

**CITY OF ROGERSVILLE
DESIGN STANDARDS
FOR
PUBLIC IMPROVEMENTS**



**2022 EDITION
CITY OF ROGERSVILLE, MISSOURI**

CITY OF ROGERSVILLE

DESIGN STANDARDS FOR PUBLIC IMPROVEMENTS

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DEFINITION OF ABBREVIATIONS, TERMS, PHRASES, AND WORDS

1. **AASHTO.** American Association of State Highway and Transportation Officials.
2. **ADA.** American with Disabilities Act.
3. **ANSI.** American National Standards Institute.
4. **ASTM.** American Society of the International Association for Testing and Materials.
5. **ASCE.** American Society of Civil Engineers.
6. **AWWA.** American Water Works Association.
7. **Bench Mark.** A permanent object of known elevation and location that is in an area where disturbance is unlikely.
8. **BMP'S.** Best Management Practices.
9. **Board of Aldermen.** The governing body of the City of Rogersville.
10. **BOC.** Back of Curb.
11. **City.** City of Rogersville.
12. **Construction Specifications.** The official City of Rogersville's Construction Specifications for Public Improvements used on public improvements within the City of Rogersville, Missouri and such other areas outside the corporate boundaries which may contract with the City for the provision of services. This document contains data for public improvements from the beginning stage of a project through the actual construction and acceptance of the project.
13. **Cul-de-sac or Dead-end Street.** A minor street with only one outlet.
14. **Curb Return.** The curved portion of curb at the beginning of a driveway approach, which serves as a transition from the height of the curb to the level of the approach or connecting a curb on one street to another curb on the intersection street.
15. **Design Standards.** The official City of Rogersville's Design Standards for Public Improvements used for public improvements within the City of Rogersville, Missouri and such other areas outside the corporate boundaries which may contract with the City for the provision of services. This document contains minimum design data for public improvements to be complied with in the design of public improvements.
16. **Driveway.** An area intended for the operation of automobiles and other vehicles from the street right-of-way line to a garage, parking area, building entrance, structure, or approved use located on the property. Unless otherwise indicated, any dimensions relating to the width of a driveway or driveway surface shall be measured at the right-of-way line.
17. **Driveway Approach.** An area intended for the operation of automobiles and other vehicles giving access between a roadway and abutting property. The driveway approach includes the sum of the curb returns on each side of the driving surface, plus the driving surface.

- 18. Easement.** A grant by the property owner to the public, a corporation, or persons of the use of land for specific purposes.
- 19. FEMA.** Federal Emergency Management Agency.
- 20. Final Plat.** The final map, drawing, or chart indicating the final approved layout of the subdivision. Approval shall be obtained from the City's Planning and Zoning Commission and Board of Aldermen.
- 21. Gutter.** That portion of the driving surface of a street, driveway, approach, or other public way, which abuts the curb and provides for the runoff of surface drainage.
- 22. Intersection.** The general area where two or more roadways meet, join, or cross at a common point establishing an area within which vehicles traveling different roadways may come in conflict.
- 23. Lot.** An undivided tract or parcel of land under one ownership, whether occupied or to be occupied by a building or building group together with accessory buildings, which parcel of land is designated as a separate and distinct tract and is identified by a tract or lot number or symbol in a duly approved subdivision plat filed of record.
- 24. MoDNR.** Missouri Department of Natural Resources.
- 25. MoDOT.** Missouri Department of Transportation.
- 26. NPDES.** National Pollutant Discharge Elimination System.
- 27. Ordinance.** A regulation, order or rule passed by the City's Board of Aldermen.
- 28. P.C.,** Point of Curve. The point at which a straight line begins to curve.
- 29. P.C.C.,** Point of Compound Curve. The point where curves of different radii meet.
- 30. P.I.,** Point of Intersection.
- 31. P.T.,** Point of Tangency. The point at which a curve ends and a straight survey line begins.
- 32. PVC.** Point of Vertical Curve.
- 33. PVI.** Point of Vertical Intersection.
- 34. PVT.** Point of Vertical Tangency.
- 35. Planning and Development Department.** The City Department that administers the subdivision regulations, zoning regulations, growth management plan, and directs the development and plan review process. In addition, the department oversees code compliance and building inspections.
- 36. Planning and Development Director.** The Director of the City's Planning and Development Department.
- 37. Planning and Zoning Commission.** The City board that makes recommendations to the Board of Aldermen for a variety of development applications such as; rezoning, plats, permits and etc.

- 38. Preliminary Plat.** The preliminary map, drawing, or chart indicating the proposed layout of the subdivision initially required in the subdivision process.
- 39. Public Improvements.** Those infrastructures that are constructed, installed, or performed on public land, or on land that is to become public in the subdivision process, including but not limited to pavement, curbs, sidewalks, water system, sanitary sewer, stormwater piping, etc., including the grading of such land.
- 40. Public Works Department.** The City department that is responsible for maintaining and improving the city's infrastructure such as stormwater, streets, sanitary sewer, and water systems.
- 41. Public Works Director.** The Director of the City's Public Works Department.
- 42. PVC.** Polyvinyl Chloride.
- 43. Record Drawings.** Revised set of drawings submitted by the design engineer upon completion of a project. They shall reflect all changes made in the specifications and working drawings during the construction process. They shall show the exact dimensions, geometry, and locations of all elements of the work completed during the project. They are also known as Record (as-built) Drawings.
- 44. Right-of-Way.** A general term denoting public ownership or interest in land, usually in a strip, which has been acquired for or devoted to the use of a street.
- 45. Right-of-Way Line or Street Right-of-Way Line.** The boundary between any street and one or more parcels of private property.
- 46. Shall, May.** The word "Shall" shall be deemed as mandatory. The word "May" shall be deemed as permissive.
- 47. Sight Distance.** The near worst-case distance a vehicle driver needs to be able to see in order to have room to stop before colliding with something in the roadway.
- 48. Storm Water Detention Facility.** A drainage facility designed and constructed for the purpose of detaining storm water runoff to reduce downstream flows and/or reduce storm water pollutant levels.
- 49. Standard Drawing Details.** The official City of Rogersville's Standard Drawing Details for Public Improvements shall be used within the City of Rogersville, Missouri and such other areas outside the corporate boundaries which may contract with the City for the provision of services.
- 50. Subgrade.** The surface of a street on which a base course or riding surface is to be placed.
- 51. Subdivision.** The division of land into two (2) or more lots, tracts, or parcels for the purpose of transfer of ownership or building development, or, if a new street or easement of access is involved, any division of a parcel of land.
- 52. Tan.** Tangent distance between PC and PI, PI to PT.
- 53. USGS.** United States Geological Survey.

ARTICLE I

GENERAL REQUIREMENTS

Section 1.1 Short Title

1.1.1. This Ordinance shall be known and may be cited as the City of Rogersville Design Standards for Public Improvements.

Section 1.2 Purposes

1.2.1. The regulations and provisions contained in the Design Standards are adopted for the following purposes:

- A. To protect and provide for the public health, safety and general welfare of the City.
- B. To provide for adequate transportation and circulation throughout the City and to ensure the adequate provision of water, sewer and other public utilities and services.
- C. To prevent the pollution of water resources, to protect from flooding and other dangers and to ensure the adequacy of drainage facilities.
- D. To preserve and protect the value of land and buildings through minimizing land development conflicts and encouraging reasonable standards of subdivision design and the provision of public improvements.

Section 1.3 Jurisdiction

1.3.1. This Ordinance shall apply to all land and infrastructure improvements within the corporate boundaries of the City of Rogersville, Missouri and such other areas outside the corporate boundaries which may contract with the City for the provision of services.

Section 1.4 Effective Date

1.4.1. This Ordinance shall be in full force and effect from and after passage.

Section 1.5 Interpretations, Conflict and Separability

1.5.1. The provisions of this Ordinance shall be considered to be the minimum requirements for the protection of the public health, safety, and general welfare. Where conditions imposed by any provision of this Ordinance are either more restrictive or less restrictive than conditions imposed by any other provision of this Ordinance or other applicable law, ordinance, rule or regulation, the regulations which are more restrictive and which impose a higher standard shall govern.

1.5.2. The provisions of this Ordinance are separable. If any section, sentence, clause or phrase of this Ordinance is for any reason held to be invalid by a court of competent jurisdiction, the decision shall not affect the remaining portions of this Ordinance. If any court of competent jurisdiction shall adjudge invalid the application of any provision of this Ordinance to a particular property, such judgment shall not affect the application of said provision to any other property.

1.5.3. Where any of the provisions contained herein may be unclear or ambiguous as they pertain to a particular site or situation, interpretations of the policies, criteria, and standards set forth herein shall be made in writing by the Public Works Director. Such written interpretations shall be kept on file for future reference for use in similar situations and shall be incorporated in subsequent revisions of this Ordinance, if deemed necessary.

1.5.4. In the event it is determined by the City that the policies, criteria and standards set forth in this Ordinance for the design and installation of required infrastructure improvements would result in practical difficulties or undue hardship for the developer on account of the particular facts and circumstances of the property, and that alternative measures cannot be proposed or effected, then the most stringent requirements of any other applicable City ordinance or State of Missouri Department or Agency in effect at the time shall take precedence and shall be applicable as if set forth herein.

1.5.5. The developer/owner/engineer has full responsibility for ensuring that all requirements of these Regulations are met.

Section 1.6 Appeals

1.6.1. Where disagreements may arise over the interpretation of the requirements set forth herein by the applicant for subdivision plat approval, (or other improvement projects that includes public infrastructure), appeals may be made to the Board of Aldermen with a written request.

Section 1.7 Variances

1.7.1. In the event that compliance with the standards and criteria set forth herein is not practical or feasible, and that reasonable alternative measures can be proposed, application for a variance can be made. Requests for variances shall be made in writing to the City Administrator.

Section 1.8 Required Engineering Reports

1.8.1. When required, two (2) paper copies and one Adobe pdf digital file of a report signed and sealed by an engineer registered in the state of Missouri shall be submitted with the preliminary plat, (or any other improvement projects that includes public infrastructure), that shall provide a study of the following items as pertaining to the proposed subdivision or improvement:

A. Storm Water Drainage

1. Drainage area map showing flow lines for onsite and offsite water.
2. Location of detention basins with estimated volumes required.
3. A field study of the downstream capacity of all drainage facilities and the effect of additional flow from the area to be improved shall be submitted. If the effect is to endanger property or life, the problem must be solved prior to plan approval.

1.8.2. Sanitary Sewer and Water; A report on water and sewer capacity and needs to include all applicable information as specified in the Design Standards, Article III and Article IV.

1.8.3. Ground Stability; If the proposed subdivision is in a mined area or other suspect area, a ground stability report shall be provided.

1.8.4. Traffic Analysis and Street Capacity; The Public Works Director/City Engineer may require a Traffic Impact Analysis at the time of a site plan request, preliminary plat, rezoning request, construction plan submittals or etc. In certain cases, the traffic analysis may also require evaluation of requirements for pedestrian ways through the development.

Section 1.9 General Plan Requirements for Public Improvement Projects

1.9.1. The following criterion is established to provide a uniform system of plan preparation for submittal to the City. Applications and material submitted for processing under the provisions of this ordinance shall conform to the specifications prescribed in this Section. The Building Department and/or the Public Works Department shall make determinations regarding the completeness of applications. All documentation associated with plats, subdivision and building projects shall be submitted to the Building Inspector. Other documentation associated only with public infrastructure improvement projects, (water, sewer, streets and storm), shall be submitted to the Building Inspector.

