Construction of manholes shall progress as rapidly as installation of the line permits, and as directed by the Inspector.

- 2311.2 Excavation for manholes shall be made with vertical sides and minimum dimensions permitting construction of the manhole in accordance with the attached Standard Details. Manholes are to be built to an elevation not less than that of the existing round surface, or as shown on the drawing.
- 2311.3 A new manhole shall be constructed around existing lines without disturbance to the line. When the manhole is completed, the existing pipe shall be removed from the invert of the manhole. Care shall be taken in removing the pipe to prevent any stoppage. Immediately upon completion of the manhole, all waste mortar and debris shall be removed from the bottom and invert. When the walls are completed, a standard manhole frame and cover shall be set in place. Changes in pipe grade, alignment or size shall be made by transition sections of the invert, determined by the lower half of the inlet and outlet pipe. All inverts shall be plastered, troweled, and brushed to a smooth, clean surface. Inlet and outlet pipes shall not project beyond the interior wall of the manhole and shall be free from all sharp masonry. All pipes shall have an approved gasket seal around the pipe.
- 2311.4 During the construction of each manhole, cast iron steps shall be set in place on the inside of the manhole, beginning 18 inches above the bottom and placed not more than 15 inches apart. No steps shall be placed closer than 18 inches to the manhole top. No concrete masonry units are to be used for the walls. Steps shall be built firmly into the wall, allowing the steps to project 5 inches inside the manhole. The centerline of the steps shall be as shown on the attached Standard Detail for Manholes. 4-½ inch steps shall be used for brick manholes and 12 inch steps for precast manholes.
- 2311.5 The use of concrete masonry units shall not be allowed.
- 2311.6 Brick Manholes: No brick manholes are to be used on sewers.
- 2311.7 Pre-Cast Manholes
- A. Pre-cast manholes with cast in place base slabs will be permitted for all standard and drop manhole installations.
  - B. Pre-cast manholes with integral pre-cast floors will be permitted only for standard manhole installations with depths of 12 feet or less.
  - C. Pre-cast manholes with integral pre-cast floors will not be permitted from drop manhole installations. Pre-cast floors shall be placed on a minimum of 18 inches of compacted Class A crushed stone.
  - D. Pre-cast manholes shall conform to the Specifications for Pre-Cast Reinforced Concrete Manhole Sections, ASTM C478. Joint construction shall be in accordance with the Standard Specification for Reinforced Concrete Pipe except that no exterior

grout band is required. No more than 8 inches of concentric rings shall be used to bring the manhole to finished grade. Each concentric ring shall have a full mortar joint, not exceeding 3/8 inch in thickness. Inside joints shall be rugged full and struck.

2311.8 Payment: Payment for this item shall be made at the unit price bid per manhole of the type specified in the Bid form, and placed as shown on the Drawings. If the manhole depth, measured from the invert to the top of the cover exceeds 6 feet, the additional depth shall be paid for at the unit price bid per linear foot of manhole depth over 6 feet. No additional payment will be made for excavation, backfilling, pipe or concrete bottoms.

## 2312 CONNECTION

2312.1 The work under this item shall include all excavation, furnishing all materials required, construction, finishing, and backfilling of connections to existing mains, valves, manholes, special connections, service line reconnections, plugs or in line tees for future connections, as indicated on the Drawings or as directed by the Inspector.

2312.2 The Drawing shows details of the various connections and they shall be made in accordance with the Details or as directed by the Engineer. On water mains, the Contractor shall make the pressure and wet connections to existing mains, as shown on the Drawing, unless specifically noted otherwise.

