

ENGINEERING DESIGN CRITERIA

and

STANDARD SPECIFICATIONS



**CITY OF SAPULPA, OKLAHOMA /
SAPULPA MUNICIPAL AUTHORITY**

JANUARY 1995

ORDINANCE NO. 2140

An ordinance amending the Sapulpa City Code by adding a new Chapter, relating to streets and public works; establishing Engineering Design Criteria and Specifications for Construction of privately or publicly financed public improvements within the City of Sapulpa, Oklahoma; Repealing all Ordinances or parts of Ordinances in conflict herewith; Providing for severability and declaring an emergency.

BE IT ORDAINED BY THE BOARD OF CITY COMMISSIONERS OF THE CITY OF SAPULPA THAT:

Section I: The Engineering Design Criteria and Construction Specifications attached hereto, made a part hereof and marked as Exhibit "A", are hereby adopted in total as if fully set forth hereinafter, and from and after the effective date same shall be controlling upon all engineering design and construction of privately or publicly financed public works projects within the City of Sapulpa, Oklahoma.

Section II: The Engineering Design Criteria and Construction Specifications referred to as Exhibit "A" shall be adopted with Section I, the Engineering Design Criteria having the following Chapters, to-wit:

- Chapter 1 General
- Chapter 2 Design Criteria for Water Mains
- Chapter 3 Design Criteria for Sanitary Sewers
- Chapter 4 Design Criteria for Streets
- Chapter 5 Stormwater Drainage Criteria
- Chapter 6 Soil Erosion and Sedimentation Control

and, the Section II Construction Specifications having the following Divisions, to-wit:

- Division I General Specifications
- Division II Water and Sewer Material Specifications
- Division III Water and Sewer Construction Specifications
- Division IV Streets and Drainage Specifications

Section III: That all Ordinances, or parts of Ordinances, in conflict herewith are hereby repealed.

Section IV: Should any section, subsection, sentence, provision, clause or phrase hereof be held invalid, void, or unconstitutional or any reason such holding shall not render invalid, void, or unconstitutional any other section, subsection, sentence, provision clause or phrase of this ordinance and the same are deemed severable for this purpose.

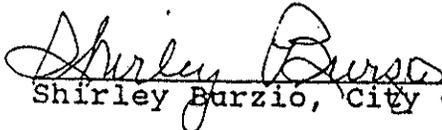
Section V: Date of Effect: This Ordinance being designated to protect the public health, safety, and welfare of the inhabitants of the City of Sapulpa, Oklahoma, and it's passage being immediately necessary, an emergency is hereby declared to exist and by reason whereof this Ordinance shall take effect immediately upon it's passage, approval, and publication as provided by law.

PASSED AND APPROVED in regular session this 17th day of January, 1995.



Brian Bingman, Mayor

ATTEST:



Shirley Barzio, City Clerk

APPROVED:



Robert DuPriest, City Attorney

RESOLUTION NO. 2090

SAPULPA MUNICIPAL AUTHORITY

SAPULPA, OKLAHOMA

A RESOLUTION OF THE TRUSTEES OF THE SAPULPA MUNICIPAL AUTHORITY, SAPULPA, OKLAHOMA, ADOPTING THE ENGINEERING DESIGN CRITERIA AND STANDARD SPECIFICATIONS FOR CONSTRUCTION FOR PRIVATELY AND PUBLICLY FINANCED PUBLIC IMPROVEMENTS.

BE IT RESOLVED BY THE TRUSTEES OF THE SAPULPA MUNICIPAL AUTHORITY, SAPULPA, OKLAHOMA, THAT:

The Engineering Design Criteria and Standard Specifications for Construction as adopted by the City Commission of the City of Sapulpa, Oklahoma, on the 17th day of January, 1995, pursuant to Ordinance No. 2140 are hereby adopted by the Trustees of the Sapulpa Municipal Authority, Sapulpa, Oklahoma, and same shall be controlling in terms of engineering design and construction of privately or publicly financed public improvements whose ultimate responsibility for maintenance and operation lies with the Sapulpa Municipal Authority.

Dated this 17th day of January, 1995.

SAPULPA MUNICIPAL AUTHORITY

BY: Brian Bingman
Brian Bingman, Chairman

ATTEST:

Shirley Burzio
Shirley Burzio, Secretary

APPROVED AS TO FORM:

Robert DuPriest
Robert DuPriest, Authority Attorney

TABLE OF CONTENTS

	<u>Page No.</u>
Section I	
Engineering Design for the City of Sapulpa Purpose, Intent, and Interpretation	
Engineering Design Criteria	
1.0 General	I - 2
1.1 Procedure Outline	I - 2
1.2 Standards and Specifications	I - 3
1.3 Drafting	I - 3
1.4 Bench Marks	I - 5
2.0 Design Criteria for Water Mains	I - 6
2.1 General	I - 6
2.2 Rural Service Area	I - 8
3.0 Design Criteria for Sanitary Sewer	I - 8
3.1 General	I - 8
4.0 Design Criteria for Streets	I -10
4.1 General	I -10
4.2 Plan Sheets and Profiles	I -10
4.3 Streets	I -11
4.4 Typical Sections	I -13
4.5 Cross Sections	I -14
4.6 Structures and Specific Details	I -15
4.7 Sidewalks	I -15
4.8 Easement and Right-of-Way	I -15
4.9 Lighting	I -16
5.0 Stormwater Drainage Criteria	I -16
5.1 Runoff	I -16
5.2 Storage	I -22
5.3 Detention Facilities	I -26
6.0 Soil Erosion and Sedimentation Control	I -27
6.1 General	I -27
Section II	
Standard Specifications for the City of Sapulpa Purpose, Intent, and Interpretation of Specifications	

TABLE OF CONTENTS

	<u>Page No.</u>
Division I General Specifications	
101. Scope and Location	II - 2
102. Scope, Nature and Intent of Specifications and Drawings	II - 2
103. Lines and Grades	
104. Protection of Property	II - 3
105. Connections	II - 5
106. References to other Specifications	II - 5
107. Protection of Materials	II - 5
108. Testing	II - 6
109. "Or Equal" Clause	II - 6
110. Dewatering	II - 6
111. Safety	II - 7
112. Removal of Condemned Materials and Structures	II - 8
113. Traffic Control Devices	II - 8
114. Clean-Up	II - 8
115. Street Wash Down	II - 9
116. Placing Work in Service	II - 9
Division II Water and Sewer Material Specifications	
200. Submittals	II -10
201. Concrete	II -10
202. Ductile Iron Pipe, Ductile and Cast Iron Fittings and Valves	II -19
203. Steel Pipe and Fittings	II -26
204. Reinforced Concrete Pipe and Fittings	II -30
205. Vitrified Clay Pipe and Fittings	II -33
206. Polyvinyl Chloride (PVC) Pipe, Water Service	II -33
207. Polyvinyl Chloride (PVC) Pipe, Sewer Service	II -34
208. Castings	II -34
209. Conduit	II -35
210. Vault, Pits, and Manholes	II -35
211. Sand for Cushion or Backfill	II -35
212. Crushed Stone for Surfacing, Base, Course and Stabilization	II -36
213. Rip Rap	
Division III Water and Sewer Construction Specifications	
301. Right-of-Way Clearing and Restoration	II -38
302. Excavation and Backfill, Unclassified	II -39
303. Pipe, Vitrified Clay	II -41

TABLE OF CONTENTS

	<u>Page No.</u>
304. Concrete Cradle and Concrete Encasement	II -42
305. Pipe, Reinforced Concrete	II -42
306. Pipe, Ductile Iron	II -43
307. Pipe, Steel	II -44
308. Polyvinyl Chloride (PVC) Pipe, Water Service	II -45
309. Locator Wire and Detectable Marking Tape	II -46
310. Tapping of PVC Pipe for Service Connections	II -46
311. Fittings	II -47
312. Polyvinyl Chloride (PVC) Pipe, Sewer Service	II -47
313. Manhole	II -49
314. Connection	II -51
315. Lamphole	II -52
316. Valve	II -53
317. Valve Box	II -54
318. Encasement, Concrete	II -54
319. Cradle, Concrete	II -54
320. Piers, Reinforced Concrete	II -55
321. Conduit	II -55
322. Structure, Special	II -56
323. Materials Furnished by Contractor and Installed by City	II -56
324. Sodding and Seeding	II -56
325. Driveway Crossing by Boring	II -57
326. Pavement, Removal and Replacement	II -58
327. Erosion Control Measures	II -59
Division IV Streets and Drainage Specifications	
401. Adoption of State Standards	II -60
402. Definitions	II -60

SECTION I
ENGINEERING DESIGN CRITERIA
FOR THE
CITY OF SAPULPA
SAPULPA MUNICIPAL AUTHORITY
January, 1995

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. While certain interim requirements may be imposed, it is the intent of these Engineering Design Criteria that the Consulting 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.

ENGINEERING DESIGN CRITERIA1.0 GENERAL1.1 Procedure Outline

1. Developer should coordinate the proposed development or project with the City Engineer's office during his preliminary studies and before actual design begins.
2. Developer executes and delivers to City Agreement Guarantying Installation of Improvements (See Appendix A).
3. Consulting Engineer submits certificates of insurance, including the provision for errors and omissions, providing coverages and in such amount as the City Commission or Municipal Authority shall, by motion, provide (Publicly financed improvements only).
4. Consulting Engineer shall submit three (3) sets of plans and an estimated cost of construction to the City Engineers office.
5. Plans 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.
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 City Engineer's office. A copy of a contractor's Bid or Proposal should accompany the bond or irrevocable letter of credit or the Consulting Engineers' cost estimate will be used in determining the amount of the bond.
7. A prework 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 City Engineers' office and a prework conference conducted to coordinate construction activities and scheduling.
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 City Engineer's office for approval.