1.9.2. All plans and reports submitted shall be prepared by, or under the direction of, a Professional Engineer, licensed in the State of Missouri, and shall be reviewed by the City for compliance with the minimum design requirements as established in the Design Standards and with all other applicable City's codes and standards.

1.9.3. Assumed elevations are not permitted. All benchmark references shall be noted on drawings. All surveys shall be accomplished in accordance with Missouri Minimum Standards for property boundary surveys. All survey data shall be vertically and horizontally tied to Missouri state plane coordinates and shall be shown on submitted digital and paper copies. Coordinates shall be provided for all exterior property corners on surveys and plats. Legal descriptions shall be written by a Registered Land Surveyor, licensed to practice in the State of Missouri, and shall comply with the minimum standards as provided for in the Missouri State Statutes for such descriptions.

1.9.4. Attention is directed to the design engineer that whenever extraordinary or unusual problems are encountered in conjunction with a proposed project, additional information and analysis beyond the minimum requirements of these standards and criteria may be required.

1.9.5. The City is not responsible for the accuracy and the adequacy of the design or dimensions and elevations as depicted on the plans (which shall be confirmed and correlated at the site of the work).

1.9.6. Review and approval of drawings and calculations by City is conceptual in nature only and does not imply detailed approval to any particular design item or data shown on the drawings, nor does it give implied approval for any variance from any City regulations or design standards. The design professional whose seal appears on the plans is responsible for all lines and grades, field data, and constructability of the design in compliance with the City's standards and regulations.

1.9.7. Prior to approval of a Preliminary Plat, it will be the individual developer's/owner's/engineer's responsibility to acquire all required off-site water, sewer, drainage, access and other utility easements required to serve the proposed development. All required off-site easements shall be recorded with copies provided to the Building Department prior to approval of the preliminary plat. Easements dedicated to the City shall be provided to the City as an original copy.

1.10 Construction Drawings:

1.10.1 The owner of the tract proposed for subdivision or public infrastructure improvements shall have an engineer licensed in the State of Missouri, prepare and submit construction drawings to the City.

1.10.2. All plans and specifications for public improvement construction within the city limits of the City and such other areas outside the corporate boundaries which may contract with the City for the provision of services shall be prepared by a professional engineer licensed in the State of Missouri. The registration seal of the responsible engineer shall be placed in a convenient place on each sheet of the plans.

1.10.3. Construction drawings shall clearly show the location and extent of proposed construction in relation to existing and proposed property lines, physical features, and utilities. They shall include all details necessary to properly construct the proposed improvements. Line-work and lettering shall be neat and clear. Copies shall be free from smudges, tears, folds, and other imperfections which affect the legibility of the drawings.

1.10.4. When necessary, the construction drawings may be on several sheets accompanied by an index sheet showing the entire subdivision or project. For large subdivisions, the construction drawings may be submitted to the building inspector for approval in complete phases satisfactory to the Public Works Department.

A. Submittal of construction drawings shall comply with the following;

1. Three (3) paper copies and one (1) Adobe pdf digital copy shall be submitted to the City for review and approval. Additional paper copies may be required if traffic and stormwater reviews by 3rd party consultants are necessary. Incomplete submittals will be returned without review.
2. All design changes that occur during the review process shall be noted in the revision block on the drawing and incorporated into the bound construction drawing set as revised redrafted full size sheets. Addendums and loose unbound sheets are not acceptable. Addendums will only be acceptable for field changes after final approval of the construction drawings. A response letter shall be provided by the design professional indicating the response to each review comment. If the response letter is not included in the resubmittal, no action will be taken until the response letter is received by the City.
3. After approval and required revision, three (3) paper copies and one (1) Adobe pdf digital copy shall be submitted to the City for City signature. Two signed approved paper copies will be returned to the developer/developer representative.

B. Drafting of construction drawings shall comply with the following:

1. General.

- a. The construction drawings shall be drawn upon 24" x 36" sheets with a one-half inch (1/2") clear border on the top, bottom, and right sides of the drawing, and a one and one-half inch (1- 1/2") clear border on the left side of the drawing. When feasible, each section shall have the related infrastructure and notes darkened with all other unrelated information and background shaded to provide clarity. The background and other unrelated information shall not interfere with the legibility of the pertinent data. The lot dimensions/bearings and other unnecessary information shall be turned off on the water and sewer sheets for clarity. Lettering shall be in a size large enough to allow

reproduction of legible half-size drawings for use in the field. Appropriate lot numbers shall be shown on all plan views. Plan and profile views shall be drawn on double or single plan and profile sheets to minimum scales of one (1) inch equals fifty (50) feet horizontal by one (1) inch equals five (5) feet vertical, unless otherwise approved by the City for special cases.

b. When more than one drawing sheet is involved in a plan view or profile, an overlap of not less than one hundred (100) feet should be provided with a match line and station noted. Each project shall show at least fifty (50) feet of topography on each side. All existing topography and any proposed changes, including all utilities, and so forth shall be shown on the plans and profile.

c. Revisions to drawings shall be indicated above the title block and shall show the nature of the revision and the date made.

d. Plans shall make consistent use of standard symbols throughout the plan set. The cover sheet shall include a legend of all symbols used. Symbols shall not be duplicated and shall be clear on their indication. Topography for which symbols are not standardized shall be indicated and named on plans and profiles. In utilizing symbols for engineering design plans, all existing utilities, telephone installations, storm sewers, pavements, curbs, inlets and culverts and so forth shall be shown with a broken line; proposed facilities with a solid line; land, lot, and property lines to be shown with a slightly lighter solid line. For improvement projects without final plats, all required easements shall be recorded with copies provided to the City prior to approval of construction drawings. A copy of the recorded easement(s) shall be provided to the City. These easements shall be indicated on the construction drawings by property ownership name plus book and page for each property.

e. Public right-of-way is reserved for City owned infrastructure only. Other utilities shall be located in easements.

f. The plans shall consist of:

- (1). Title Sheet, (Cover Sheet)
- (2). General Layout Sheet, (Overall main plan, for street, storm, water and sewer)
- (3). Sediment & Erosion Control Plan (SECP)
- (4). Grading Plan (Street and/or storm drainage improvement plans only unless otherwise required by the City)
- (5). Plan and Profile Sheets
- (6). Cross-Section Sheets, when required by the City
- (7). Standard and Special Detail Sheets
- (8). Other sheets as required

g. Each sheet should contain a sheet number, including the individual sheet number and total number of sheets, the engineer's seal, name, phone number and email address, revision block, proper project identification and date. The Missouri One-Call utility locate symbol shall be shown on all drawings involving earthwork. The top of each plan shall be either north or east and a north arrow shall be provided. The stationing on plans and profiles shall be from left to right. On drainage and sewer plans stationing shall always begin from the low point.

h. Each respective type of development/improvement project (i.e. sanitary sewer, streets, water mains, etc.) shall be submitted and bound as a common set of plans unless otherwise allowed by the City.

2. Title Sheet.

a. The following items shall be included on the title sheet.

- (1). Name of project
- (2). Index of sheets included in plans
- (3). A location map adequately showing project location in relation to primary streets (minimum scale of 1" = 2000')
- (4). General description of project area (by Township, Range, and Section)
- (5). The on-site project control bench mark shall be identified as to location and elevation; USGS datum.
- (6). Name, address, telephone number and email address of consulting engineer and owner/developer.
- (7). List containing name and telephone number of each utility company and public agency listed below;
 - Electric Power
 - Telephone
 - Cable Television
 - Gas
 - Highway Department (Local Office)
 - City of Rogersville for Water & Sewer
 - Any others
- (8). Engineer of Record name and seal.
- (9). Revision schedule.

3. General Layout Sheet.

a. The following items shall be included on the general layout sheet for all improvement projects.

- (1). A legend of applicable symbols and abbreviations shall be shown.
- (2). North arrow and graphic scale. Scale of the general layout map shall be one inch equals one hundred (100) feet, unless otherwise approved.
- (3). Layout shall include names of subdivision, block designation, if any; lot designation, or proposed block and lots, all street names, and an accurate tie to at least one quarter section corner.
- (4). Boundary line of project area.
- (5). In addition, the following items shall be included on the general layout sheet for the particular type of improvement stated below.
 - (a). Streets
 - Location of all existing and proposed streets and roadways within and adjacent to the project area.
 - Location of all existing and proposed drainage system improvements.
 - (b). Storm Drainage
 - Storm drainage piping system layout.

- Detention basin location.
- (c). Sanitary Sewer
 - Sanitary Sewer System layout.
 - Wastewater Pumping Station location, if necessary.
- (d). Water System
 - Water System layout.

4. Sediment & Erosion Control Plan, (SECP)

- a. An overall plan of the site showing proposed sediment and erosion control measures shall be included in the construction drawings. The sediment and erosion control plan may be superimposed upon the site dimension plan, grading plan or storm drainage facilities plan if legible. The sediment and erosion control plan shall also show the following:
 - b. General limits of the area to be stripped of vegetation or disturbed by construction activities shall be shaded or otherwise clearly delineated.
 - c. A summary table showing the total site area and the total area estimated to be disturbed.
 - d. Proposed location(s) of temporary construction entrance(s) and concrete washout area.
 - e. Proposed sediment containment measures: vegetative filter areas, straw bale dikes, silt fences, temporary containment berms, diversion berms, inlet protection, etc. Adequate details and notes for each containment measure shall be included.
 - f. Site stabilization measures, showing the type of surface stabilization to be provided in various areas of the site, whether sod, erosion control blanket, mulch, concrete, etc. If more than one (1) type of erosion control blanket or mulch is specified, the different areas should be distinguished by use of varying shading or symbols.
 - g. Seeding and mulching specifications, and allowable seasons for temporary and permanent seeding.
 - h. Temporary and permanent erosion control measures, such as outlet protection, channel linings, or paved chutes, etc.

6. Site Grading Plans

- a. The following items shall be included on the general layout sheet for all streets and/or drainage improvement projects.
 - (1). Property lines identified as to existing or proposed lot and block number.
 - (2). Elevation and location of nearest bench mark along with an On-Site temporary bench mark(U.S.G.S. datum).
 - (3). One-hundred year flood plain line.

- (4). Existing streets, transportation facilities, utilities, and storm drainage facilities.
- (5). Existing physical features including waterbodies and watercourses, sinkholes, springs, caves, faults, fracture trends, and photolineaments.
- (6). Existing structures, pavements, sidewalks, tree masses, pavements, and fences.
- (7). Proposed streets, transportation facilities, utilities, and storm drainage facilities.
- (8). Proposed structures, sidewalks, and pavements.
- (9). Proposed topographic contours.
- (10). Existing and final grading contours drawn at intervals not to exceed five feet. Each fifth contour shall be drawn as an index contour by using a heavier line weight. Index contours must be labeled. Intervals of less than five (5) feet may be required by the City dependent on the character of the topography.