2312.3 Connections to existing manholes shall be made by cutting into the manhole at the specified grade, inserting the pipe, and encasing the joint with concrete. The Contractor shall not break into any existing sewer unless the Inspector is present and the work done shall be under the direction of the Inspector. Inlet and outlet pipes at the invert shall not project beyond the interior walls of the manholes. The manhole base shall be cut and reconstructed in such a manner that a proper invert section is maintained. All waste mortar, debris, and sharp edges shall be removed from the joints, bottom, and invert. The Contractor shall remove and replace the manhole steps in the proper location and in accordance with the attached Standard Details if they are not properly located after the connection is made. Any and all diversion or pumping of water or sewerage in a wet connection is included in this Item.

2312.4 Methods of construction shall be the same for house line reconnections as for main sewers. Cast iron pipe shall be used for all lines in parking areas, across open or closed storm sewers, across backfilled ditches, or within public rights of way. Vitrified clay pipe shall not be used in any location.

2312.5 In-line tee fittings shall be installed for future service connections, as shown on the plans, in accordance with the Standard Detail for In-Line Tees. The tee shall be capped

with a screw plug of either bronze, brass or a capped detectable plastic, marked by a non-magnetic, Mylar tape, and stapled to both sides of a nominal 2 inch by 4 inch marker, 8-foot long, 4-foot buried, and 4-foot exposed, directly above fitting plug. The Mylar tape shall be minimum 2-½ inch width, green in color, marked “Caution, Sanitary Sewer Below”, as manufactured by Terra Tape or Line Guard.

- 2312.6 After new water mains have been tested and chlorinated, the Contractor shall excavate around the new main for the service transfer. The existing mains and new mains shall remain in service during the transfer of services. The Contractor shall clamp, bend, copper tubing, and required fittings. The new service shall be connected to the existing meter after the service has been tested for leakage. The excavated area shall be backfilled and restored to original condition. Where galvanized service lines are encountered, they shall be replaced with copper. Where long services are replaced, they shall be bored under existing pavement. Open cutting will not be permitted unless approved by the Engineer. Copper tubing shall be Type K soft annealed conforming to ASTM B 88.
- 2312.7 Payment: Payment for this item shall be made at the unit price bid for each type of connection constructed, or in-line tee for future connection, as specified on the Bid form, or as directed by the Engineer. Payment for the first drop connection to a new manhole is included in the Manhole Item. No additional payment will be made for excavation, backfilling, furnishing and placing of concrete, removing and replacing of manhole steps, if necessary, or for the diversion or pumping of water or sewerage necessary to make the connection. Payment for water service transfers shall be made at the unit price bid for pipe and fittings under the appropriate connection bid item and shall include all necessary excavation, backfill, right of way clearing and restoring, materials, and labor.

### 2313 LAMPHOLE

- 2313.1 The work under this item shall include all excavation, furnishing all materials required, construction, pipe connection thereto, finishing and backfilling of new lampholes. Lampholes shall be located and constructed as shown on the Drawings, or as directed by the Inspector. When the concrete lamphole frame base is completed, a standard lamphole frame is to be set in place and closed with a lamphole cover.
- 2313.2 Payment: Payment for this item shall be made at the unit price bid per lamphole constructed as specified on the Bid form. No additional payment will be made for excavation, backfilling, or pipe.

### 2314 VALVE

- 2314.1 The work under this item shall include furnishing, hauling, and installation of valves at the locations shown on the Drawings, and in accordance with the attached Standard Details. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600 shall govern the installation, as

applicable. If the paint is damaged, the valve shall be cleaned by wire-brushing and given two coats of black asphalt paint.