9. Upon completion of construction, the Consulting Engineer will furnish the City Engineer's office a complete set of mylar reproducible "Record" drawings including those changes made during the construction process.

10. The City Engineer will make recommendations regarding the acceptability of the improvements to the City Commission or Municipal Authority. The City Commission or Municipal Authority will decide on whether or not to accept the improvements as constructed. The date on which City Commission or Municipal Authority accepts the improvements will be the effective date of the contractor's maintenance obligation.

1.2 Standards and Specifications

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.

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 approval of the City Engineer.

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 first submittal for review and approval by the City Engineer.

4. Approval of plans by the City Engineer does not release the Consulting Engineer from his responsibility to meet the planing and design of the project as required by the City Engineer's office and/or other departments of the City.

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 City Engineer's office for review.

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.

1.3 Drafting

1. Construction plans shall be drawn on a transparent reproducible medium (vellum or mylar).

2. Standard sheets shall be either 34" wide by 22" high or 36" wide by 24" high having a margin of 1 - 1/2" along the left border and 1/2" along the top, bottom and right border.
3. Consulting Engineer's with the capability to generate AutoCAD system layout drawings (plats, water, sewer, street, drainage, grading, etc.) shall provide the City Engineer's office with working files of "Record" drawings on floppy disks compatible with City's computer system.
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.
5. North shall be oriented to the top or right hand side of all plan sheets.
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.
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.
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.
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 minimum. Sizes greater than these are desirable and suggested.
10. All base maps shall be referenced to existing land lines (section corners, etc.). Property lines, right-of-way, easements, building lines, etc. shall be located and dimensioned.

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. Restricted easements will be filed by the City.

12. All structures (manholes, junction boxes, inlets, headwalls, etc.) shall be numbered and labeled both in plan and in profile and detailed on plans.

13. Waterlines, sanitary sewer and storm sewer lines shall be identified on both plan and profile sheets by letter or number.

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.

15. Drawings shall show existing and proposed elevations.

16. A list of construction pay items and estimate of quantities shall be shown on the plans.

17. The Contractor shall be responsible for coordinating all street crossings with the City Engineer's office and securing approval for crossing, and for method of construction (bore, tunnel or open cut).

18. Consulting Engineer shall submit check prints of "Record" drawings for review and approval of City Engineer. Upon approval, Engineer shall submit reproducible of "Record" drawings as outlined in Section 1.1.

1.4 Bench Marks

1. All elevations shown on the plans shall be based on USGS or USC&GS datum.

2. The permanent bench mark location and description used to extend level datum to the projects shall be noted on the front sheet of the plans.

3. 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.

4. A permanent bench mark shall be established on the project. This permanent bench mark will be a brass cap set in concrete in locations approved by the City Engineer. The cap shall read "City of Sapulpa Bench Mark" together with a letter and/or numerical designation assigned it by the City

Engineer's office from the master file of bench marks maintained by the City Engineer's office. The location, description and elevation of the permanent bench marks shall be shown on the front sheet of the plans.

5. Level notes shall be provided to the City Engineer's office for all permanent and temporary bench marks. All levels notes shall be of closed loop survey.

2.0 DESIGN CRITERIA FOR WATER MAINS

2.1 General

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.

1. All plans pertaining to distribution and treatment of public drinking water must be approved by ODEQ. 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 plan review fee.
2. If a water main is within 2.0 feet vertically or 10.0 feet horizontally of a sanitary sewer, Oklahoma State Department of Health requirements shall govern.
3. 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.
4. The minimum size of water main on all section lines shall be 12 inches in diameter, eight (8) inches in diameter on half-section lines and all collector streets. The minimum size of all other mains shall be six (6) inches in diameter, except on deadend 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 four (4) inch diameter main may be allowed.
5. Maximum permissible depth of cover is 8 feet, and minimum cover is 3 feet, except at air relief valves and 4.5 feet bury fire hydrants, where a minimum of 4.5 feet is required.
6. Centerline grade above water mains and curb grade, or centerline of street grade, shall be shown on profile.
7. 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. Three and one-half (3.5) foot bury fire hydrants may be allowed where approved by the City Engineer. A base elevation for each fire hydrant shall be shown on the profile. Fire hydrants shall be installed on a minimum of a six (6) inch water line.

8. 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.

9. Fire hydrant connection to the water main shall be in accordance to standard details provided by the City Engineer's office. All fire hydrants shall be installed with valves to isolate the fire hydrant.

10. 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.

11. IF PVC pipe is used, detectable mylar marking tape shall be required for location of water pipe.

12. Cover over water lines at creek crossings shall be 4 foot minimum. Water lines shall be restrained joint pipe through the creek area.

13. If conduits are planned to be installed for future long services, the plan sheet should be revised to show the location of the conduits.

14. The City Engineer's 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.

15. 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.

16. Where a rural roadway section is allowed, as provided for in Section 4.3.3, a separate easement a minimum of 15 feet wide shall be granted adjacent to the street right-of-way, in which the proposed waterline shall be placed.

17. A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 1.1.6 of these Design Criteria in an amount equal to 100 percent of the

determined amount of construction costs for a one-year period.

2.2 Rural Service Area

This Section shall apply only to rural systems. The standards included in Section 2.1 shall apply except as amended herein.

1. Developer shall submit executed Waterline Construction Agreement for consideration by the City Commission for the extension of lines to the water distribution system (See Appendix B).

2. Water mains in the rural service area (not within the corporate limits of the City) shall be centered in a minimum 15 foot restricted waterline easement or utility easement.

3. Tamper resistant operating mechanism shall be installed on all fire hydrants in the rural service area or as directed by the City Engineer (where required only the Mueller Centurion will be permitted).

3.0 DESIGN CRITERIA FOR SANITARY SEWER

3.1 General

The minimum design criteria for all sanitary sewer collection and treatment facilities shall be the latest edition of Water Pollution Control and Construction Standards.

1. All plans pertaining to the collection and treatment of public wastewater plants must be approved by OSDH. The Developer shall submit two (2) additional sets of plans, as approved by the City Engineer, to be submitted to OSDH by the City for review and approval. The Developer will be responsible for the plan review fee.

2. 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.

3. Where possible, sewer line will be located in an easement adjacent to the street right-of-way. Other sewer lines shall be located in the south or west half of back-to-back easements, 7.0 feet from the property line. (See attached Standard Underground Utility Location). Total back-to-back easement width is 22.0 feet minimum. Sewer 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 Engineer. Side lot easement widths will be based upon other utilities in the easement and the location and depth of the sewer.

4. No public gravity sewer shall be less than eight (8) inches in diameter, except that the use of six (6) inch diameter sewer may be permitted where it cannot be extended and where not more than 100 feet will be installed in any one place.
5. 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. If all utilities are to be underground, this may be reduced in certain situations. If property is unplatted, service shall be provided for the minimum lot size permitted. Where a lamphole is used a long radius 90 degree elbow shall be installed. A concrete base, a minimum of 18" x 18", shall be constructed around opening of lamphole.
6. Alignment, size and grade of lines shall be subject to approval.
7. 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.
8. 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 high water level in these areas, or water tight manhole lids maybe installed. 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 a drop manhole shall be constructed (minimum difference in inverts shall be 2.0 feet, or as required for construction).
9. 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.
10. Maximum permissible depth for service connections to property is 16 feet.
11. Design depth shall be based on service line stubbout 1.5 feet below surface, 2.08 percent minimum grade, and a 1.5 feet drop into the sewer.
12. All sewer pipe shall conform to the current specifications. All installations in excess of 16 feet deep shall require special approval. Polyvinyl chloride

(PVC) pipe shall be restricted from use under streets and adjacent to arterial streets, except AWWA C-900 PVC Class 200 pipe will be allowed under local and collector streets.

13. Concrete encasement or ductile iron pipe (C1.51) 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, where trench conditions require.

14. 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.

15. A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 1.1.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a one-year period.

4.0 DESIGN CRITERIA FOR STREETS

4.1 General

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.

A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 1.1.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a two-year period.

4.2 Plan Sheets and Profiles

1. All intersections, cul-de-sacs, and other critical locations shall be shown in plan detail at a minimum scale of 1" = 20', 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.

2. All drainage areas shall be clearly marked on the drainage area plan sheet; showing acreage, runoff and off site pickup points.

3. A site plan showing proposed locations and elevations of all utilities shall accompany the street and storm sewer plans.

4. 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.

5. 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.

6. Curb returns with elevations shall be clearly labeled on profile.

7. Vertical curves in profile shall give the top of curb elevation at the PC, PI, PT and high or low point, at a minimum of 50 feet intervals.

8. Storm sewers shall be located along centerline of streets unless otherwise approved by City Engineer.

4.3 Streets

1. Minimum street widths

Width of streets shall be according to the classifications as provided for in the Major Street and Highway Plan. Width shall be measured from curb face to curb face or from edge of design strength pavement.