7. Storm Drainage

- a. Detailed alignment of the storm sewer along with all appurtenances, sizes of lines, conduit material and wall thickness, and other details relating to the storm drainage system including inlet and junction box (manhole) stations and top and invert elevations. Curb inlet boxes shall be installed at roadway grades. Each curb inlet shall be provided with a minimum of two (2) top elevations to ensure roadway grades compliance.
- b. All existing drainage facilities and structures such as, but not limited to, irrigation ditches, roadside ditches, improved or unimproved drainage channels, gutter flow directions, culverts, etc. All pertinent information such as size, shape, slope, location, etc. of such facilities shall be included to facilitate review and approval of the plans.
- c. Roadway section and grade including type of curb and gutter and gutter flow directions.
- d. Erosion control and energy dissipation devices.
- e. Proposed outfall point for runoff from the project area along with required easement information.
- f. Routing and cumulative flows at various critical points along storm runoff.
- g. Minimum finished floor elevations of all buildings adjacent to the project for protection from major storm runoff.
- h. Distances between storm sewer system components and sanitary sewers within the right-of-way or drainage easement.
- i. Supporting calculations for storm drainage facilities must be included with the plan submittal. Supporting calculations shall be as required in this Design Guide.
- j. Storm drain piping shall be located on the opposite side of street from waterlines.

8. Sanitary Sewers/Water Lines

- a. Existing water distribution facilities including, but not limited to, pipe size and location, valves, fire hydrants, blow-offs, etc.
- b. Existing sanitary sewer facilities including, but not limited to size, slope, location, hydraulic capacity, and all pertinent information regarding which trunk line will ultimately receive the wastewater collected by the proposed system.
- c. Proposed piping with all appurtenances plainly labeled. Proposed piping shall be a heavier line-work.
- d. Existing or proposed easements and/or tracts through offsite areas.
- e. Estimated average quantity of wastewater generated offsite that would be tributary to the proposed development/improvement project, naturally as developed.
- f. All design elevations shall be invert of pipe. Top of pipe is acceptable for existing utilities except for those utilities being connected thereto.
- g. Existing utilities, particularly where crossed, with "as-built" elevations and stations.
- h. Stationing for the entire length of the utility beginning at the downstream end of the project. Stationing shall be provided for all manholes, fire hydrants, valves, elbows, tees, service laterals, dead-end assemblies and all other related items. Inline and isolation valves shall be connected to fitting with Foster Adapters.
- i. A uniform system of line and manhole designation shall be used subject to the approval of the Public Work Director.
- j. Detailed alignment of the proposed sewer with the manhole designation, station and angle shown at each manhole to provide unquestionable locations of the sewer within street right-of-way or on private property.
- k. All manholes shall be shown with manhole designation station, deflections, rim elevations and invert elevations. Drop manholes shall be designated as such. Bolt-down covers shall be designated as such. Invert elevations shown shall be the invert of the pipe in and out of the manhole. Proposed elevation of top of manhole shall be 0.2' above finished grade. Distance between manholes shall be shown as well as the gradient, pipe size, and type of material.
- l. The channel center line of waterways within fifty (50) feet either side of center line of sewer shall be shown.
- m. Results of all rock borings shall be shown at the proper locations.
- n. Accurate elevations of the first-floor surface shall be shown, and identified, for all existing and/or proposed structures or for all building sites to be served by the proposed sewer system.

o. Station, length, and size of each service lateral.

p. Profile view shall show existing grade at the center line as a dashed line, proposed finish grades or established street grades by solid lines. Each line shall be properly identified. The proposed water and sewer shall be shown as double solid lines properly showing the height of the pipe.

q. Alignment of the proposed water line and sewer line dimensioned from curb lines or right-of-way lines.

r. Water and sewer lines shall be located in the front of the lots on opposite sides of the street within street right-of-way.

9. Plan and Profile Sheets

a. The following items shall be included on the plan and profile sheets for all improvement projects.

- (1). North arrows and graphic scale.
- (2). Elevation and location of all applicable bench marks (USGS datum).
- (3). Existing and proposed streets with names and widths.
- (4). Property lines properly identified as to existing or proposed lot, block and subdivision.
- (5). All existing and proposed utilities such as power, gas, oil, water, telephone, sewer, cable television, and other items shall be properly located in conformance with the best information available (from the records of the owner of such facilities or field location) and identified as to size, material, and type of construction.
- (6). All existing and known proposed improvements within fifty feet each side of center line shall be shown at their proper locations. This shall include such existing items as paved streets, curbs and gutters, driveways, culverts, fire hydrants, utility poles, trees, shrubs, fences, walls, houses, and other such items, and shall be identified as to type, size, material, etc., as may be applicable. In case of new developments, some irrelevant items may be omitted.
- (7). All existing easements and right-of-way information recorded with the county.
- (8). All proposed easements and right-of-way information.
- (9). Minor construction notes shall appear on the proper plan and profile sheets.
- (10). Locations and widths of existing and proposed sidewalks.
- (11). In addition, the following items shall be included on the plan and profile sheets for the particular type of improvement stated below.

(a). Streets

- Width of right-of-way and width of pavement, (BOC to BOC), on all plan sheets.
- Typical cross-section for roadway(s).
- Station and critical elevation (flowline, invert of pipe, etc.) of all utility or drainage appurtenances, both existing and proposed.
- Indicate vertical and horizontal locations of all existing and proposed utility crossings on street profiles, including curb inlets.

- Flow direction arrows, particularly at intersections.
- Match lines and consecutive sheet number, beginning with cover sheet.
- Station and elevation of all curb returns (at 1/5 points); horizontal P.C.'s, P.T.'s, etc.; high or low point of all vertical curves; existing and proposed.
- Curb return radii, existing and proposed.
- Complete horizontal curve data for curbs and right-of-way, (R, L, Tan)
- Centerline stations and widths of all non-single family residential driveways and all intersecting roadways.
- Basis of plan view and profile elevations shall be the same, i.e., flowline and flowline, top of curb and top of curb, etc.
- Existing grades or established street grades shown as a solid line.
- All design elevations shall be centerline, top of curb, lip of gutter, or flowline (preferred) for 6" vertical curb and gutter; or lip of gutter, or flowline (preferred) for combination curb and gutter. The basis for as-built information shall be the same as the design (both flowline or both top of curb, etc.).
- Stationing continuous for the entire portion of the roadway shown in the plan view (100 feet minimum stationing).
- Location of any pavement expansion joints in the plan view.
- All existing curbs, gutters, sidewalks, and pavement adjacent to the proposed design (minimum distance of 100 feet). Basis for existing grades shall be "as-built" or field verified elevations at intervals not to exceed fifty (50) feet. Previously approved designs are not an acceptable means of establishing existing grades.
- Station and elevation of all horizontal P.C.'s, P.C.C.'s and etc.; existing and proposed.
- Station and elevation of all vertical grade breaks, existing (as-built) and proposed.
- Distance and grade or slope between grade breaks.
- Vertical curves, where necessary, with PVI, PVC, and PVT, high or low point (if applicable) stations and elevations. All vertical curves shall be labeled with length of curve (L) and K ($=L/A$). All vertical curves shall be symmetrical.
- Existing and proposed utilities, (location, type and size). Field verified elevations and locations are required to be indicated on the plans for all utilities (existing or proposed) which will potentially affect the design and construction of the improvement.

10. Cross Section Sheets

a. The following items shall be included on the cross-section sheets.

(1). Typical roadway cross-section for all roadways, existing or proposed, within and adjacent to the proposed development. These cross sections shall appear on the detail sheet. They shall indicate type of roadway(s), profile grade design point (centerline, flowline, top curb, lip of gutter, etc.), roadway width, right-of-way,

- type of curb, gutter, and walk, pavement cross slope, etc... Cross-sections shall show existing grade lines a minimum of ten (10) feet beyond right-of-way lines.
- (2). Cross-sections shall be shown at all intersecting streets and driveways.
 - (3). Channel cross-sections shall be shown for all drainage channel improvements.
 - (4). Additional cross-sections shall be shown as required by the City to clearly describe the extent of the grading operations.

11. Standard and Special Detail Sheets

- a. Detail sheets shall be included to show all details of appurtenances, material, and construction whether or not covered by the Standards Drawing Details. When available, details shall conform to the Standard Drawing Details, labeled with the City's detail identification and are to be drawn clearly and neatly with proper identifications, dimensions, materials, and other information necessary to insure the desired construction.

12. Private Improvements.

- a. Private improvements, if any, shown on public improvement plans, shall be clearly defined and marked as such. These improvements will not be maintained by the City and, as such, an appropriate note shall be included on the drawings.

13. Required Notes

- a. The following general notes will be required as a minimum on all plan submittals for public improvement projects. These notes are not meant to be all-inclusive, and in certain situations the City may require the use of additional notes.

(1). Water

- Development plans are approved initially for one (1) year after which they automatically become void and must be updated and re-approved by the City before any construction will be permitted.
- The City's plan review is only for general conformance with City Design Criteria and the City Code. The City is not responsible for the accuracy, quality, and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City through approval of this document assumes no responsibility other than that as stated above for the completeness and/or accuracy of this document.
 - The contractor shall have a minimum of one (1) signed copy of the plans (approved by the City) and one (1) copy of the Construction Specifications at the job site at all times.
 - Construction of the improvements shown or implied on this set of drawings shall not be initiated or any part thereof undertaken until the City is notified of such intent.
 - The City of Rogersville's Construction Specifications for Public Improvements, latest edition, shall govern construction of this project.
 - All existing utilities indicated on the drawings are according to the best information available to the Engineer; however, all utilities actually existing may not be shown. Utilities damaged through the negligence of

the contractor to obtain the location of same shall be repaired or replaced by the contractor at his expense.

- All backfill shall be compacted to prevent settlement.
- Contractor shall not be allowed to work on Sundays. Holiday or Saturday work shall be as approved in advance by the City.
- All materials and workmanship associated with this project shall be subject to inspection by the City. The City reserves the right to accept or reject any such materials and workmanship that does not conform to the Construction Specifications.
- The contractor shall notify the Public Work's Department twenty-four (24) hours prior to the beginning of construction. In addition, a minimum of twenty-four (24) hours notice shall be provided for any required inspections.
- City required inspections shall include but not be limited to; all water and sewer crossings, all encasements, all water lines, all service lines and all thrust blocks prior to backfilling. All water lines will be pressured tested and bacteria tested after backfilling. All testing after backfilling except bacteria testing, will be conducted by the contractor under the observation of the City's representative. After final grading is complete, the City's representative will verify proper final grade at all meter lids, valve boxes and fire hydrant. In addition, all tracer wire installation shall be located using typical low frequency (512Hz) line tracing equipment and witnessed by the City's representative prior to acceptance.
- Relocation of any water line, sewer line, service line or any other utility thereof required for the construction of this project shall be the responsibility of the contractor at his expense.
- Contractor shall provide two operating keys (T-bars) for operation of the wrench nuts for the water valves.

(2). Sanitary Sewer

- Development plans are approved initially for one (1) year, after which they automatically become void and must be updated and re-approved by the City before any construction will be permitted.
- The City's plan review is only for general conformance with City Design Criteria and the City Code. The City is not responsible for the accuracy, quality, and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City through approval of this document assumes no responsibility other than as stated above for the completeness and/or accuracy of this document.
- The contractor shall have a minimum of one (1) signed copy of the plans (approved by the City) and one (1) copy of the Construction Specifications at the job site at all times.
- Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the City is notified of such intent.
- The City of Rogersville's Construction Specifications for Public Improvements, latest edition, shall govern construction of this project.
- All existing utilities indicated on the drawings are according to the best information available to the Engineer, however, all utilities actually existing may not be shown. Utilities damaged through the negligence of

the contractor to obtain the location of same shall be repaired or replaced by the contractor at his expense.