- 2314.2 Gate valves shall be set with the stems plumb. Ball valves shall be set with the hand wheels horizontal. Air relief valves shall be set so that the square operating nut on the two inch valve can be operated from the top. Check valves shall be set horizontally. Construction standards for air relief and check valve vaults shall be the same as for manholes.
- 2314.3 Fire hydrants shall be set so that the bottom of the steamer nozzle is not less than 12 inches nor more than 21 inches above the finish grade of the ground. Breakable bolts damaged in the installation shall be replaced in kind. If the Mueller hydrant is used, the oil reservoirs shall be filled before the hydrant is set. Concrete blocking shall be placed so that the drain and joints are accessible. Fire hydrant and stem extensions shall be provided and installed as necessary, in accordance with the manufacturer's recommendations.
- 2314.4 Payment: Payment for this item shall be made at the unit price bid per valve, of the type specified on the Bid form, and placed as shown on the Drawings. If fire hydrant and stem extension are required, they shall be paid for at the unit price bid for each different length of extension used. The unit price bid for air relief and check valves shall include the valve vault. No additional payment shall be made for: excavation; backfilling; concrete blocking; the pipe length between the line and the fire hydrant (except where the pipe is shown on the Drawings in a separate profile); crushed rock for drains; or air relief valve piping vaults.

#### 2315 VALVE BOX

- 2315.1 The work under this item shall include furnishing, hauling, and installation of valve boxes at the locations shown on the Drawings. The American National Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances, AWWA C-600, shall govern the installation, as applicable.
- 2315.2 Payment: Payment for this item shall be made at the unit price bid per valve box.

#### 2316 ENCASUREMENT, CONCRETE

- 2316.1 The work under this item shall include the installation of concrete encasement as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail No. 1. Care shall be taken to assure that placing of encasement does not deflect the pipe from the proper grade and alignment.
- 2316.2 Sanitary sewers shall be encased when the depth of cut from the original ground elevation to the flow line of the pipe is 4 feet or less. Concrete encasement necessitated by trench widths more than the maximum as shown on the attached Standard Detail for Thrust Blocks and Trench conditions shall be placed as directed by the Inspector.

2316.3 Payment: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as encasement. All concrete encasement required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

#### 2317 CRADLE, CONCRETE

2317.1 The work under this item shall include the installation of concrete cradle as shown on the Drawings or as directed by the Inspector, in accordance with the attached Standard Detail for Thrust Blocks and Trench Conditions. Care shall be taken to assure that placing of cradle does not deflect the pipe from the proper grade and alignment.

2317.2 For sanitary sewers, standard concrete cradle is required at any location where the depth of cut to the flow line of the pipe is 16 feet or more. Concrete Cradle necessitated by trench widths more than the maximum as shown on the attached Standard Detail No. 1 shall be placed as directed by the Inspector.

2317.3 Payment: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as cradle. All concrete cradle required because of excessive trench width shall be placed at the expense of the Contractor. No payment will be made for concrete used as fill or in excess of the theoretical quantity computation based on the attached Standard Detail for Thrust Blocks and Trench Conditions.

#### 2318 PIERS, REINFORCED CONCRETE

2318.1 The work under this item shall include all materials, forming, construction and finishing of reinforced concrete piers, and necessary pipe anchorage. Piers shall be located and constructed at pipe joints. Forms shall be made to conform to the shape of the pier and securely braced. Reinforcing steel shall be shop bent as detailed in approved fabrication drawing and securely tied in place. Bearing area for the pipe shall be made to fit the outside diameter of the pipe and shall support the pipe at the proper grade. Steel strapping and bolts shall be installed and painted with one heavy coat of coal tar or asphalt or approved coating after bolting in place. Any honeycomb or other unevenness in the concrete shall be patched with cement mortar immediately after form removal.

2318.2 Payment: Payment for this item shall be made at the unit price bid per cubic yard of concrete placed as reinforced concrete piers in accordance with the attached Standard Details, at the location shown on the Drawings, or as directed by the Engineer. No additional payment will be made for excavation, reinforcing, forming, bracing, dewatering, backfilling, or pipe anchorage.

#### 2319 CONDUIT

2319.1 The work under this item shall include the installation of railroad, street, or other crossings by boring or tunneling as shown on the Drawings. The conduit pipe shall be

installed to the line and grades given. Voids between the outside of the conduit and the surrounding earth shall be filled with cement grout or other material approved by the Engineer. The space between the outside of the carrier pipe and conduit shall be filled with sand if required by the Inspector. The Engineer shall approve the following options: tunneling or boring, conduit material, construction method details, carrier supports, and sand fill.