RESIDENTIAL (LOCAL)	26 FEET
RESIDENTIAL COLLECTOR	36 FEET
COMMERCIAL AND INDUSTRIAL	40 FEET

2. All secondary and primary arterial street designs shall be furnished by the City Engineer's office.

3. Where Residential Estate (RE) zoning has been allowed the typical pavement section may be a minimum width of 32 feet with two (2) foot turf shoulders on each side. When allowed additional right-of-way shall be dedicated such that the borrow ditch, including the back slope, can be maintained from within the street right-of-way. Borrow

- ditches shall be constructed in accordance with Section 5.1.35.
4. All streets shall be constructed with concrete curbs, except as provided for in Section 4.3.3., in accordance with standard details.
 5. The centerline of paving shall be the centerline of right-of-way where dedication has been made according to the major street plan. All other cases shall be determined by the City Engineer.
 6. The minimum grade set along the curb shall be .5 percent. The maximum desirable grade for non-arterial streets shall be limited to 8 percent. For situations where the topography is unusually hilly, grades will be permitted up to a maximum of 12 percent providing they do not exceed 500 feet in length from PT to PC.
 7. The grade of the curb returns will continue for the full arc on all intersections where a midway opposing break is not provided.
 8. Sag vertical curves shall be designed according to the current AASHTO Specifications using the criteria of safe stopping sight distance.
 9. Vertical curves shall be the minimum length available for the two grades entering into a sump area as defined by the AASHTO publication titles, "A POLICY ON GEOMETRIC DESIGN OF HIGHWAYS AND STREETS - 1984."
 10. Design speed shall be 25 miles per hour on all residential streets and 30 miles per hour on all collector streets.
 11. For horizontal curves the minimum centerline radius on street alignment shall be 125 feet.
 12. 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.
 13. 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.

14. 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.

15. Cross slope may be 1/4-inch or 3/8-inch per foot; however, crown will be flattened off so that crown never exceeds curb height.

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

17. Proposed developments of residential areas shall keep to a minimum the use of four (4) way intersections.

4.4 Typical Sections

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

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

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

4. The developer shall provide soil tests for all areas to be paved. Soil tests will be submitted to the City Engineer for approval. If soil tests indicate that the soil has a plasticity index of 10 or greater, a minimum of 6 inches of subgrade shall be modified with a minimum of 5 percent hydrated lime by weight or Class III fly ash. If the soil tests indicate that the soil is granular and unstable, the method of stabilization shall be approved by the City Engineer. If desired, subgrade may be built of an approved borrow material.

5. Industrial and commercial pavement sections shall be a minimum of 10-inch asphaltic concrete or 8-inch Portland cement concrete. Residential pavement sections shall be a minimum of 6-1/2-inch asphaltic concrete or 6-inch Portland cement concrete.

6. Pavement sections for secondary and primary arterial streets shall be furnished by the City Engineers office.

7. 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.

8. Joints in Portland cement concrete paving, curbs and gutters shall be placed in accordance with the City Engineer's recommendation.
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.
10. All curb sections shall be barrier type curb. No mountable type curbs will be allowed.
11. Asphaltic Concrete shall be Types A, B and C per Oklahoma Department of Transportation Standard Specifications for Highway Construction.
12. Concrete shall be Class "A" Paving Concrete with 5-7% entrained air, with cement content determined by AASHTO T121 standard.
13. Where Residential Estate (RE) zoning has been allowed the typical roadway section may be a minimum of 6 inches of stabilized aggregate base on compacted subgrade with 3 inches of asphaltic concrete surface.

4.5 Cross Sections

1. Cross sections may be required by the City Engineer as a part of the construction plans when necessary to reflect more clearly the intent of the design.
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.
3. Typical cross sections shall be shown for each street if the slope to the property line exceeds one quarter inch per foot.
4. Each section shall be stationed clearly.
5. The beginning and ending points of a project shall be stationed and cross sections for both the stations shall be drawn.
6. Maximum distance between cross section stations shall be 100 feet.
7. Sufficient information shall be furnished to show that water is not ponded behind curbs or in ditches.
8. Scale for cross sections shall not be less than:

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

Streets 1" - 5' Horizontal 1" = 5' Vertical

4.6 Structures and Specific Details

1. All special structures will be detailed.
2. Special structures shall be drawn to scale unless noted otherwise.
3. Sufficient details, dimensions and related notes shall be provided for all structures.
4. All structures subject to vehicular traffic shall be designed for H-20 loading.
5. All bridge design shall meet the requirements in the latest edition of Standard Specifications for Highway Bridges prepared by AASHTO.

4.7 Sidewalks

1. All sidewalk layouts and designs for the central business district and other commercial and industrial areas shall be furnished by the City Engineer's office.
2. Sidewalks shall be required on both sides of local and collector streets.
3. All sidewalks shall be of Portland cement concrete. Sidewalks shall include pedestrian bridges across creeks and streams where applicable.
4. 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.
5. 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.
6. Sidewalks must provide personable 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 standard details provided by the City Engineer's office.

4.8 Easement and Right-Of-Way

1. Easements and rights-of-way shall be clearly dimensioned on the plans.
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.
3. An unimproved drainageway 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 drainageway shall be provided with adequate vehicular ingress and egress for maintenance purposes. If said drainageway 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 reverter provision.
4. The City may accept dedication of the entire floodplain area for an unimproved channel.
5. Adequate restrictive easements for dedicated right of way must be provided for access and maintenance.
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.

4.9 Lighting

1. Installation of street lights by the Developer, as approved by the City, will be for the purpose of traffic safety only.
2. The City 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).
3. The City 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.

5.0 STORMWATER DRAINAGE CRITERIA

5.1 Runoff

1. All stormwater runoff shall be subject to review and approval by the City Engineer with regard to analysis, design and construction of drainageway facilities. The appropriate public authority shall have the right to maintain or to cause to be maintained the drainageway 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 adhered to.

The drainage system, both public and private, may consist of storm sewers (which are closed conduits); improved channels constructed in conformity with adopted City Standards; unimproved drainageways left in their natural condition; the areas covered by restricted drainageway easements for the purpose of providing overland flow; and all appurtenances to the above including inlet, manholes, junction boxes, headwalls, dissipators, culverts, etc. All portions of the drainage system that exist on dedicated rights-of-way or restricted drainage easements shall be owned and maintained by the City, unless provided otherwise by agreement or covenant.

The drainage system plans shall show both plan and profile views of the proposed improvements. Any manhole or access point to the system that is buried out of sight shall be dimensioned to permanent objects in the vicinity.

2. The stormwater drainage system shall be designed to receive and pass the runoff from a 100-year frequency rainstorm under full urbanization. Full urbanization is defined as the total development in an area that is anticipated. The entire flow shall be confined within the said stormwater drainage system.

3. The stormwater collection system shall be designed either:

A. To pass a minimum of the runoff from a 5-year frequency rainstorm in a pipe network with overland flow capacities so that the combination of any two will pass the runoff from a 100-year frequency rainstorm under fully urbanized conditions.

B. Or, to pass the entire runoff from a 100-year frequency rainstorm in the pipe network. Should the entire runoff from a 100-year frequency rainstorm be conveyed in a pipe network, a nominal frequency rainstorm shall be designed to carry flow in the event of inlet blockage or bypass.

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. The main channel of the drainage system shall not be bound to carrying the 5-year frequency rainstorm in a pipe network.

4. The rational method of runoff analysis may be used for the design of the closed pipe networks of the storm sewer

system up to drainage areas of 100 acres, a hydrograph method shall be used.

5. The Rainfall Intensity Curves prepared from TP-40 and National Weather Service HYDRO-35 (June, 1977 or latest edition) shall be used for design in determining the rainfall.

6. The Oklahoma Department of Transportation Technical Manual (latest edition) shall be used for determining the basic "C" values.

A weighted "C" value shall be determined with minimum values of 0.45 for residential (RS and RD), 0.65 for multifamily (RM) and 0.90 for industrial and commercial areas. Unplatted areas with 300 feet either side of an arterial shall be either considered commercial or shall be in accordance with the comprehensive plan in estimating runoff coefficients.

The weighted "C" value shall be increased by 25 percent for the 100-year frequency rainstorm.

7. The distance between inlets, as well as the distance to the first inlet, shall be determined by the following, whichever is less:

A. For the 5-year frequency rainstorm two driving lanes must remain open for streets on grade.

B. For the 100-year frequency rainstorm, one driving lane must remain open for streets on grade. Further, the depth of flow shall not exceed curb deep.

C. A maximum time of concentration of 10 minutes to the first inlet shall be used for single or multifamily residential areas.

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

E. 600 feet.

8. At sump locations, the water depth shall not exceed 12 inches above the top of the curb, or 18 inches above the top of the grate, whichever is less, for the 100-year frequency rainstorm.

9. Where sump collection systems are used, an overflow route shall be established in the event of complete blockage of the sump.

10. Runoff from areas greater than one half (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.

11. 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.

12. Drainage areas, runoff from 5-year and 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.

The flows and velocities for each pipe and open channel shall be summarized and tabulated as above.

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.

13. Trapezoidal channels shall be designed with a hard lined low flow channel, such as concrete. The low flow channel shall branch off to pick up any storm sewers discharging into the channel. 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 not erodes around it. The minimum cross slope on the bottom of the trapezoidal channel shall be 2 percent. 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.

14. 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).