- All backfill shall be compacted to prevent settlement.
- All laterals shall be laid on 2.00% minimum grade unless approved otherwise.
- All materials and workmanship associated with this project shall be subject to inspection by the City. The City reserves the right to accept or reject any such materials and workmanship that does not conform to the Construction Specifications.
- The contractor shall notify the Public Work's Department a minimum of twenty-four (24) hours prior to the beginning of construction. In addition, a minimum of twenty-four (24) hours notice shall be provided for any required inspections.
- City required inspections shall include but not be limited to; all water and sewer crossings, all encasements, waterlines, sewer lines, all service lines and all manholes prior to backfilling. All sewer lines will be air tested and also pulled with a mandrel after backfilling. All manholes will be vacuum tested after backfilling. All testing after backfilling will be conducted by the contractor under the observation of the City's representative. In addition, all tracer wire installation shall be located using typical low frequency (512Hz) line tracing equipment and witnessed by the City's representative prior to acceptance. After final grading is completed, the City's representative will verify proper grade variation between finished grade and manhole rims. In addition, the City may require developer/contractor, at his expense, to perform lamping, smoke testing or camera testing of all sewer mains for discovery of defects, irregularities and compliance with design profile and specifications.
- Contractor shall not be allowed to work Sunday. Holiday or Saturday work shall be as approved in advance by the City.
- Relocation of any water line, sewer line, service line or other utility thereof required for the construction of this project shall be the responsibility of the contractor and shall be at his expense.
- The Contractor shall install and properly maintain a mechanical plug at all connection points with existing lines until such time that the new line is tested and approved.

(3). Streets and Storm Drainage

- Development plans and drainage reports are approved initially for one (1) year, after which they automatically become void and must be updated and re-approved by the City before any construction will be permitted.
- The City's plan review is only for general conformance with City Design Criteria and the City Code. The City is not responsible for the accuracy, quality, and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City through approval of this document assumes no responsibility other than as stated above for the completeness and/or accuracy of this document.
- The contractor shall have a minimum (1) signed copy of the plans (approved by the City) and one (1) copy of the Construction Specifications at the job site at all times.

- Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the City is notified of such intent.
- The City of Rogersville’s Construction Specifications for Public Improvements, latest edition, shall govern construction of this project.
- All existing utilities indicated on the drawings are according to the best information available to the Engineer; however, all utilities actually existing may not be shown. Utilities damaged through negligence of the contractor to obtain the location of same shall be repaired or replaced by the contractor at his expense.
- All backfill shall be compacted to prevent settlement.
- A minimum of one (1) compaction test and a maximum of two (2) compaction tests shall be performed by a qualified testing laboratory for every 300 feet of street construction. Additionally, soil compaction test shall be performed at two-foot increments vertically for fill placement. Soil samples for such tests shall be collected by laboratory technicians. All testing laboratory expenses shall be paid for by the contractor.
- All materials and workmanship associated with this project shall be subject to inspection by the City. The City reserves the right to accept or reject any such materials and workmanship that does not conform to the Construction Specifications.
- The Contractor shall notify the Public Work’s Department a minimum of twenty-four (24) hours prior to the beginning of construction. In addition, a minimum of twenty-four (24) hours notice shall be provided for any required inspections.
- City required inspections shall include but not be limited to; subgrade prior to base course application, base course prior to sidewalk, curb or asphalt/concrete application and the final sidewalk, curb and asphalt/concrete application. The City will perform proof rolling prior to black base installation. Nuclear density tests shall be provided by the contractor prior to pavement installation Any failed areas must be corrected before black base pavement can be installed. Black base shall be inspected prior to application of asphalt surface course. All storm pipes and boxes shall be inspected by the City’s representative prior to any backfilling.
In addition, the City may elect to camera test all storm sewer mains at the developer’s expense.
- Contractor shall not be allowed to work Sundays. Holiday or Saturday work shall be as approved in advance by the City.
- Relocation of any water line, sewer line, service line or other utility thereof required for the construction of this project shall be the responsibility of the contractor and shall not be at the City’s expense.

(4). Sediment and Erosion Control Plan

This plan shows the location and details for primary sediment controls to be constructed. The contractor is responsible for controlling erosion and discharge of sediment from the site at all times during construction. The contractor shall provide necessary measures during

all phases of his operations regardless of whether they are specifically noted on this plan and shall maintain and replace controls as necessary during the course of his operations.

- Temporary construction entrance(s) and silt fences, fiber rolls or other initial sediment controls shown on this plan must be installed prior to any land disturbance.
- Detention facilities shown on this plan shall be installed prior to any other land disturbance.
- The contractor shall clean streets both interior and adjacent to the site, as needed, after each rainfall, at the end of construction, and as determined by the City staff or governing law enforcement agency.
- The contractor is responsible for controlling dust during construction and shall water the construction areas whenever conditions warrant.
- The contractor is responsible for cleaning accumulated sediment from storm drains prior to approval of construction.
- All disturbed areas not receiving other permanent stabilization such as pavement, roofs, sod, etc., shall be seeded and mulched, as specified. Vegetation shall be established before temporary sediment controls can be removed and prior to final approval of construction.
- The contractor is responsible for inspecting the BMPs, weekly and after it rains in accordance with the MoDNR erosion control permit.
- The contractor is responsible for maintaining copies of the Sediment and Erosion Control Plan, the Stormwater Pollution Prevention Plan, (SWPPP), and the weekly inspection reports on site at all time.
- The City's approval of these erosion control plans in no way releases the developer/contractor from the responsibility for all sediment/erosion control methods to be in compliance with the City's Standards and Codes. This includes, but is not limited to; proper maintenance of all controls in place and providing additional control as required for both sheet flow and concentrated flow areas.

14. Approval Block. A signature block shall be required on the cover sheet of all plans and reports submitted for review and approval. All plans and reports require the signature of the Public Works Director and the date of such signing for formal approval by the City. After one year, the plans and reports shall become null and void and shall be resubmitted prior to approval of construction of that project. The general form of the approval block for construction drawings shall be as follows:

APPROVED FOR ONE YEAR FROM THIS DATE

City of Rogersville Public Works Director

Date

The City's approval of these improvement plans in no way releases the developer/contractor from the responsibility to be in compliance with the City's Standards and Codes.

1.11 Record (as-builts) Drawings:

A. Record (as-builts) drawings shall be provided to the Public Works Department prior to acceptance for any other improvement projects that includes public infrastructure. The drafting of the record (as-built) drawings shall comply with all of the same criteria as the construction drawings and shall be corrected to show the project as constructed. The drawings shall accurately and completely denote all changes made during the course of the work. Each sheet within the plans shall be clearly marked as "Conformed to Construction Records" and shall include the date of revision and certifications by the engineer of record. All manhole depths shall be measured and noted. The Developer's Engineer shall gather field notes and shall conduct field surveys of all items, (fire hydrants, valves, manholes, storm boxes, exposed storm pipe ends, storm water detention basins etc.) to ensure the accuracy of the record (as-built) drawings. Where changes occur, the Developer's Engineer shall verify and certify in writing that all design criteria are still met. The record (as-built) drawings shall comply with the following:

1. As-built information shall be clouded and noted with a symbol showing the revision number.
2. The record (as-built) drawings shall be sealed by an engineer registered in the State of Missouri.
3. In addition, when construction of the improvements is completed, the Developer's Engineer shall perform surveys to determine that the location, dimension, and grade of the drainage improvements is in substantial conformance with the approved plans. Location of improvements shall be checked by field survey to ensure that the improvements are completely located within the easements or rights-of-way which have been provided. The location of improvements which vary more than six inches (6") from the location shown on the approved plans must be approved in writing by the City.
4. Elevations and grades shall be verified at the following locations:
 - a) Center of access manhole or grate for junction structures and inlets.
 - b) Inlet entry for side opening inlets (except curb opening inlets).
 - c) Pipe and culvert inverts. For box culverts greater than five feet (5') wide, invert elevation shall be checked at each side of the inlet and outlet.
 - d) Detention basin and sediment basin outlet structures.
 - e) Maximum intervals of one hundred feet (100') and at grade changes in drainage channels (excluding road side borrow ditches).
 - f) Detention and sediment basins.
5. Elevations differing by more than one-tenth of a foot (0.1') from plan grades or five-hundredths of a foot (0.05') for detention basin outlet structures must be approved in writing by the City prior to final approval.
6. Dimensions must be verified for the following:
 - a) Pipe diameter for circular pipe.
 - b) Height and width for elliptical or arch pipe, or box culverts.
 - c) Drainage channel cross-sections at maximum intervals of two hundred feet (200').
 - d) Erosion protection at pipe outlets.
 - e) Overflow spillways and outlet structures for detention and sediment basins.
 - f) Detention and sediment basin volume.

B. Submittal of Record Drawings.

1. After approval and any required revision, three (3) paper copies and one (1) Abode pdf digital copy file shall be submitted to the City. The digital copies may be submitted on a USB Flash Drive to City Hall. The paper copies shall be separately bound on 24" x 36" sheets. Each sheet within the plans shall be clearly marked as "Conformed to Construction Records" and shall include the date of revision and certifications by the Engineer of Record. The digital copies and the paper copies shall be to standards acceptable to the Public Works Department.

Section 1.12 Pre-Construction Conference

1.12.1. Prior to the commencement of any construction or installation of any infrastructure improvements, a pre-construction conference shall be held with the developer/owner or his representative, the contractor(s) responsible for installation of the infrastructure improvement, the Public Works Director or his representative, Public Works staff and City Engineer. The pre-construction conference shall be held to ensure that all applicable provisions of this Ordinance or other applicable law, rule, or regulation have or will be met, that all applicable permits have been obtained, and that any questions regarding the scheduling of construction and installation of improvements are resolved. The developer/owner or his representative shall be responsible for contacting the Building Inspector to schedule the pre-construction conference. Building Inspector will then notify the parties of the date and time of the pre-construction conference.

Section 1.13 Inspection Requirements

1.13.1. Apart from inspections performed by the City, periodic inspections shall be required during construction work. These inspection requirements are outlined in the individual standards for streets, sidewalks, drainage or other public improvements.

1.13.2. Apart from inspections performed by the City, the developer shall provide inspection services for all improvements that will be dedicated to the City of Rogersville and all stormwater facilities improvements. These inspections shall be performed by or under the direct supervision of the developer's engineer who shall be registered in the State of Missouri. Inspections shall be of sufficient frequency to enable the developer's engineer to provide to the City a sealed certification that the improvements were constructed in accordance with the approved engineering design plans, or in accordance with approved record (As-Built) plans.

1.13.3. The developers Engineer of Record shall also submit copies of field inspection reports and testing results in sufficient detail to record the history of the installation and deviations from the approved engineering design plans. These reports shall bear the seal of an engineer registered in the State of Missouri.

1.13.4. These inspections, reports and certifications shall be the financial responsibility of the developer. In no case shall the presence of City personnel during any part of the construction and testing constitute acceptance by the City or a substitute for on-site observation by the developer's engineer.