2319.2 Payment: Payment for this item shall be made at the unit price bid per linear foot of conduit, of the size specified in the Bid form, and placed as shown on the Drawings. All carrier pipe shall be paid for under other items. No additional payment shall be made for excavation, backfilling, boring, tunneling, dewatering or sand fill.

2320 STRUCTURE, SPECIAL

2320.1 The work under this item shall include the furnishing of all materials and performing all work necessary to complete any special structures shown on the Drawings.

2320.2 Payment: Payment for this item shall be made at the unit price bid for each structure as specified in the Bid form, and constructed as shown on the Drawings. Pipe, fittings, valves and other appurtenances will be paid for under other items. No additional payment will be made for excavation, reinforcing, backfill, foundations, or any particular element of construction.

2321 MATERIALS FURNISHED BY CONTRACTOR AND INSTALLED BY CITY

2321.1 The work under this item shall include furnishing and hauling of materials to the site of work. All necessary clearing, excavation, other site preparation, backfill and restoration, shall be performed by the Contractor so that the City may install the materials in place with a minimum amount of delay. The Contractor shall furnish assistance to the City in installing the materials so that they may be readily installed. The City's responsibility shall be only for the actual installation of the materials. All other work shall be performed by the Contractor.

2321.2 Payment: Payment for this item shall be made at the unit price bid per material item of the type specified in the Bid form and actually installed per Drawings. Only materials specifically noted in the Bid form are included in this item. All necessary clearing, excavation, other site preparation, backfill and restoration will be paid for under other bid items.

2322 SODDING AND SEEDING

2322.1 Where the installation of water or sanitary sewer mains traverse developed areas, residential or commercial, the Contractor shall restore all damaged sod turf. The restoration of sod turf shall be by either Sod Replacement or Hydro-mulch Seeding, as directed by the Engineer. Only that turf in one residential block may be removed at any time. Where residential blocks are not involved, only that turf in approximately 1,000

linear feet of trench excavation may be removed at any time. The Contractor shall restore all turf damaged by the Construction. Payment for turf restoration will be per linear foot, based on the length of main installed through an area. The Contractor shall consider, when preparing his/her bid, the width of turf restoration required.

- 2322.2 Sod Replacement: Remove the sod turf with approved cutting equipment. Store the turf in an area where construction operations will not damage it and apply sufficient water to preserve the root system. Replace with sufficient water to preserve the root system. Replace the sod turf after the trench has been backfilled and compacted. As an alternate to this method, the Contractor may furnish and install new solid slab grass sod of the same type as that which was removed. The new sod shall be moist when excavated from the source and kept moist until planted. Sod shall consist of vegetative parts (rhizomes, stolons, and roots) with an appreciable quantity of adhering soil. Sod which becomes dry shall be discarded. Sodded areas shall be thoroughly watered after placement.
- 2322.3 Hydromulch Seeding: Remove, store, and replace top soil. Apply seed, fertilizer, and mulch together in a homogeneous mixed slurry. Fertilizer shall be 10-20-10 and shall be applied at a rate of 10 pounds per 1,000 square feet. Mulch shall be wood fiber and applied at a rate of 46 pounds per 1,000 square feet. Grass seed shall be either hulled Bermuda applied at a rate of 2 pounds Per 1,000 square feet or Rebel Fescue applied at a rate of 8 pounds per 1,000 square feet as directed. Mulch shall be kept moist for a minimum of 10 days or until seeds have germinated and rooted. Watering shall be provided as required to maintain the grass.
- 2322.4 The Contractor shall obtain a hydrant meter from the Customer Service Department and pay all required fees for any watering. The Contractor shall maintain all sodded or seeded areas until acceptance of the Contract.
- 2322.5 Payment: Payment for Sod replacement or Hydromulch Seeding will be made at the unit price bid per linear foot and shall include all necessary top soil replacement, fertilizing, watering, and maintenance. The linear foot pay quantity will be measured parallel to the pipe through the area being restored. The Contractor shall consider the width of turf restoration required for each area. No additional payment will be made for extra sodding or seeding required due to valve vaults, fire hydrants, tie-in service transfers, leak repairs, plugging, manholes, lampholes, or other appurtenances.