15. The minimum velocity in any drainage system shall be 2.5 feet per second, for all events of 5-year frequency and greater. The maximum velocity in a pipe shall be 30 feet per second and the maximum velocity in an unlined ditch shall be 6 feet per second.

16. Culverts shall be sized using either Kutters or Mannings charts, and the Federal Highway Administration's

inlet control charts, for the design flow. The slope used for design shall be the slope of the invert of the culvert.

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

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

A. Concrete pipe shall not be less than ASTM C-76 Class III. Corrugated metal pipes shall meet Oklahoma Department of Transportation gauge requirements for fill heights, and be bituminous coated and lined.

B. Polyvinyl chloride (PVC) and smooth walled polyethylene (HDPE) pipe may be utilized, in sizes from 15-inches to 30-inches, in storm drainage systems. This material, however, may not be used under City streets or alley ways. Pipe must meet ODOT specifications.

19. 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.

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

21. 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.

22. The minimum storm sewer pipe size shall be 15 inches. Use of smaller pipes, such as for detention pond outlets, shall require prior approval by the City Engineer's office.

23. Radius pipes will not be used on storm sewers having a diameter of 36 inches or less. Radius pipes may be used on storm sewers larger than 36 inches. The radius of the curve shall be no less than 5 times the diameter of the pipe. The degree of deflection shall be no more than 7 1/2 degrees per joint of radius pipe, or the pipe manufacturer's recommendation, whichever is less. The City is allowed to require radius pipe, should the energy loss be excessive and thereby detrimental to the system.

24. A minimum of 6 inches cover 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.

25. 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, starting from 0+00, from their connection with the main line. Lines shall be stationed on the profile drawing from left to right increasing upstream.

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

27. New box culverts and bridges shall have adequate capacity to pass 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.

28. Pipes discharging at a steep gradient into drainageways and detention facilities shall be provided with a headwall and energy dissipators. A steep gradient is defined as an energy grade line whose outlet velocity is greater than six feet per second.

29. 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.

30. 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.

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

$$H = \frac{V^2 * b}{64.4 * r}$$

Where: H is Height of freeboard in feet.
 V is the average Velocity in feet per second.
 b is the Width of the channel at the design water surface in feet.
 r is the Radius of curvature of the channel centerline in feet.

The increased freeboard height shall be maintained a minimum of one channel width upstream and downstream of the bend.

31. When storm sewers are constructed in fill areas, all materials in fill areas shall be compacted to a 95 percent standard proctor density prior to the trenching and laying of the pipe.

32. Maximum spacing between manholes or junction boxes shall not exceed 400 feet for pipes of 15 inches and 500 feet for pipes greater than 15 inches.

33. All junction boxes and manholes shall be built with the Standard Manhole Ring and Cover at grade.

34. A manhole or junction box shall be constructed at the P.C. or P.T. of all curves in sewers.

35. 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" 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.

36. A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 1.1.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a two-year period.

5.2 Storage Requirements

1. The detention storage requirements shall be that excess runoff from an 100-year frequency storm.

The excess runoff is that runoff generated due to urbanization which is greater than the runoff historically generated under existing conditions, for a given frequency storm.

Peak release rates from developments shall not exceed the existing runoff that occurred before development for all storm frequencies up to and including the 100-year frequency storm. As a minimum, the 5-year and 100-year storms shall be investigated.

If a stormwater master drainage plan is adopted in the area under consideration, then the provisions of the plan shall be adhered to.

2. For the design of stormwater storage facilities, the following methods are approved for the use:

Method	Drainage Area
HEC-1 Snyder's Method	Greater than 10 acres
HEC-1 SCS Method	2 to 2000 acres
Modified Rational Approach with volume factors*	Less than 10 acres
Graphical method*	Less than 2 acres

* These methods are available from the City.

3. U.S. Weather Bureau Technical Paper No. 40 and National Weather Service HYDRO-35 (June, 1977) shall be used for rainfall information.

4. The rainfall pattern shall be used in accordance with the modeling technique selected.

5. For Snyder's synthetic unit hydrograph method, the loss rates in determining the runoff/hydrograph shall be an initial loss of 0.5 inches and a uniform loss of 0.08 inches per hour for the subsequent hours once the initial losses are satisfied.

6. All calculations for detention facilities shall be submitted for review by the City.

The submittal shall include hydrographs for both existing and developed conditions, detention facility stage-area-volume relationships, outlet structure details, and a stage versus time analysis through the facility.

7. The intent of the stormwater detention requirements shall be identified at the preliminary plat stage of the project review. The 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.

The 100-year frequency rainstorm floodplain is defined as the area of land that the runoff from the 100-year frequency rainstorm inundates.

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

9. Detention facilities may be located in the floodplain area or flood hazard area, providing the floodplain area and the flood hazard area are determined with the facility in place and that no rise in the water surface off site of the development results from the installation of the facility except that permitted by City Ordinance. Additionally, the detention storage volume shall be above the base flood elevation.

10. Additional detention storage, in excess of the required storage for a drainage area, can be provided to satisfy the detention requirements for a tract of land downstream of the detention facility, providing the detention facility is constructed prior to the development of the downstream tract.

11. All detention facilities shall be designed "dry" unless a special maintenance agreement, in writing, has been approved by the City.

12. A minimum number of detention facilities is encouraged for each development.

13. If runoff has a natural tendency to drain in several directions for a given development tract of land where detention is required, then detention storage shall be provided for the biggest drainage area. Additionally detention storage may be provided, at the same facility, to satisfy detention requirements for a separate drainage area on the same development, provided that:

A. The whole developmental tract of land is in the same watershed.

B. The smaller drainage area(s) that, has/have been compensated for does/do not, either singly or in combination, adversely impact the health, welfare and safety of the general public downstream.

14. 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.

A drainage area is defined as an area of land that funnels stormwater runoff to a common point at the downhill side of that tract being developed.

15. Detention facilities may be used for compensatory storage when encroaching into the floodplain area provided that the overall drainage system does not:

A. Cause a rise in the water surface elevation beyond the extent of the developmental tract of land.

B. Adversely impact adjacent properties by an increase in velocity.

16. All dikes and spillways on detention facilities shall have typical cross sections shown on the plans.

17. Side slopes on detention facilities shall not be steeper than 4:1. (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.

18. 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.

19. The easements for the storm sewers and detention ponds shall appear on the plat.

20. An accessway 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.

21. If the detention facility is approved by the City to serve areas outside the subdivisions in which it is located, such additional areas shall be specifically identified in the provision for detention.

22. An operations and maintenance guide shall be prepared to illustrate the proper use and care of the detention facility, and by who, when and how. The guide shall include text and diagrams.

23. Any dam or berm constructed shall be designed and constructed under the supervision of a Registered Professional Engineer.

24. Spillways on detention facility dams shall be constructed to pass the 500-year flood event with a minimum of one (1) foot of freeboard on the earth dam structure. All detention facilities shall meet the Oklahoma Water Resources Board's requirements.

25. 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.

26. Detention facilities shall be environmentally sound and compatible with the area (neighborhood). Where feasible, multiple uses for the facilities should be established.

27. The maintenance responsibility for on site 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.

28. A Maintenance Bond or Irrevocable Letter of Credit shall be posted in accordance with Section 1.1.6 of these Design Criteria in an amount equal to 100 percent of the determined amount of construction costs for a two-year period.

5.3 Detention Facilities

1. Definition

A. A regional detention facility is a stormwater detention facility and collection system which provides stormwater detention capacity for all new development in a defined drainage area.

B. An on-site detention facility is a stormwater detention facility built on the site of the development to provide detention storage for that development.

C. Major developments are defined as any development which is planned to have greater than 1/2 acre of impervious surfaces. For single family residential lot development, the impervious surface is assumed to include 2700 square feet per building lot, unless better information is available. An impervious surface shall include all surfaces which do not allow an appreciable amount of infiltration. This includes, but not limited to roads, driveways, roofs and parking lots both paved and gravel.

D. Minor development is a development which is less than a major development.

E. An existing problem is defined as stormwater runoff from the 100-year frequency rainfall event which flows out of the drainage easement. If there is no drainage easement covering the watercourse, then a problem is when the runoff flows out of its channel banks in developed areas. In undeveloped areas without a drainage easement, a problem is when the runoff flows but of its channel banks and overtops roads and/or impacts structures.

2. Regional Detention Facility in Place or Planned

When there is a regional detention facility in place in the drainage area where development is planned, or one is planned in the near future, then all new development may incorporate the regional detention facility into the design of the drainage system for the development.

3. No Regional Detention Facility

When there is no regional detention facility constructed or planned in the near future for a particular drainage area where development is planned, then the following shall apply:

A. When there is an existing drainage problem downstream of the development, then new major development is required to provide on-site detention. The method of maintenance shall be set forth in the deed restrictions.

The only exception to on-site detention is new construction of a single family home on an existing lot, tract or parcel, which has not complied with the storm drainage detention requirements of this ordinance.

B. When there is no drainage problem downstream of the development, then new development shall build on-site detention facilities, unless the development can show that the development will not produce a problem downstream.

4. Maintenance Responsibility

A. The property owners in the development shall be responsible for maintenance to its detention facility in a minor residential, commercial or industrial development. If the detention facility is privately maintained, then the maintenance requirements shall be set forth in the deed restriction and the City shall be party to these deed restrictions.

B. The City shall be responsible for the maintenance of detention facilities in major residential developments. If the detention facility is to be publicly maintained then the detention facility and access to it shall be deeded to the City.