1.13.5. The developer shall notify the City a minimum of twenty-four (24) hours prior to any testing of public improvements. If the City requests to be present during any phase of construction and testing and is not notified by the developer, the developer shall uncover concealed work or retest any materials or systems for the City's personnel to observe.

ARTICLE II

STREETS, SIDEWALKS AND OFF-STREET PARKING STANDARDS

Section 2.1 Street-General Requirements

2.1.1. The classifications, extent, width, grade and location of all streets shall conform to the City's Comprehensive Plan.

2.1.2 In any case where additional street right-of-way is required, the additional right-of-way shall be split evenly on both sides of the existing right-of-way unless otherwise approved by the Board of Aldermen.

2.1.3. Where not shown, the arrangement and design standards of streets shall conform to the provisions herein or the Missouri Department of Transportation or Greene County or Webster County where applicable. Streets which have an entry onto a state highway will require approval from the Missouri Department of Transportation. Streets which have an entry onto a Webster County or Greene County roadway will require Webster County or Greene County approval.

2.1.4. The arrangement of streets in new subdivisions shall be coordinated with existing, proposed and anticipated streets outside of the subdivision. Provision shall be made for the continuation of existing streets in adjoining areas.

2.1.5. When a new subdivision adjoins a tract susceptible to being subdivided, new streets shall be extended to the boundaries of such tract.

2.1.6. Streets shall be related appropriately to the topography and street grades shall conform as closely as practical to the original topography. Street grades shall be in accordance with the requirements of these Design Standards.

2.1.7. Local streets shall be designed to discourage through traffic. However, provisions must be made for the extension of arterial and collector streets into and from adjoining areas.

2.1.8. Every lot shall access an interior road that provides reasonable ingress and egress for emergency and non-emergency vehicles as well as for the intended use of the lot. Commercial or industrial lots shall have access to a collector street, but shall not have direct access to any residential street or residential collector street, except in the case of appropriately separated planned retail center.

2.1.9. When a subdivision abuts or contains an arterial street, the Planning and Zoning Commission may require marginal access streets, reverse frontage lots, or other such treatment as may be necessary for adequate protection of abutting properties and to provide separation of through and local traffic.

2.1.10. Half-streets shall be prohibited except where such streets, when combined with a similar street (developed previously or simultaneously) on property adjacent to the subdivision, create a street that meets the right-of-way and pavement requirements and this Ordinance. In such case, the developer shall dedicate that portion of land in the proposed subdivision that will complete the street right-of-way to the minimum standards.

2.1.11. Blocks shall have sufficient width to provide for two (2) tiers of lots of appropriate depth, except in the case of reversed frontages. The lengths of blocks shall be appropriate in the opinion of the Planning and Zoning Commission for the locality and the type of development contemplated and shall comply with the provisions of Chapter 410, Subdivision Regulations and Requirements of the City’s Municipal Code.

Section 2.2 Street-Design Guidelines

2.2.1. **General.** Street improvements shall be designed to conform to applicable codes, regulations, ordinances, and the provisions set forth in these criteria as established by the City. Plans for said improvements shall be submitted to the Building Inspector for approval and shall include all information as may be required or described hereinafter.

2.2.2. **Functional Classification of Streets.** The classification of streets shall be generally defined as follows:

A. Arterial Streets. Arterial streets augment and feed the arterial system and are intended for moderate-volume, moderate-speed traffic movement. Access to abutting property is partially controlled.

B. Collector/Commercial Streets. Collector streets collect and distribute traffic between arterial streets and residential/local streets and are intended for short length trips while also providing access to abutting properties. Commercial streets serve areas predominately zoned for commercial or industrial uses. The City may require additional lanes as required to serve intended or future developments.

C. Residential/Local Streets. Residential/Local streets are designed to provide direct access to abutting property. Residential/Local streets are intended for low-speed low-volume traffic movement and for short length trips.

2.2.3. Street Design Standards

	ARTERIAL	COLLECTOR	RESIDENTIAL/ LOCAL
Minimum Right-of-way Width (ft)	60	60	50
Street Width (BOC-BOC in ft)	44	36*	28*
Median Width (ft)	NA	NA	NA
Minimum Pavement Depth (Asphaltic Concrete) inches	**	See Standard Details	See Standard Details
Maximum Grade	6%	6%	7%
Minimum Grade	0.5%	0.5%	0.5%
Curb Return Radius	**	30’	25’
Maximum Radii, Horizontal Curves	**	300’	200’
Sidewalk Width	4’ Min.	4’ Min.	4’ Min.
Parking Permitted	No	No	One Side
Storm Sewers	Yes	Yes	Yes
Curb & Gutter	Barrier	Barrier	Barrier
Number of Lanes	4 to 6	2 to 3	2

- * Increased width if bicycle route is included.
- ** To be individually designed and approved.

2.2.4. Off-Center Street Intersections. Off-center street intersections shall be separated by a minimum centerline to centerline dimension of 150 feet.

2.2.5. Intersection Vertical Alignment. In all cases where a higher functional street intersects with a lower functional street, normal street crown shall be maintained on the higher functional street. Where streets of equal function intersect, street grades shall coincide in the center of the intersection with reduced rideability for both streets, or a warping of the cross slope for both streets

2.2.6. Right-of-Way Triangle Requirements

Intersection with	Arterial	Collector	Residential/Local
Arterial	A	B	C
Collector	B	B	D
Residential/Local	C	D	E

- B– 30 X 30’ ROW triangle w/50’ corner radii
- C– 10’ X 10’ ROW triangle, (or 15’ ROW radius) w/30’ corner radii
- D– 10’ X 10’ ROW triangle, (or 15’ ROW radius) w/20’ corner radii
- E – No ROW triangle w/15’ corner radii

2.2.7. Leveling Areas of Intersection. Any approach leg of an intersection that is subject to either stop control or a signalized intersection where vehicles may be stored while waiting to enter an intersection shall be designed with a maximum grade on the approach legs of three (3) percent within a minimum length of 100 feet. The 100 foot shall be measured from the intersection of the edge of gutter flag or edge of pavement, with a maximum cross-fall of 6” at the throat of the radius returns of the intersection street.

2.2.8. Street Intersections. Intersections involving the junction of more than two (2) streets shall be prohibited.

2.2.9. Sight Distances at Intersections. Sight distance is a function of the intersection control and vehicle speed. See appropriate AASHTO standards in the latest edition of Geometric Design of Highway and Streets.

2.2.10. Minimum Angle of Intersection. It is desirable for all intersections to meet at approximately a 90 degree angle. No street shall intersect any other street at an angle of less than 75 degrees.

2.2.11. Maximum Gradient. The maximum gradient for streets as noted in Section 2.2.3 may be exceeded only upon written approval of the Director of Public Works. Such approval will only be granted in unusual cases where grades within the acceptable limits cannot be obtained.

2.2.12. Grading Gradients. Except for the sidewalk surface, the finished grade within the limits of the right-of-way shall slope from one-quarter (1/4) inch vertical to one (1) foot horizontal minimum; to one-half (1/2) inch vertical to one (1) foot horizontal maximum measured above the back of the curb. The grading gradients may be varied only upon written approval of the Director of Public Works. See details in the Standard drawing details.

2.2.13. Grade Breaks. A vertical curve will be required for all street center-line profile grade differentials. Grade of road extensions to development boundaries for future extensions shall be designed to accommodate the grade of the adjoining property.

2.2.14. Connections to Existing Pavements. Where a new street is to connect to an existing street, all deteriorated or cracked asphalt within five (5) feet of the connection point shall be removed to a point where sound material is found. If full-depth pavement removal is required, the subgrade will be recompact to 95% of standard density. Connection shall be made with a saw-cut of the existing pavement to create a clean butt connection.

2.2.15. Storm Drainage. All storm drainage works constructed in connection with street improvements shall be designed in accordance with the Design Standards.

2.2.16. Cul-De-Sacs. Permanent dead-end streets or cul-de-sac shall be no longer than 500 feet and shall provide at the closed end a paved turn-around having a minimum diameter of one hundred (100) feet to the back of the outside curb and one hundred twenty (120) feet to the street right-of-way line. See details in the Standard Drawing Details.

2.2.17. Temporary Turn-Arounds. At locations where streets are to be temporarily terminated which will be extended at a later date, and said street extends beyond the intersection of an adjacent street more than 150 feet, a temporary cul-de-sac or "hammerhead" turnaround shall be constructed. This requirement may be omitted only upon written approval of the Logan-Rogersville Fire Protection District Chief. See details in the Standard Drawing Details.

2.2.18. Other Design Criteria. All other street design elements not contained within these criteria shall be in accordance with the most current edition of "A Policy on Geometric Design of Highways and Streets" authored by the American Association of State Highway and Transportation Officials (AASHTO) or other applicable AASHTO design guides.

2.2.19. Driveway Elevations. Driveways shall attain top of curb elevation within the right-of-way. Break-over grades for crest drives shall be 8% maximum and sag drives shall be 12% maximum. Driveway elevation shall allow for a smooth sidewalk profile and appropriate ADA cross-slopes. See details in the Standard Drawing Details.

2.2.20. Curb and Gutters. All streets shall be constructed with concrete curb and gutter. Curb and gutter shall be installed in conformance with details in the Standard Drawing Details.

2.2.21. Cut and Fill Slopes. Slope adjoining right-of-ways shall be sloped no steeper than a 3:1 grade. 4:1 grades are preferred where possible.

2.2.22. Driveway Approaches

A. All driveway entrances and other openings onto streets within the City of Rogersville shall be constructed so that:

1. Vehicles can enter and exit from the lot in question without posing any substantial danger to themselves, pedestrians or vehicles traveling on abutting streets. Interference with the free and convenient flow of traffic on abutting or surrounding streets is minimized.
2. For residential streets, only one driveway approach shall be permitted abutting any frontage of less than eighty (80) feet. The number of driveways abutting any frontage of eighty (80) to one hundred fifty (150) feet shall not exceed two (2).

3. No driveway approach shall be permitted which will interfere with any traffic control devices or public utilities including curb inlets and fire hydrants. The direction of any garage opening shall not align with an existing fire hydrant or curb inlet location.

4. All driveway approaches shall be located a minimum of 5' from edge of driveway to property line. Radius or sloped edge of the driveway approach shall not extend beyond the projection of the adjacent property line, extended perpendicularly to the right-of-way line. See details in the Standard Drawing Details.

B. The size of culverts under City streets shall be as determined in the stormwater analysis.

2.2.23. Sidewalks

A. Sidewalks shall be required on one (1) side of the street in all residentially zoned areas. Sidewalks shall be required on both sides of the street in all industrial and commercially zoned areas. Sidewalks may also be required along existing public streets for the full length of all street frontages of any proposed development or structure. Sidewalks shall comply with all requirements of the latest edition of the ADA Standards for Accessible Design.

B. Public sidewalks shall be located within the street right-of-way but shall not be built longitudinally over sanitary sewer or water mains. Sidewalks shall be constructed of Portland concrete. Decorative brick walk ways may be permitted with approval by the Board of Aldermen. Colored, stamped concrete resembling brick would be preferred over decorative brick.

C. Maximum longitudinal grade for sidewalks shall either be 5% maximum running grade or matching the profile grade established for the adjacent roadway. Cross slopes of sidewalks shall not exceed 2% maximum. Minimum cross-slope of sidewalks shall be 0.5%.