## 2323 DRIVEWAY CROSSING BY BORING

- 2323.1 Waterline installed under existing concrete or asphalt driveways shall be bored. The diameter of the bore shall be a maximum of 4 inches larger than the outside diameter of the pipe bell. The annular space between the carrier pipe and the surrounding undisturbed earth shall be filled with sand. If the carrier pipe is ductile iron, it shall be polyethylene wrapped and taped at 1 foot intervals through the entire length of the bore.

If the Engineer determines that boring is not possible, the driveway shall be open cut and the pavement replaced as directed by the Engineer.

- 2323.2 Payment: Payment for driveway crossings by boring shall be at the unit price bid per linear foot as measured from edge to edge of the driveway. Removal and replacement of driveway pavement will be paid for under other items. No payment will be made for additional bore required due to obstructions on either side of the driveway.

#### 2324 PAVEMENT, REMOVAL AND REPLACEMENT

2324.1 Work under this item includes removal and replacement of concrete or asphalt for sidewalks, driveways, parking lots, curbs, streets, alleys, and the like. Pavement crossed at right angles shall be saw cut, removed, and replaced as shown on the standard drawings or as directed by the Engineer for the type of pavement indicated on the Bid form. Pavement crossed diagonally shall be squared by saw cutting at right angles to the paved area. If a construction joint is within 3 feet of a proposed saw line, the pavement shall be replaced to the joint as directed by the Engineer. New concrete pavement shall bridge the top of the trench by 1 foot on each side. All paving shall conform to the Standards and Specifications of the Sapulpa Office of the Engineer. Concrete shall be high early strength. All asphalt shall be hot mix, and hot laid.

2324.2 Payment: Payment for removal and replacement of concrete or asphalt pavement shall be at the unit price bid per square yard. The pay quantity of square yards will be computed using the standard pay width for the type of pavement replaced and the length of the pavement cut along the centerline of the pipe. The pay quantity will include pavement replaced due to the proximity of a construction joint if the specified criteria is met. For diagonal crossings, the pay quantity will include the areas replaced due to the squaring. Payment for saw cut shall be at the unit price bid per linear foot. Payment for curb and gutter shall be at the unit price bid per linear foot. No payment will be made for preparation of subgrade, forms, or reinforcing. No payment will be made for removal or replacement of gravel, macadamized, or oiled surfaces.

#### 2325 EROSION CONTROL MEASURES

2325.1 Refer to section 600 in the Criteria manual. The Contractor is responsible to insure that measures are taken to minimize erosion and sedimentation problems including but not limited to the following:

- A. Place erosion control devices at 500 feet intervals on relatively flat grades and 200 feet intervals on grades over 5 percent.
- B. Place sediment sumps to collect sediment. Remove sediment on a regular basis.
- C. Keep excavation and silt off of streets.
- D. In areas where water lines are being constructed adjacent to improved streets, measures shall be taken which will minimum siltation and excavation accumulating

in existing storm sewers. Precautions should be taken during heavy rains to assure that a flooding condition is not created.

E. Straw mulch can be used as an effective means of erosion control. Straw bales are not allowed.

F. Erosion control measures shall be placed at the top of slope of all cut and fill areas.

2325.2 The Contractor shall furnish and install straw mulch as directed. Mulch shall be applied at a rate of 1-½ tons per acres. Mulch shall be securely anchored in place.

2325.3 Payment: Payment for straw bales will be at the unit price bid and shall include the cost of sediment sumps and anchoring. Payment for straw mulch will be at the unit price per square yard and shall include the cost of anchoring.