6.0 SOIL EROSION AND SEDIMENTATION CONTROL

6.1 General

Soil erosion and sedimentation is greatly accelerated during construction activities. In order to control these natural processes the following practices shall be adhered to:

1. A temporary barrier consisting of a straw bale dike shall be placed around all storm sewer inlets to prevent sediment from entering the storm sewer system.
2. Straw bale dikes shall also be placed along streets adjacent to areas of land exposed or stripped of vegetation due to grading or construction activities.
3. A diversion or perimeter dike shall be constructed where concentrated flow of surface runoff is to be conveyed down slope onto adjacent properties.
4. A stabilized construction entrance shall be built to reduce or eliminate the tracking or flowing of sediment onto public right-of-ways.
5. Immediately upon completing construction, all exposed areas of land shall be properly seeded in accordance with adopted standards.
6. A copy of the approved stormwater quality permit (NPDES) filed with EPA shall be provided to the City Engineer.

SECTION II
STANDARD SPECIFICATIONS
FOR THE
CITY OF SAPULPA
SAPULPA MUNICIPAL AUTHORITY
January, 1995

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 end 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.

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 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 responsibilities.

DIVISION IGENERAL SPECIFICATIONS101. SCOPE AND LOCATION

101.1. 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 City Engineer. Said Drawings clearly show the general work involved, but are not intended to show all details of the work.

101.2. 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 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.

102. SCOPE, NATURE, AND INTENT OF SPECIFICATIONS AND DRAWINGS

102.1. 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.

102.2. 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 information purposes only, and are not to be construed as a true representation of actual subsurface conditions.

102.3. Should anything be omitted from the Specifications and Drawings which is necessary to 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.

103. LINES AND GRADES

103.1. 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 batterboards, forms, straight edges, and other materials for lines, levels, and measurements.

104. PROTECTION OF PROPERTY

104.1. 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.

104.2. No valve or other control on any utility main or building service line shall be operated for any purpose by the Contractor.

104.3. At places where the Contractor's operations are adjacent to, or crossing, the plant of 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. Contractor shall 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 ten (10) days nor later than forty-eight (48) hours prior to start of work, excluding Saturdays, Sundays and legal holidays.

104.4. 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 in order 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 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.

104.5. 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.

104.6. 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 forty-eight (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 contract.

105. CONNECTIONS

105.1. All connections to existing water mains shall be made by the Contractor, unless noted otherwise. The Contractor shall perform his 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.

105.2. 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.

106. REFERENCES TO OTHER SPECIFICATIONS

106.1. Where a standard American Society for Testing Materials, American Concrete Institute, American Standards Association, American Water Works Association, 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.

107. PROTECTION OF MATERIALS

107.1. 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 storage yards in good order, pile his materials neatly, and protect them from damage.

108. TESTING

108.1 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.

108.2. 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. 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.

108.3. 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 thirty minutes 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.

109. "OR EQUAL" CLAUSE

109.1. 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.

110. DEWATERING

110.1. 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.

111. SAFETY

111.1. 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.

112.2. 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 ten 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.

111.3. 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 twenty 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.

111.4. Power Lines: No person, materials, or equipment shall come within ten feet of any power line carrying more than 440 volts unless the electric power service has been first discontinued.

111.5. Fire Prevention and Protection: The Contractor shall take all necessary measures to prevent fire, and shall provide satisfactory fire fighting means at the location of work.

111.6. 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 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.

111.7. 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.

112. REMOVAL OF CONDEMNED MATERIALS AND STRUCTURES

112.1. 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 failure to do so, or to make satisfactory progress in so doing, within forty-eight (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.

113. TRAFFIC CONTROL DEVICES

113.1. 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).

114. CLEAN-UP

114.1. 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.

114.2. 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.

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

115. STREET WASH DOWN

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

116. PLACING WORK IN SERVICE

116.1. 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 IIWATER & SEWER MATERIAL SPECIFICATIONS200. SUBMITTALS

200.1. 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.

200.2. 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 manufacturer shall be submitted, along with the detail design calculations.

200.3. Submittals for material other than pipe shall consist of manufacturer's product literature or shop drawings, indicating dimensions and material specifications. Submittals shall include reference to compliance with AWWA, ASTM, NSF, and other applicable standards.

201. CONCRETE201.1 Cement

201.1. 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/A.S.T.M. 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.

201.1.2. 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 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.

201.1.3. 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 ninety-four pounds of cement, net weight, and four bags shall be the equivalent of one barrel. Packages received in broken or damaged condition will be rejected or accepted only as fractional packages.

201.1.4. 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 seven 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.

201.1.5. 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.

201.2. Water

201.2.1. 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.

201.3. Aggregate

201.3.1. 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 three per cent, 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.

201.3.2. 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:

Per Cent Passing Standard Square Mesh Screens

<u>No. 4</u> 95-100	<u>No. 20</u> 45-80	<u>No. 50</u> 10-30	<u>No. 100</u> 5-10
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201.3.3. 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.

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

Per Cent Passing Standard Square Mesh Screens

Aggregate Max Size	2-1/2"	2"	1-1/2"	1"
2"	100	95-100	60-95	50-83
1-1/2"		100	95-100	
3/4"				100
Aggregate Max Size	3/4"	1/2"	3/8"	No. 4
2"	40-70	20-40		0-5
1-1/2"	40-70		10-30	0-5
3/4"	95-100		40-75	0-5

201.3.5. Coarse aggregate shall conform to Standard Specifications for Concrete Aggregates, ANSI/ASTM C33, except as to gradation. The maximum size aggregate to be used in structures six inches thick and under shall be three-quarters inch; in structures from six inches to ten inches thick, the maximum size of aggregate shall be one and one-half inches. If required, the Contractor shall furnish test certificates showing the aggregates meet the above requirements.

201.3.6. 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.

201.4. Steel Reinforcement

201.4.1. 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.

201.4.2. 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.

201.5. Strength and Proportion

201.5.1. The concrete shall have a compressive strength of not less than three thousand pounds per square inch, unless otherwise specified in the plans, as determined from test cylinders at twenty-eight days, made, cured, and broken, as hereinafter specified.

201.5.2. The concrete shall be mixed in the approximate proportion of 1:2-1/2:4-1/4 and shall contain not 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.

201.6. Testing of Concrete

201.6.1. 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 not less than three test cylinders. At least one test shall be made for each one hundred 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 relating to making compression tests on concrete test specimens as given in the Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens, ANSI/ASTM C39.

201.6.2. 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 seven 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.

201.6.3. 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.

201.7. Responsibility of Contractor for Strength

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.

201.7.2. 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 ration 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 Engineer may condemn the part of any structure in which concrete of insufficient strength has been placed and the Contractor, at his cost, shall remove and replace such concrete with concrete meeting these specifications.

201.8. Experimental Concrete Mixes

201.8.1. 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.

201.9. Mixing

201.9.1. 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.

201.10. Consistency

201.10.1. 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 corners and angles of forms and around reinforcing steel; it can be readily spaded to the bottom of the pour or to a depth of several feet any time within thirty minutes after placing.

201.10.2. A desirable consistency is one which results in a very slight accumulation of water at the top of a layer several feet in thickness, but not with segregation or accumulation of laitance.

201.10.3. 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.

201.11. Placing Concrete

201.11.1. 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.

201.11.2. 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 five 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 excepted 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.

201.11.3. 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.

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

201.12. Placing in Cold Weather

201.12.1. No concrete shall be placed without the specific permission of the Engineer when the air temperature is at or below thirty-five degrees Fahrenheit.

201.12.2. 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 provision 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 not less than fifty degrees Fahrenheit, nor more than eighty degrees Fahrenheit. The concrete shall be adequately protected in order to maintain this temperature for a minimum of seventy two hours after it has been placed and a temperature above thirty-two degrees Fahrenheit for a period of two additional days. The work shall be done entirely at the Contractor's risk.

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

201.13. Ready-Mixed Concrete

201.13.1 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 specifications 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 ready-mix concrete.

201.13.2. 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.

201.14. Construction Joints

201.14.1. 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 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 one-third of the area of the joints.

201.14.2. 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 one-half 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.

201.15. Finish of Concrete Surfaces

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

201.15.2. Immediately after removing the forms, all wires or other exposed metal shall be cut back of the concrete surface, and the depressions thus made and all honeycombs and other defects shall be pointed with mortar and then rubbed smooth. If the Engineer deems any honeycomb or other defect to require such treatment, the defective concrete shall be cut out to a depth sufficient to expose the reinforcement and to afford a key for the concrete replacing that cut out.

201.16. Curing Concrete

201.16.1. Exposed surfaces of concrete shall be protected by approved methods from premature drying for a period of at least seven 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.

201.17. Placing Reinforcement

201.17.1. 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.

201.17.2. 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 Engineers 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.

201.18. Forms

201.18.1. 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.

201.18.2. 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.

201.18.3. 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 dirt, sawdust, shavings, or other debris within the forms shall be removed. No wood device of any kind used to separate form will be permitted to remain in the finished work.

201.18.4. 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.

201.19. Removal of Forms

201.19.1. Forms shall be removed in such 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:

201.19.2. Forms on ornamental work, railings, parapets, and vertical surfaces which do not carry loads and which will be exposed in the finished work shall be removed within twenty-four to forty-eight hours after placing, depending upon weather conditions.