D. Sidewalks shall be a minimum of 4 feet wide. A grass planting strip shall normally be provided between the curb and the sidewalk. Sidewalks shall not be located adjacent to the back of curb. Public sidewalks located adjacent to multi-store front commercial buildings shall be a minimum of six (6) feet wide.

E. Whenever the City of Rogersville finds that a means of pedestrian access is necessary from the subdivision to schools, parks, playgrounds, or other roads or facilities and that such access is not conveniently provided by sidewalks adjacent to the streets, the developer may be required to construct other walkway improvements to provide such access.

F. All sidewalks shall be constructed up to each intersecting street and curb ramps shall be provided for intersections at the curb return and other major points of pedestrian flow. A curb ramp shall be provided across from the curb ramp at the opposite curb return where sidewalks exist or are proposed. Cross slopes for accessible crosswalks on street crossings shall not exceed 2% maximum. Curb ramps and the flared sides of curb ramps shall be located so that they do not project into vehicular traffic lanes, parking spaces or parking access aisles. Curb ramps at marked crossings shall be wholly contained within the markings excluding any flared sides. Diagonal curb ramps with flared sides shall have a segment of curb 24" long located on each side of the curb ramp within the marked crossing. Curb ramps, street crossings and depressed curbs shall be constructed in accordance with the latest edition of the ADA standards in effect at the time of construction. See details in the Standard Drawing Details.

2.2.24 Street Lights

- A. Street lights shall be provided for any type of subdivision. A street light shall be installed at each intersection of a street and each cul-de-sac; but in no event shall there be fewer than one (1) street light for each two hundred fifty (250) linear feet, or portion thereof, of street frontage between intersections or between a street intersection and the terminus of a dead-end street.
- B. In a multi-family dwelling residential subdivision, the minimum distance between two (2) street lights shall be not less than two hundred (200) linear feet.
- C. All street lights shall have underground wiring and meet minimum specifications for the electric utility company serving the area of the proposed subdivision. Street lights shall be installed prior to occupancy of structures within the subdivision.

ARTICLE III

SANITARY SEWERS

Section 3.1 General Requirements

3.1.1. All developments/public improvements shall be provided with an approved system for wastewater disposal in accordance with this Article and subsequent sections of this Design Standard.

3.1.2. All sanitary sewer main extensions, pump stations, appurtenances, and all collection and treatment systems shall be designed and constructed in accordance with the most current regulation of the MoDNR's rules, regulations, and Statutes of the State of Missouri. Any proposed extensions or modifications to the City's sanitary sewer system shall in general, comply with the City's Sanitary Sewer Master Plan. Any deviations shall require approval by the Director of Public Works.

3.1.3. All sanitary sewer improvements plans including all gravity and pressure systems within the City, shall be submitted to the Building Inspector, for review and approval by the Public Works Director and/or a representative designated by the City. The developer/applicant shall be responsible for all costs associated with the required review and approval of submitted plans.

3.1.4. Any review by the City, or approval of construction shall not relieve the developer or the developer's engineer from complying with all rules, regulations, ordinances, laws or statutes that are in effect at the time of design or construction.

3.1.5. In addition to the rules, regulations and state statutes specified in Section 3.1.2, the City will require conformance with the following design guidelines and with the Standard Drawing Details and Constructions Specifications for Public Improvements.

3.1.6. Construction of new proposed sewer holding tanks or sewer septic systems are not permitted within the city limits of Rogersville. Only replacements of existing facilities are permitted when no other option is feasible.

Section 3.2 Design Guidelines

3.2.1. Sanitary Sewers shall be designed for the ultimate tributary population. Due consideration shall be given to current zoning regulations and approved planning and zoning reports where applicable. The most current City of Rogersville Comprehensive Plan shall be consulted when determining proposed land uses within the ultimate tributary area for calculation of the required size of the proposed sewer collection system for areas that have not been developed. In the absence of a proposed and/or up to date Comprehensive Plan for the ultimate tributary area, the design engineer shall use sound professional judgment to establish proposed land uses in order to calculate anticipated flow rates. All planning interpretations and/or predictions shall be subject to the approval of the City. Whenever possible, actual platted land uses shall be used for calculations of ultimate tributary population flow rates. Sewer capacities shall be adequate to handle the anticipated maximum hourly quantities of sewerage and industrial waste together with reasonable consideration given to infiltration/inflow.

A. Sewers shall be designed for the total tributary areas using the following minimum criteria:
Using these criteria all pipes are to be sized flowing full.

1. Interceptors and trunk lines 0.015 CFS/Acre

2. Laterals and sub-mains 0.03 CFS/Acre

3. Lift Station Pumping Rates: The capacity of proposed lift stations or modifications/upgrades to existing lift stations shall be calculated per the MoDNR Design Guide. In the absence of measured and accurate flow or data, the following shall be used, for the land uses indicated, for sizing calculations:

- a. Single Family Residential: 3.7 persons/lot
- b. Multi-Family (Duplex & Townhomes): 3.7 persons/unit
- c. Multi-Family (Apartments, Condos): 3.0 persons/unit
- d. Commercial/Industrial: Unit flow rates shall be established by the design engineer for the proposed facility to be constructed, and shall be approved by the City.

B. The diameter of proposed sewers shall not exceed the diameter of the existing or proposed outlet, whichever is applicable, unless otherwise approved by the Public Works Director. No public sewer shall be less than eight (8) inches in diameter.

C. Stublines for service connections shall not be less than four (4) inches in diameter for residential lots. Tees shall be SDR -26 for SDR-26 pipe. Sewer services shall be Schedule 40 PVC. No split services, (except for R-3 multi-family), or 90° turns are permitted. Service connections on the mains shall have a minimum of five (5) feet of separation and shall be located a minimum of five (5) feet from the exterior wall of a manhole. Service connections shall be provided for every lot and every structure and shall be centered in the lot frontage where feasible. Tracer wire shall be provided for all service connections as per Details in the Standard Drawing Details and shall extend from the sewer main to the building cleanout.

D. Clean outs shall be located not more than 100 feet apart measured from the upstream entrance of the cleanout. See the International Plumbing Code for services 8” in diameter and larger. No clean outs shall be located within public right-of-way.

E. Sanitary sewers shall be constructed of pipe material resistant to or protected from bacterial degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, and industrial wastes or other material which may be transmitted by the collection system.

1. The following types of commercial pipe are approved for gravity sanitary sewer systems constructed in the City. All PVC sewers shall be SDR-26 pipe, regardless of depth of cover. Director of Public Works may require the use of ductile iron pipe in isolated locations. Vitrified Clay sewer pipe is not permitted.

Ductile Iron Pipe ANSI A21.51, AWWA C151, ASTM A536, Grade 60-42-10; thickness Class 50, ASTM A746, Pressure Class 350, with 1.5-2.5 mils of coal tar Paint, MIL-C-18480, or Bituminous Coating per Manufacturer’s Standard unless otherwise required by the Public Works Director. Interior lining shall be a minimum of 40 mils of Tnemec “Perma-Shield PL, Series 431 or equal.

Mechanical joints shall comply with ANSI A21.11 and AWWA C111, except gaskets shall be synthetic rubber. Natural rubber will not be acceptable. Fittings shall comply with ANSI A21.10 and AWWA C110. Polywrap all pipe and fittings in accordance with AWWA C-105 and install per AWWA C-600.

PVC Pipe

ASTM D3034, Type PSM Polyvinyl (Chloride), SDR 26; PVC Material shall conform to ASTM D3034 and shall have a cell classification of 12454-B, as defined in ASTM D1784. 18" or larger diameter pipe shall comply with ASTM F679 and shall have a cell classification of 12364-C or 12454-C. Minimum pipe stiffness (F/Y) at 5ø deflection shall be 46 for all sizes when tested in accordance with ASTM D2412. All joints of PVC pipe and fittings shall conform to ASTM D3212 with elastomeric seals conforming to ASTM F477.

F. All sewers shall be designed to give mean velocities when flowing full of not less than 2.0 feet per second. All velocity and flow calculations shall be based on Manning's formula using an "n" value of 0.013.

G. The velocity of flow in sewers shall not exceed 12 feet per second.

H. Sewers mains shall be laid with uniform slope and straight alignment between manholes. Curvilinear alignment of sewers is not allowed.

I. Steep slope protection. Sanitary sewers on twenty percent (20%) slope or greater shall be anchored securely with concrete slope anchors or equal, spaced as follows:

1. Not over thirty-six feet (36') center-to center on grades twenty percent (20%) and up to thirty-five percent (35%);
2. Not over twenty-four feet (24') center-to center on grades thirty-five percent (35%) and up to fifty percent (50%);
3. Slopes shall not exceed fifty percent (50%).

J. The following shall be minimum slopes for the size indicated.

Sewer Size	Minimum Slope In Feet per 100 feet
8"	0.50
10"	0.39
12"	0.30
15"	0.22
18"	0.18
21"	0.15
24"	0.13

K. Exceptions to these minimum slopes shall be made at the upper end of the sewers serving fewer than thirty houses. Said sewers shall have a minimum slope of 0.76%.

L. Where sewers serve less than ten (10) houses; the minimum slope shall not be less than 1% unless otherwise approved by the Public Works Director.

M. When a sewer joins a larger one, the invert of the new sewer should be set to match 0.8 depths to maintain a continuous energy gradient.

N. In situations where flow is continuous and grit is a problem, and where velocities greater than 10 feet per second are possible, special provisions shall be made to protect against abrasion damage to the pipe. Such protection may be attained utilizing ductile iron pipe.

O. The flow-line angle for manholes shall not be less than 90 degrees.

P. Manholes shall be installed at the end of each line; at all changes in grade, size, or alignment; at all intersections; and at a distance not greater than four hundred (400) feet for sewers fifteen (15) inches or less in diameter and not greater than five hundred (500) feet for larger sewers. Lampholes are not allowed.

Q. The construction of all manholes and castings shall conform to the specifications and details shown in the Construction Specifications and Standard Drawing Details. Where corrosive conditions due to septicity or other causes are anticipated, corrosion protection on the interior of the manholes shall be provided. Corrosive conditions are considered to be present where sewer mains are 12" or larger in size or where discharge is occurring from a force main. Where discharge is from a force main an additional two manholes downstream shall be epoxy lined. The lining shall be an epoxy with a minimum of 90% solids by volume. A concrete admixture of "Con-Shield" or equivalent may be substituted for epoxy lining.

R. The minimum horizontal clear distance within the barrel of standard manholes shall not be less than four (4) feet. Manholes with connecting pipe diameters greater than eighteen (18) inches shall have a minimum inside clear dimension of five (5) feet and manholes with connecting pipe diameters greater than 30 inches shall have a minimum inside clear dimension of six (6) feet.

S. Drop manholes should be avoided as much as possible. However, inside drop pipe shall be provided for a sewer entering a manhole at an elevation of twenty-four (24) inches or more above the manhole invert. The drop pipe shall have the same nominal diameter as that of the incoming sewer. The minimum diameter of an in-side drop type manhole shall be increased to five (5) feet.