201.19.3. Girder, beam, and joist sides only, column, pier, abutment, and wall forms may be removed within twenty-four to forty-eight 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.

201.19.4. 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.

202. DUCTILE IRON PIPE, DUCTILE AND CAST IRON FITTINGS, AND VALVES

202.1. Pipe and Fittings

202.1.1. Where ductile iron pipe (DIP) three (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 three (3) inches in diameter shall conform to the manufacturer's standards, either centrifugally or statically cast with a minimum thickness of 0.25 inches. The ductile iron (nodular cast iron) shall conform to the Standard Specification for Ductile Iron Castings, ANSI/ASTM A536, with physical properties of Grade 60 - 42 - 10. Length of joints shall be either eighteen or twenty feet. The minimum standard thickness of each pipe shall be as follows:

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

51
50

For 16-inch and larger Ductile Iron Pipe, all 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.

202.1.2. 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, 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).

202.2. Joints

202.2.1. 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.

202.2.2. 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.

202.2.3. Bell and spigot joints shall consist of square, braided, sterilized hemp and 99.73 per cent pure lead caulking.

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

202.2.5. 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.

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

202.2.7. 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.

202.2.8. 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.

202.3. Coating, Lining and Polyethylene Wrap

202.3.1. 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, ANSI/AWWA C104/A21.4.

202.3.2. 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 p.s.i. with elongation of 500 percent. The material shall be Polytube, or approved equal, as manufactured 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 one (1) foot overlap is provided at each joint of pipe.

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

202.4. Gate Valves

202.4.1. 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 disc 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 flanged).

202.4.3. 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" through 12" 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).

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

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

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

202.5. Ball Valves

202.5.1. 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 operator 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.

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

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

202.6. Butterfly Valves

202.6.1. Butterfly valves shall be of the tight-closing, rubber-seat type, shall have a rated pressure of 150 psig, and shall be bubble-tight at this pressure with flow in either direction. 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 A536, Grade 65-45-12. Flanges shall be ANSI B 16.1, Class 125, cast iron flanges. Valve discs shall be constructed of alloy cast iron conforming to 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, Type 304 or 316 stainless steel, or alloy cast iron conforming to ANSI/ASTM A436, Type 1, or bronze Grade A, D, or E. Valve bearings shall be corrosion resistant and self lubricating.

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

202.6.3. Interior and exterior surfaces of the valve, except seating surfaces, shall be thoroughly cleaned and painted with two (2) coats of asphalt varnish conforming to Federal Specification TT-V-51C. For non-buried service, exterior surfaces shall be coated with two (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.

202.6.4. Only the following makes will be permitted: Pratt

202.7. Air Relief Valves

202.7.1. 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.

202.7.2. Only the following makes will be permitted: American, Apco, Crispin and Val-Matic.

202.8. Check Valves

202.8.1. 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).

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

202.9. Fire Hydrants

202.9.1. 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 1/4-inch compression main valve; 6-inch inlet connection; or mechanical joint hub; four-foot six-inch bury length, or as specified on drawings; two 2- 1/2-inch hose nozzles 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); Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

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

202.9.3. Only the following makes will be permitted: Mueller Centurion, Kennedy Guardian K81A, American-Darling B62B. (NOTE: In the Rural Service Area, only the Mueller Centruion will be permitted with tamper resistant operating mechanism).

202.10. Five-Way Fire Hydrant

202.10.1. 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; four-foot six-inch bury length; three 2-1/2-inch nozzles with National Standard threads; two 4-inch pumper nozzles with City of Sapulpa (refer to Standard Details as shown on the Drawings); "O" ring seal; drain valve; left (counter-clockwise) opening; Federal yellow finish paint above ground line; and National Standard pentagon operating nut.

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

202.10.3. Only the following makes will be permitted: American Darling; and Mueller Improved.

202.11. Blow Off Hydrant

202.11.1. Where blow off hydrants are specified or required, they shall be an Eclipse Model 85 TU or equal. Blow off hydrants shall have; 2-1/2-inch main valve; one 2- 1/2-inch brass hose nozzle with National Standard Threads;

cast iron yoke and base; drain valve; left (counter-clockwise) opening; and 7/8-inch brass pentagon operating nut.

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

203. STEEL PIPE AND FITTINGS

203.1. General

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 three (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 not 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.

203.1.2. All steel pipe shall be manufactured with ends of true circular shape, free from indentations, projections, or roll marks for a distance of eight inches (8") 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 eight inches (8") from the end of the pipe a ring gauge with a bore three-thirty

seconds of an inch larger than the outside diameter of the pipe.

203.1.3. 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.

203.1.4. Where field cutting of steel pipe is permitted, pipe shall be cut by sawing. The inside lining shall be removed for a minimum of six 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.

203.1.5. 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 is 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.

203.2. Joints

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

203.2.2. Welded joints shall conform to, and be tested in accordance with the AWWA Standard for Field Welding of Steel Water pipe Joints, AWWA C206. Slip 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.

203.2.3. 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.

203.2.4. 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 thicknesses shall be the "O" Ring-Bar Type, or the "O" Ring-Carnegie Section, or rolled groove 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" and not more than 0.10" 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 + 1-1/8" for the Bar and Carnegie Type Joints. Hold back for the rolled groove joint shall be the spigot engagement + 1/2". Interior lining for the spigot, shall be continuous to the end. Field replacement of the interior joint linings shall be in accordance with Section 203.4. of these specifications for cement-mortar linings. All "O" Ring joints shall be electrically bonded using a #4 bare copper wire, 6" 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.

203.2.5. 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.

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

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

203.3. Exterior Coating

203.3.1. 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 3/4" 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.

203.3.2. 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.

203.4. Interior Lining

203.4.1. 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" and Larger, Shop Applied. The lining shall be 3/8" thick for

diameters through 36", and 1/2" thick for 42" and larger, whether shop or in place lined. Tolerances shall be in accordance with the applicable AWWA standards. Coal-tar enamel and coal tar epoxy interior linings will not be permitted.

203.4.2. Where in 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.

203.5. Strutting and Bracing

203.5.1. Strutting and bracing shall be provided on all specials, fittings, and straight pipe, where shop lined or coated with cement mortar, so as to limit the pipe deflection to 2% maximum of inside diameter. A minimum of three strutting braces shall be installed in each standard pipe joint. For pipe 54" and larger in diameter, the strutting shoes at each bearing point shall be minimum 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.

204. REINFORCED CONCRETE PIPE AND FITTINGS

204.1. Reinforced Concrete Pipe and Fittings for Water Lines

204.1.1. 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.

204.1.2. 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.

204.1.3. 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.

204.1.4. 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.

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

204.1.6. 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 ASSTM A307, Grade A only, in accordance with ANSI/ASSW C207.

204.2. Reinforced Concrete Pipe and Fittings for Sanitary Sewers

Where reinforced concrete pipe (RCP) and fittings are specified or required for sanitary sewers, except as herein modified, they shall be designed, manufactured, and tested in accordance with ASTM C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe. Pipe shall be a minimum Class III. Pipe length shall be no less than seven and one-half feet except for shorts and specials. Pipe sections connected to a manhole or structure

shall be no more than 4' - 0" in length, as measured from the inside face of the structure to the point of flexure of the joint. Elliptical reinforcement is not allowed. At least three circumferential reinforcing bars shall be provided in each pipe bell equal in area to an equivalent length of outside cage in the pipe barrel. Concrete shall have a minimum 28 day compressive strength of 6,000 psi, and an absorption not to exceed six percent.

204.2.2. Testing shall be observed and reported by an independent testing laboratory approved by the Engineer. One (1) Three-Edge Bearing Test in accordance with ASTM C497 shall be performed on a representative sample of each diameter and class of pipe to be furnished. One (1) absorption test in accordance with ASTM C497 shall be performed for each 300 tons of pipe manufactured, not less than one (1) test per day's production. Four (4) concrete cylinders or core samples shall be tested for compressive strength from each days production, two at 7 days and two at 28 days. An in-plant hydrostatic test in accordance with ASTM C361 shall be performed on each section of pipe and each pipe joint at an internal hydrostatic head of 25 feet. The joints shall be tested for a minimum period of one (1) hour under constant pressure as specified. Each pipe unit that satisfactorily passes all hydrostatic testing shall bear the seal of the testing laboratory. This seal does not constitute acceptance of the pipe installation which will be subjected to further testing and inspection in the field.

204.2.3. In lieu of the in-plant hydrostatic testing of each joint, the Contractor may substitute the following procedure: (1) Perform one in-plant hydrostatic test per days production, in accordance with the previously specified criteria; and (2) Perform an air test on each joint in the field after assembly, in accordance with the City of Sapulpa Water and Sewer Department Standard Air Test procedure. The Contractor shall furnish all air test equipment. Testing and test conclusions shall be verified by the Engineer. The Engineer reserves the right to require additional in-plant hydrostatic testing.

204.2.4. The interior surfaces of the pipe shall be shop coated with two coats, minimum of 30 mils total, of coal tar epoxy, Koppers Bitumastic 300M, High Build or Tnemec Hi-Build Tneme-Tar, or equal, in accordance with the manufacturer's recommended application methods. The inside surfaces of the bell and the outside surfaces of the spigot shall be coated with 8 mils of latex paint. All surfaces to be coated shall be clean, dry, and free of oil or loose material.

204.2.5. Reinforced concrete pipe and fittings for sanitary sewer shall be jointed in accordance with ASTM

C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.

Joints shall be concrete bell and spigot, employing an o-ring rubber gasket and cement mortar formed by a diaper. The spigot end shall contain a groove to confine and compress the gasket on four surfaces when the joint is in final position.

205. VITRIFIED CLAY PIPE AND FITTINGS

205.1. Pipe and Fittings

205.1.1. Where vitrified clay pipe (VCP), fittings and in-line tees are specified or required, they shall conform to the Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated ANSI/ASTM C700. Testing shall be in accordance with methods of Testing Clay Pipe, ANSI/ASTM C301.

205.1.2. Where vitrified clay pipe is being installed, in-line tees for future connections to the sanitary sewer shall be manufactured specifically for vitrified clay pipe.

205.2. Joints

205.2.1. Vitrified clay pipe shall be jointed with material conforming to the Standard Specification for Compression Joints for vitrified Clay Pipe and Fittings, ANSI/ASTM C425. All jointing materials shall be used in accordance with the manufacturer's instructions and subject to the approval of the Engineer.

205.2.2. Where it is necessary to connect vitrified clay pipe to ductile iron pipe a rigid type adapter shall be used. Only the following adapters will be permitted: Dickey DPB-VC x DI, Dresser Style 39, and Rockwell Omni. Flexible couplings will not be permitted.

206. POLYVINYL CHLORIDE (PVC) PIPE, WATER SERVICE

206.1. Where polyvinyl chloride (PVC) pipe four (4) inches in diameter through twelve (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 Testing Laboratory for potable water pipe. Polyvinyl chloride water pipe shall be restricted from use under or adjacent to arterial streets.

206.2. 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.

206.3 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.

206.4. 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.

206.5. Contractor shall submit certifications from the manufacturer that PVC pipe has been manufactured in accordance with AWWA C900, and that it meets the approval of the "NSF".

207. POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

207.1. Pipe and Fittings

207.1.1. Where polyvinyl chloride (PVC) pipe eight (8) inches in diameter through twelve (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 on in-line tee fittings shall be Schedule 40.

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

207.1.3. 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.

207.1.4. 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.

208. CASTINGS

208.1. 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.

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

209. CONDUIT

209.1. 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:

<u>TYPE OF CONDUIT</u>	<u>SPECIFICATION</u>
Reinforced Concrete Culvert, Storm and Sewer Pipe	ANSI/ASTM C76; Class IV
Corrugated Galvanized Metal Pipe for Railroad Crossings	AASHTO M36; 12-guage
Corrugated Galvanized Metal Pipe for Street Crossings	AASHTO M36; 14-guage
Corrugated Galvanized Metal Pipe Liner Plate	AASHTO M36; 12-guage
Steel Pipe, 6-inches and larger thickness	AWWA C200; 3/8-inch wall thickness

210. VAULT, PITS AND MANHOLES

210.1. Concrete masonry units shall conform to, and be tested in accordance with the specifications for Concrete Masonry, Hollow Load Bearing Concrete Masonry Units, ANSI/ASTM C90, or Concrete Building Brick C55, Grade A.

210.2. Manhole units shall conform to, and be tested in accordance with, one of the following: Sewer Brick (made from Clay or Shale), ANSI/ASTM C32 Grade SM; Concrete Building Brick, ANSI/ASTM C55, Grade N; or concrete Masonry Units for Construction of Catch Basins and Manholes, ANSI/ASTM C139.

210.3. 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.

211. SAND FOR CUSHION OR BACKFILL

211.1. Sand shall be graded from fine to coarse, free from objectionable material, and contain not more than ten percent (10%) clay or loam by weight. One hundred per cent shall pass a three-quarter inch screen, and ninety-five per cent shall pass a number four screen.

212. CRUSHED STONE FOR SURFACING, BASE, COURSE, AND STABILIZATION

212.1. Crushed stone shall consist of clean, tough, durable fragments, free from an excess of soft or disintegrated particles. Sampling shall be in accordance with the Standard Method of Sampling Aggregates, ANSI/ASTM D75.

212.2. Sieve analysis shall be performed in accordance with the method of Sieve Analysis, ANSI/ASTM C136. Gradation to be used at each location will be specified by the Engineer.

SURFACING AND BASE COURSE

SIEVE SIZE	PER CENT PASSING	
	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

213. RIP RAP

213.1. Quality of Materials: All stone for Rip Rap shall be either sandstone, limestone, or other hard stone of good quality that will not materially disintegrate under action of air or water. It shall weigh not 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 C127-68, "Test for Specific Gravity and Absorption of Coarse 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 stone 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.

213.2. 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 forty percent (40%) 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 interledge layers or from blasting or loading operations, will be accepted if such material does not exceed ten percent (10%) by weight.

213.3. 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. At least forty percent (40%) of any shipment shall consist of rocks weighting 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 IIIWATER & SEWER CONSTRUCTION SPECIFICATIONS301. RIGHT-OF-WAY CLEARING AND RESTORING

301.1. 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. Any such obstructions which are not to be reconstructed are so designated on the drawings. Such shall be removed and disposed of by the contractor. All obstructions to be replaced or reconstructed shall be restored to substantially the same condition as existed prior to the construction except as otherwise noted. The Contractor shall remove and dispose of all debris, restore the grade of the surface of the earth as reasonably as may be done to the grade existing prior to construction, and upon completion of the work shall leave the site in as neat, clean and orderly condition as nearly as it was prior to construction as may be reasonably done. Contractor shall photograph all concrete and asphalt driveway crossings with a poloroid type camera, in the presence of an inspector, marking the location by street address on each photo. Photographs shall be filed with this Department prior to commencing work. All costs of photography shall be included in Bid Item 301 a. Right-of-Way Clearing and Restoring.

301.2. 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 reoiled. Gravel or macadamized surfaces shall be replaced with the same.

301.3. If an obstruction is of public ownership, the Contractor shall notify the appropriate agency, and obtain any necessary permit or license forty-eight 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.

301.4. 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.

302. EXCAVATION AND BACKFILL, UNCLASSIFIED

302.1. 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.

302.2. 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 one hundred (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 for 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 twelve inches above the top of the pipe. If for any reason this portion of the trench exceeds the permitted width and if the Inspector shall determine that cradling or encasement then is required, said concrete cradle or encasement shall be installed. Any part of the bottom of the trench excavated more than four 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 four 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.

302.3. 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 six 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.

302.4. 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 the 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 six inches above the pipe to eighteen inches above the pipe, the trench shall be backfilled by hand or 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 one hundred (100) feet or less of the finished line at all times, as directed by the Inspector.

302.5. 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% 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.

302.6. 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, roadway fills, streets, alleys, driveways, sidewalks, parking lots or as shown on the Drawings; removing and replacing topsoils 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.

303. PIPE, VITRIFIED CLAY

303.1. The work under this term shall include furnishing, hauling, and placing and jointing of vitrified clay pipe (VCP) in the trench in specific conformity with the line and levels given.

303.2. 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 commenced at the lowest point, with the spigot ends pointing in the direction of flow. Pipe shall be laid continuously through new manholes in 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 a manner that there is no shoulder or unevenness of any kind. The pipe grade shall be obtained by using batterboards and a "top line". A top line shall be maintained over a span of three 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 batterboards' settings. Any errors, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

303.3. Prior to making pipe joints, all surfaces of the portion of the pipe to be jointed shall be cleaned and dried. Jointing shall be done in strict accordance with the manufacturer's recommended procedure. Trenches shall be

kept water-free during jointing and for a sufficient period thereafter to allow the joint to become fully set and completely resistant to water penetration. There shall be no realignment of the pipe after the joint is completed unless the pipe is removed and a completely new joint constructed.

303.4. Double joints of eight inch pipe may be prepared and laid, provided the double joints are prepared by jointing the pipe in a vertical position using a straight edge inside the pipe to align the joint. Double joints shall not be placed in a horizontal position prior to laying unless suitably supported in racks. Double joints of pipe shall be supported at the middle joint, as well as the ends, when the pipes are lowered into the trench.

303.5. 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.

304. CONCRETE CRADLE AND CONCRETE ENCASEMENT

304.1. Concrete cradle and concrete encasement requirements for ABS pipe shall be in accordance with Specification 318 for Concrete Encasement and Specification 319 for Concrete Cradle.

304.2. 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.

305. PIPE, REINFORCED CONCRETE

305.1. 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.

305.2. 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 jointing 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 in accordance with the attached Standard Detail.

305.3. For sanitary sewers, the methods of laying pipe, foundation, and grade specified under Pipe, Vitrified Clay, shall apply. All pipe shall be installed with the mark "C-76" visible on the top of the pipe. The ends of the pipes to be jointed shall be cleaned immediately prior to jointing 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.

305.4. For all lines, after the pipe has 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 stiff mixture of 1:1 cement mortar which shall be troweled in place to produce a continuous, smooth, flush surface across the joint.

305.5. 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.

306. PIPE, DUCTILE IRON

306.1. 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, slip-on polyethylene film. The polyethylene film shall be slipped 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 this 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 four (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.

306.2. For water lines, all fittings or specials included as pipe shall be blocked in accordance with the attached Standard Detail, the size to be determined by the Engineer.

306.3. 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.

307. PIPE, STEEL

307.1. 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 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 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

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 commenced at the lowest point, with the spigot ends pointing 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 or unevenness of any kind. The pipe grade shall be obtained by using batterboards and a "top line". A top line shall be maintained over a span of three 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 batterboards' settings. Any error, discrepancies, or displacement of grade stakes shall be called to the attention of the Inspector for correction.