T. The minimum drop through manholes shall be 0.2 feet.

U. Where manholes are to be built in close proximity to streets, the top of manhole elevation shall be set within the following limits:

- | | |
|----------------------|---|
| 1. Minimum Elevation | 1/4" per foot rise above top back of curb |
| 2. Maximum Elevation | 1/2" per foot rise above top back of curb |

V. All other sanitary sewer lines shall have the tops of manholes set 2" above final grade.

W. Any variation from the above top of manhole criteria will require a letter of explanation to be submitted with the drawings and be subject to approval by the Public Works Director.

X. Sanitary sewers mains shall be located within public right-of-way unless topography dictates otherwise. A 15' minimum easement width, (unless combined with right-of-way), shall be provided for all sanitary sewer mains outside of public right-of-way and normally shall be centered on the main. Additional width may be required as determined by the Public Works Director. This determination will be based on depth, location or presence of adjacent utilities. The planting of trees in sanitary sewer easements is not permitted. Temporary construction easements shall also be provided as necessary. Sanitary sewer lines shall be constructed on the opposite sides of streets from water lines. Construction of sidewalks longitudinally above sanitary sewers is not permitted. No sanitary sewer main shall be constructed under storm boxes.

Y. A tracer wire shall be provided for all pressure sewers and service laterals per details in Standard Drawing Details. Access boxes (valve boxes) for tracer wire splices not corresponding to structures shall be provided.

Z. Sanitary sewer line with easements shall be extended to provide access from street rights-of-way where possible.

AA. Not less than 48" of cover shall be provided over top of pipe in all areas unless otherwise approved by the Public Works Director.

BB. Open cutting of streets shall be permitted only where approved by the Public Works Director or the local agency responsible for the roadway. At locations where open cutting is not permitted, the crossing shall be made by boring or tunneling. Crossings made by boring or tunneling shall require a casing pipe. All work and materials shall be in conformity with all requirements of the Construction Specifications. The diameter and length of the casing pipe to be used shall be in accordance with details in the Standard Drawing Details.

CC. Cleanouts and lampholes are not permitted on sanitary sewer mains.

DD. Manhole Frames and Lids: Manholes shall not be located in traffic areas.

1. Type A frames and lids shall be provided for non-traffic areas.
2. Type B frame and lid shall be bolt-down type. Type B lids shall be installed in all areas subject to flooding and as required by the Public Works Director.

EE. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply.

1. Horizontal Separation:

- a. All sanitary sewers, storm sewers, or manholes shall be laid at least 10 feet, horizontally, from a water main. The distance shall be measured from edge to edge of pipes. In cases where it is not practical to maintain a ten-foot separation, deviation may be allowed on a case-by-case basis, if supported by data from the design engineer. Such a deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of

the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer. A request for variance shall be submitted to the MoDNR Public Drinking Water Branch and the Public Works Director for approval. This request shall include proposed alternate installation configuration.

2. Vertical Separation:

a. Water mains crossing sanitary sewers, house sewers, or storm sewers shall be constructed to provide a minimum clear distance of 18 inches between the outside of the water main and the outside of the sewer. This clearance is required whether the water main is above or below sewer pipes. The designer shall make every effort to install proposed water lines at sanitary sewer crossing above the sanitary sewer pipe, whenever practical. At crossings, the full length of water pipe shall be located so that both joints will be as far from the sewer as possible but in no case less than 10 feet. Special structural support for the upper pipe may be required. In areas where the proper separation cannot be maintained as stipulated above, either the water main or sewer line must be constructed of mechanical joint pipe or cased in a continuous casing.

FF. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. Precautions against freezing, such as insulation and increased slope, shall be provided. Expansion jointing shall be provided between above-ground and below-ground sewers. Where buried sewers change to aerial sewers, special construction techniques shall be used to minimize frost heaving. For aerial stream crossings, the impact of flood waters and debris shall be considered. The bottom of the pipe shall be placed no lower than the elevation of the fifty-year flood. Only ductile-iron pipe with restrained joints shall be used. Otherwise, they shall be constructed so that they will remain watertight and free from changes in alignment of grade.

GG. Appropriate sewer mains and easements shall be extended to the property line for potential future extension. Manholes shall be placed at the ends of these dead end lines with an invert formed for future connection. There shall also be a formed opening, gasket, 5' pipe stub and a pipe plug placed at the manhole invert for future connection.

HH. Where a sewer must be constructed on fill, a profile of the original undisturbed ground line along sewer centerline shall be shown. All sewers to be constructed on fill shall be a special design approved by the Public Works Director. Compacted fill shall be placed a minimum of 24" above top of pipe prior to construction of sanitary sewer piping. Compaction shall meet 95% maximum dry density in accordance with ASTM D698.

II. Sewer systems shall be designed to minimize the number of stream crossings. Sewer crossings shall be designed to cross a stream as nearly perpendicular as possible and shall be free from change in grade. All structures, such as manholes and etc. shall be located so they do not interfere with the free discharge of flood flows of the stream. Sewers entering or crossing streams shall be constructed of ductile-iron pipe with mechanical joints; otherwise, they shall be constructed so they will remain watertight and free from changes in alignment or grade. Material used to backfill the trench shall be stone, coarse aggregate, washed gravel, or other materials which will not readily erode, cause siltation, damage pipe during placement, or corrode the pipe. The design engineer shall include in the project specifications the method(s) to be employed in the construction of sewers in or near streams. Such methods shall provide adequate control of siltation and erosion by limiting unnecessary excavation, disturbing or uprooting trees and vegetation, dumping of soil or debris, or pumping silt-laden water into the stream.

Section 3.3 Lift Stations

3.3.1. In the design of sanitary sewer systems, it is the policy of the City that lift stations will not be acceptable when gravity flow is reasonably available, or when overflows of raw sewage would flow into spring recharge areas, public water supplies, sinkholes and streams, except where the developer provides additional design and construction features sufficient to overcome environmental concerns to the satisfaction of the City. Advance coordination with the Public Work Director is required prior to proceeding with any lift station plans. Design details, criteria and capacities for any sanitary sewer lift station shall be determined during that coordination. Individual lift stations and locations would require site-specific conditions and or equipment to ensure proper construction, performance and operation.

3.3.2. Developers or property owners who desire to utilize a lift station and force main for the development of property within the city limits of Rogersville, shall submit to the City of Rogersville, through the normal processes of subdivision plat or development plan approval, a plan for the lift station and force main. This plan shall include the following:

A. A certification by an engineer registered in the state of Missouri that a gravity flow connection to the sewer system is not reasonably available to service the subject property, with the reasons that gravity flow is unavailable stated with particularity and to include calculation of costs for installation of gravity flow sewer for the proposed development, prepared by the developer's engineer.

B. A certification by an engineer registered in the state of Missouri that the lift station, as proposed, is sufficient to perform the desired functions for the entire proposed development and that the force main and wetwell are sufficient to service the entire drainage area.

C. A certification by an engineer registered in the state of Missouri what the costs of construction of the proposed lift station and force main will be.

3.3.3. Upon review of the developer's plan and recommendation of the Public Works Director, the City of Rogersville shall make a determination if the lift station and force main may be utilized for the development.

3.3.4. A request by a developer or property owner to connect a new development to a sewer system served by an existing lift station will be reviewed on a case-by-case basis by the City of Rogersville. The request will be accompanied by a certification with sufficient justifying calculations by an engineer registered in the State of Missouri that the existing lift station and force main are sufficient in capacity to serve the properties proposed to hook onto the existing lift station and force main. In the case where an existing lift station is found to have insufficient capacity for a proposed development, the Developer may propose potential upgrade to the existing lift station and force main to provide sufficient capacity. The Developer's engineer shall provide calculations and plans for the proposed improvements. All proposals, calculations, and plans are subject to approval by the Public Works Director. The City may reject existing lift station upgrades that are not part of the City of Rogersville Sewer Master Plan.

3.3.5 Developers or property owners who have received approval from the City of Rogersville to utilize a lift station and force main shall be responsible for complying with all applicable requirements of the City of Rogersville and as follows:

3.3.5.1 General: A sewage pumping station shall consist of a wet well with sewage pumps, valve vault, control system, electrical system (normal and emergency) and site development.

3.3.5.2 Flooding: Sewage pumping stations shall be protected from flooding due to stormwater runoff. Structures and electrical and mechanical equipment shall be protected from physical damage by the 100-year frequency flood and remain fully operations and accessible during the 25-year frequency flood.

3.3.5.3 Fencing: A fence surrounding the pump station site shall be provided. The fence shall be six (6) feet high with three strands of barb-wire around top of fence. The fence shall be provided with a twelve (12) foot wide, double leaf gate. The fence shall be located to provide ten (10) feet clearance between all pumping station components and the fence perimeter. Fencing shall be galvanized chain link. The gate shall be located so that entranceway does not go over manholes. The pump station and emergency generator unit shall be easily accessible for maintenance from entranceway. The gate shall be set back at least twenty-five (25) feet from edge of public street.

3.3.5.4 Surfacing: The area inside the fence must be constructed with 6-inches of 3/4" to 1" crushed limestone aggregate on a medium weight, non-woven geotextile, permeable vegetation barrier placed over the entire enclosed area and extending 2 feet beyond fencing. Subgrade shall be graded to provide positive drainage away from structures. Maintain finished grade/surfacing a minimum of 6' below face of exposed concrete at locations around the perimeter of all structures. Slope subgrade and surfacing for adequate drainage.

3.3.5.5 Access to Pumping Station: Pump station shall be provided with an asphalt or concrete access road. Road shall be a minimum of 12 feet in width and extend from the pump station gate to the adjacent street pavement. Access road shall be constructed with a minimum of 4" thick base rock, 7" minimum thickness of black base and 1-1/2" of asphalt surface mix (or concrete equivalent). Access road shall be provided with a turn-around at the pumping station.

3.3.5.6 Exterior Lighting: A weather-proof, pole mounted, exterior LED area lighting fixture with dusk-to-dawn operation shall be provided. The fixture shall be dimmable with the capability to provide an average range of illumination for one (1) footcandle over the entire site for security purposes and fifteen (15) footcandles over the wet well and equipment areas for maintenance purposes.

3.3.5.7 Pump Type: Sewage pumping stations shall be provided with non-clog, solids handling submersible type pumps. Submersible pumps shall be provided with a quick disconnect connection, stainless steel guide rail lifting system and stainless lifting chain for easy removal of each pump. Grinder pumps are not allowed.

At least two pumps of the same rated capacity shall be provided where each pump shall be capable of handling the design peak hourly flow.

Pumps shall be capable of passing spheres of at least three (3) inches in diameter or be a design that includes equivalent protection from clogging. Submersible sewage pumps shall be manufactured by Flygt.

3.3.5.8 Structures: Pumping station wet well and valve vault shall be constructed of either pre-cast or poured-in-place reinforced concrete. Precast section shall conform to ASTM C478 and ASTM C890. Poured-in-place structures shall conform to Section 3300 of the City's Construction Specifications for Public Improvements. All pumping station wet wells shall be designed for buoyancy impact considering the maximum exterior water level at ground surface.

3.3.5.9 Wet Well: Wet wells shall be sized in accordance with requirements for Missouri Department of Natural Resources with the exception of a minimum size wet well diameter of 96 inches. Wet well floor shall be provided with concrete fillets to prevent sedimentation. Water levels during pumping cycles must be great enough to suppress surface vortices yet low enough at intervals to increase velocity and turbulence.