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

312.2.4. A manhole water stop gasket and clamp assembly as approved by the Engineer shall be constructed at each point where a line enters or exits 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.

312.3. Testing

312.3.1. 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 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% 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.

312.3.2. 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.

311. FITTINGS

311.1. 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.

311.2. 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.

312. POLYVINYL CHLORIDE (PVC) PIPE, SEWER SERVICE

312.1. 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.

312.2. Installation

312.2.1. 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 option, provide approved laboratory analysis to establish optimum moisture content. However, the Engineer's decision will be final.

312.2.2. The pipe shall be laid on a firm trench bottom, true to the lines and grades shown on the Drawings and/or as

312.3.3. 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.

312.3.4. 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.

313. MANHOLE

313.1. 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.

313.2. 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 ground surface, or as shown on the drawings.

313.3. New manholes 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. Above the base, manhole inverts shall be carefully constructed of solid concrete to maintain proper velocities. 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 pipes, but not greater than that of the 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.

313.4. During the construction of each manhole, cast iron steps shall be set in place on the inside of the manhole, beginning eighteen inches above the bottom and placed not more than fifteen inches apart. No steps shall be placed closer than eighteen inches to the manhole top. If concrete masonry units are used for the walls, special cut step blocks shall be installed to receive the steps. Steps shall be built firmly into the wall, allowing the steps to project five inches inside the manhole. If five-inch concrete

masonry units are used, the ends of the steps projecting beyond the outside wall shall be cut off flush with the wall, and plastered over. The centerline of the steps shall be as shown on the attached Standard Detail for Manholes. Four-and-one-half-inch steps shall be used for brick manholes and twelve-inch steps for precast manholes.

313.5. The use of concrete masonry units shall not be allowed in connection with pipes larger than eight inches in diameter. If concrete masonry units five inches thick are used, the manhole shall not be located within any dedicated street or alley, or any other location subject to vehicular traffic; and shall not exceed twelve feet in depth. The foregoing restrictions as to location and depth shall not apply if eight-inch concrete masonry units, brick, or precast manholes are used.

313.6. For brick manholes, a single rowlock course shall be turned over each pipe. Every unit shall have a full mortar joint on the bottom and sides, which shall be formed in one operation by placing sufficient mortar on the bed and forcing the unit into it. Horizontal joints shall not exceed three-eighths inch and one-quarter inch in thickness. All joints on the inside are to be rubbed full and struck as the manholes are built up. Walls shall be constructed in horizontal courses with vertical joints staggered. When the manhole top is above the proposed graded elevation, the taper shall be drawn in the manhole top to twenty-four inches I.D. at a point one foot below said proposed elevation and the remainder constructed with brick as a twenty-four inch cylinder. The inside and outside walls of the manholes are to be plastered with one-quarter inch of mortar to give a smooth and regular finish.

313.7. Pre-Cast Manholes

313.7.1. Pre-cast manholes with cast-in-place base slabs will be permitted for all standard and drop manhole installations.

313.7.2. Pre-cast manholes with integral pre-cast floors will be permitted only for standard manhole installations with depths of 12 feet or less.

313.7.3. 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.

313.7.4. 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 eight (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 three-eighths (3/8) inch in thickness. Inside joints shall be ruffed full and struck.

313.8. 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 six feet, the additional depth shall be paid for at the unit price bid per linear foot of manhole depth over six feet. No additional payment will be made for excavation, backfilling, pipe or concrete bottoms.

314. CONNECTION

314.1. 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.

314.2. 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.

314.3. 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. 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. 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.

314.4. 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 be used in

all other locations, unless cast iron pipe is specifically required by the Engineer. All reconstructions shall be constructed in conformance with the BOCA Plumbing Code of the City of Sapulpa, unless modified herein. New pipe used shall be of the same diameter as the existing line.

314.5. Plugs shall be constructed of manhole brick and mortar, extending at least one foot into the line plugged from the manhole. The plug shall be watertight and troweled to a smooth finish on the interior of the manhole.

314.6. 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 detectable plastic, marked by a non-magnetic, Mylar tape, and stapled to both sides of a nominal 2" x 4" marker, 8' long, 4' buried, and 4' exposed, directly above fitting plug. The Mylar tape shall be minimum 2-1/2" width, green in color, marked "Caution, Sanitary Sewer Below", as manufactured by Terra Tape or Line Guard.

314.7. 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.

314.8. 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.

315. LAMPHOLE

315.1. 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.

315.2. 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.

316. VALVE

316.1. 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.

316.2. Gate valves shall be set with the stems plumb. Ball valves shall be set with the handwheels 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.

316.3. Fire hydrants shall be set so that the bottom of the steamer nozzle is not less than twelve inches nor more than twenty-one 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.

316.4. 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.

317. VALVE BOX

317.1. 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. Exposed parts of valve boxes shall be given one coat of red lead and one finish coat of yellow paint.

317.2. Payment: Payment for this item shall be made at the unit price bid per valve box.

318. ENCASEMENT, CONCRETE

318.1. 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.

318.2. Sanitary sewers shall be encased when the depth of cut from the original ground elevation to the flow line of the pipe is four feet (4') 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.

318.3. 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.

319. CRADLE, CONCRETE

319.1. 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.

319.2. For sanitary sewers, standard concrete cradle is required at any location where the depth of cut to the flow

line of the pipe is sixteen feet (16') 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.

319.3. 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.

320. PIERS, REINFORCED CONCRETE

320.1. 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 as shown on the Drawings and attached Standard Details. Forms shall be made to conform to the shape of the pier and securely braced. Reinforcing steel shall be bent as detailed 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 paint after bolting in place. Any honeycomb or other unevenness in the concrete shall be patched with cement mortar immediately after form removal.

320.2. 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.

321. CONDUIT

321.1. The work under this item shall include the installation of railroad, street, or other crossings by boring or tunnelling 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: tunnelling or boring, conduit material, construction method details, carrier supports, sand fill.

321.2. 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, tunnelling, dewatering or sand fill.

322. STRUCTURE, SPECIAL

322.1. 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.

322.2. 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.

323. MATERIALS FURNISHED BY CONTRACTOR AND INSTALLED BY CITY

323.1. 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.

323.3. 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.

324. SODDING AND SEEDING

324.1. 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 Hydromulch 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 bid, the width of turf restoration required.

324.2. 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 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.

324.3. Hydromulch Seeding: Remove, store, and replace top soil. Apply seed, fertilizer, and mulch together in a homogenously mixed slurry. Fertilizer shall be 10-20-10 and shall be applied at a rate of 10 lbs. per 1,000 square feet. Mulch shall be wood fiber and applied at a rate of 46 lbs. per 1,000 square feet. Grass seed shall be either hulled Bermuda applied at a rate of 2 lbs. per 1,000 square feet or Rebel Fescue applied at a rate of 8 lbs. 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.

324.4. 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.

324.5. 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.

325. DRIVEWAY CROSSING BY BORING

325.1. 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 one (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.

325.2. 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.

326. PAVEMENT, REMOVAL AND REPLACEMENT

326.1. 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 three (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 one (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, hot laid.

326.2. 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 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.

327. EROSION CONTROL MEASURES

327.1. 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 straw bale dikes in bar ditches at 500 ft. intervals on relatively flat grades and 200 ft. intervals on grades over 5 percent.

B. Place sediment sumps upstream of straw bales. Remove sediment on a regular basis.

C. Keep excavation and silt off of streets.

D. In areas where water line are being constructed adjacent to improved streets, measures shall be taken which will minimize siltation and excavation accumulating in existing storm sewers. Straw bales should be placed around inlets. 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.

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

327.2. Straw bales shall be standard rectangular size, approximately 18" x 20" x 36", and shall be securely bound with wire. Bales shall be firmly anchored with wood or metal stakes approximately 3 feet long. A sediment sump shall be placed immediately upstream of each bale. Contractor shall clean and maintain sediment sumps throughout the maintenance period.

327.3. The Contractor shall furnish and install straw mulch as directed. Mulch shall be applied at a rate of 1-1/2 tons per acre. Mulch shall be securely anchored in place.

327.4. 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.

DIVISION IVSTREETS & DRAINAGE SPECIFICATIONS401. ADOPTION OF STATE STANDARDS

The latest edition of the Oklahoma Standard Specifications for Highway Construction, as published by the Oklahoma Department of Transportation, are hereby adopted as the standard specifications for grading, street, road and drainage construction for the City, except as amended herein. In the event of any conflict between any of the provisions of the Oklahoma Standard Specifications for Highway Construction and the specific provisions set forth herein, then in such event the specific provisions set forth herein shall control.

402. DEFINITIONS

Certain terms included in the adopted specifications referenced in Section 401 shall incorporate the following substitution of definitions in their use thereof.

402.1. Commission means the duly authorized officers or agents of the City of Sapulpa, Oklahoma constituted by law to administer the affairs of the City.

402.2. Department means the City of Sapulpa, Oklahoma, a municipal corporation, acting through its duly authorized officers or agents.

402.3. Director means the duly authorized officer of the City in whom executive or administrative powers are vested or his duly authorized representative.

402.4. Engineer means the City Engineer of the City of Sapulpa or his duly authorized representative.

402.5. Materials Division means the Public Works Department of the City of Sapulpa.