Wet well shall be provided with passive ventilation consisting of a 4-inch stainless-steel or aluminum vent pipe extending at least 18-inches above top of wet well with a return bend and stainless-steel insect screen.

Wet well access hatch cover and frame shall be aluminum construction and sized by the pump manufacturer to provide adequate clearance for removal of pumps, motors and other equipment. Access cover frames shall be extruded aluminum angle frame with concrete anchors around the perimeter. Covers shall be suitable for a live load of 300 pound per square foot and be provided with stainless-steel accessories. Covers shall be double leaf type, reinforced diamond pattern checkered plate, spring loaded to minimize opening effort, provided with automatic latching mechanism to prevent hatch from closing unintentionally. Structural shapes and plates shall have a minimum thickness of ¼ inch. Hatch cover shall be set in concrete top. All aluminum surfaces to be in contact with concrete shall be given a heavy coat of coal tar paint.

Hatch covers shall be provided with a hinged safety grate system. Grate shall be aluminum construction, designed to support a minimum live load of 300 pounds per square foot. Grate openings shall be 4-inches by 6-inches to allow for visual inspection and limited accessibility for maintenance purposes when the grate is closed. Grate shall open to 90° and automatically lock with an aluminum or stainless-steel hold open release handle. All hardware shall be stainless-steel. Grate shall have an OSHA safety yellow finish.

3.3.5.10 Valve Vault: A suitable valve vault shall be provided, separate from the wet well, to house a plug valve and check valve from the discharge of each pump. Check valve shall be located between the plug valve and pump. Valves shall be placed in the horizontal pipe runs. Dismantling joint fittings shall be provided adjacent to valves to facilitate installation or removal of valves. Each pump discharge line shall be provided with a minimum 4-1/2" diameter oil-filled pressure gauge with shut-off valve.

Valve vault shall be constructed of concrete and be provided with an aluminum access hatch cover of similar design and manufacture of the hatch cover provided for the wet well. Access hatch cover shall be of single leaf and be a minimum of 30 inches x 30 inches.

Valve vault shall be provided with a drain connecting to the wet well. A shut off valve shall be provided in the drain between the vault and wet well. Shut off valve shall be provided with a valve box and extension stem.

An emergency pump connection shall be provided in the valve vault that consists of a check valve, plug valve and quick coupling cam connection.

Section 3.4 Force Mains

3.4.1. At design average flow, a cleansing velocity of at least three (3) feet per second shall be maintained.

3.4.2. The force main pipe and fittings shall be designed to withstand normal pressure and pressure surges. Force main pipe shall be designed and so constructed to provide a minimum cover of forty-two (42) inches and a maximum cover of sixty (60) inches over the top of the pipe. Justification shall be provided where additional depth is required. Concrete thrust blocking shall be provided at all bends 11-1/4 degrees or greater. Force mains designed to cross public streets shall be encased with steel casing of adequate size to allow for future removal of the force main pipe.

3.4.3. Include on the plans that testing of the force main shall be in accordance with the requirements of AWWA C-600. Testing pressure shall be: Total Design Head x 0.433 x 1.5

3.4.4. Forcemains shall be laid on a positive grade to prevent the need for an air release valve. Where a high point is unavoidable, the Public Works Director may allow the installation of an air release valve. In those rare cases, an ARI S-025 automatic air release/vacuum relief combination valve shall be installed. The air release valve shall be equipped with shutoff valve, blowoff valve and backflushing attachments. A standard four-foot diameter shallow manhole with standard frame and cover shall be installed around the forcemain relief valve for maintenance access to valve. The cover shall be labeled "Sanitary Sewer". See details in the Standard Drawing Details.

3.4.5. Provide tracer wire at force mains as per details in Standard Drawing Details. Use access boxes (valve boxes) for tracer wire splices when an air release valve is not available.

3.4.6. All force main piping shall be AWWA C900, with minimum pressure class 235 and thickness class DR 18.

Section 3.5 Grease, Oil and Sand Interceptors

3.5.1. General Provisions. Grease, oil, and sand interceptors shall be provided at the developer's or user's expense when the Public Works Director determines that they are necessary for the proper handling of wastewater containing grease or any flammable wastes, sand, and other harmful ingredients, except that such interceptors shall not be required for private living quarters or dwelling units. All interceptors shall be of a type and capacity approved by the Public Works Director and shall be so located as to be readily accessible for cleaning and inspection. Grease and oil interceptors shall be constructed of impervious materials capable of withstanding abrupt and extreme changes in temperature. They shall be of substantial construction, watertight, and equipped with easily removable covers which when butted in place shall be gas tight and water tight. When installed, all grease, oil and sand interceptors shall be maintained by the user, at his/her expense, in continuously efficient operation.

3.5.2. Grease Interceptor Standards

A. Grease interceptors shall be provided on kitchen drain lines from institutions, hotels, restaurants, school lunch rooms, nursing homes and facilities, and other establishments from which significant amounts of grease may be discharged to the public sewer collection and treatment system.

B. Grease interceptors should be located on the exterior of the facility but as close to the fixtures being served as possible and should receive only the waste streams from grease-producing fixtures. Sanitary waste streams, garbage grinder waste streams and other waste streams which do not include grease should be excluded from passing through the grease interceptors. This separation is mandatory for new construction or replacement facilities. Grease interceptors must be cleaned on a regular basis and must be readily accessible for this purpose.

C. Sizing of grease interceptors is based on wastewater flow and can be calculated from the number and kind of sinks and fixtures discharging to the interceptor. The following two (2) equations shall be used to determine the capacity of grease interceptors for restaurants and other types of commercial facilities: (Water use data and the number of meals served at similar facilities may be used to determine the gallons of wastewater per meal.) Grease interceptors should not be less than 1,000 gallons' capacity without submittal of proper justification based on formulas below and with approval by the Director of Public Works.

1. Restaurants

$D \times GI \times Sc \times (Hr/2) =$ Size of grease interceptor in gallons, where:
D = Number of seats in dining area;
GI = Gallons of wastewater per meal, normally 5 gallons;
Sc = Storage capacity factor, minimum of 1.7;
Hr = Number of hours open; and

2. Hospitals, nursing homes, other type commercial kitchens with varied seating capacity.

$M \times GI \times Sc \times 2.5 \times Lf =$ Size of grease interceptor in gallons, where:
M = Meals per day;
GI = Gallons of wastewater per meal, normally 4.5;
Sc = Storage capacity factor, minimum of 1.7; and
Lf= Loading factor,
1.25 garbage disposal and dishwashing

D. Grease interceptors shall be provided with a manhole or opening of sufficient size to permit inspection and cleaning. When the grease interceptor is located below ground, the access opening shall be extended to grade. The opening shall be fitted with a tight fitting cover which will prevent the entrance of insects and vermin. Sampling manholes shall be provided at the outlet of all grease interceptors as per details in the Standard Drawing Details.

E. The grease interceptor should be constructed of materials similar to septic tanks and be properly baffled on both the inlet and outlet.

F. Grease interceptors shall not discharge prohibited substances as defined in the City of Rogersville Sewer Use and Sewer Rate Ordinance in any single event as determined by a grab sample.

G. The City shall have the right to inspect facilities from time to time, during regular business hours, to determine if the facility is in compliance with this provision. The City shall have the right to require regular sampling, to be conducted at the Owner's expense, should the City deem sampling activities necessary for compliance by the subject industry.

3.5.3. Variances to Grease Interceptor Requirement. Under certain conditions, as indicated in this Subsection, a variance from the requirement of a grease interceptor of 1,000 gallon or more may be given after following the procedure set out for obtaining a variance.

A. Variance may be granted to a temporary food preparation and clean-up facility when:

1. Food preparation and clean-up will be limited to a specific event or time, and
2. It can be shown that only minor levels or incidental quantities of fats, oils and grease would be released into the sewer collection system.

ARTICLE IV
WATER SYSTEMS

Section 4.1 General Requirements

4.1.1. All development shall be provided with an approved system for water service in accordance with this Article and subsequent sections of this Design Standards.

4.1.2. All water wells, well houses, water storage tanks, water pumping facilities and related systems shall be designed and constructed in accordance with the latest edition of the MoDNR's "Minimum Design Standards for Missouri Community Water Systems".

4.1.3. At a minimum, all water main extensions and appurtenances shall be designed and constructed in accordance with the City of Rogersville's Design Standards for Public Improvements, Construction Specifications for Public Improvements, Standard Details and the most current regulation of the MoDNR's rules, regulations, and Statutes of the State of Missouri.

4.1.4. All water improvements plans, including an engineering report, shall be submitted to the Building Inspector for review and approval by the Public Works Director and/or a representative designated by the City. The Developer/Applicant shall pay for costs associated with the required review and approval of submitted plans.

4.1.5. Any review by the City, or approval of construction shall not relieve the developer or the developer's engineer from complying with all rules, regulations, ordinances, laws or statutes that are in effect at the time of design or construction.

Section 4.2 Design Guidelines

4.2.1. In addition to the rules, regulations and state statutes specified in Section 4.1.3, the City will require conformance with the following design guidelines and with the Constructions Specifications and Standard Drawing Details.

- A. All public water lines shall be designed to deliver a minimum of one thousand (1,000) gallons per minute for fire fighting. Multi-family dwellings, building of three (3) or more stories and structure larger than ten thousand (10,000) square feet in size shall have the waterline serving them designed to deliver a minimum of two thousand (2,000) gallons per minute for fire fighting. Nothing in these water requirements is intended to prevent the Fire Department from requiring greater fire protection measures.
- B. No public water line shall be constructed less than eight (8) inches in diameter.
- C. Water mains shall be extended to the property line for future extension. A gate valve the same size as the extended main shall be placed at the end of the line with a fire hydrant assembly and plug.
- D. Construction of sidewalks above water mains shall not be permitted, except for main crossings.

- E. All water mains shall have a minimum cover of forty-two (42) inches and a maximum cover of sixty (60) inches. Justification shall be provided where additional depth is required.
- F. Open cutting of streets shall be allowed only where permitted by the Public Works Director or the local agency responsible for the roadway. At locations where open cutting is not permitted, the crossing shall be made by boring. Crossings made by boring shall require a casing pipe. All work and materials shall be in conformity with all requirements of the Construction Specifications. The diameter and length of the casing pipe to be used shall be in accordance with details in the Standard Drawing Details.
- G. The design of all water systems shall provide for a complete loop-type water distribution system adequate to service the area with a service connection and meter setter for each lot. City of Rogersville will provide the flow meter.
- H. Water pressures in distribution systems below 20 PSIG are a violation of Missouri Safe Drinking Water Regulation 10 CSR 60-4.080 (9). All water mains shall be sized in accordance with a hydraulic analysis based on flow demands and pressure requirements. Distribution systems shall be designed to maintain at least 35 PSIG normal working pressure at ground level at all points in the distribution system under all conditions of design flow not including fire flow.
- I. Proposed water mains shall be located within roadway right-of-way and on the opposite side of the roadway from sanitary and storm sewer piping. Where water mains are required away from roadway right-of-way, water line shall be centered in a minimum 15' easement. Additional width may be required as determined by the Public Works Director. This determination will be based on depth, location or presence of adjacent utilities. Planting of trees within water main easements is not permitted. Temporary construction easements shall also be provided as necessary. Construction of sidewalks longitudinally above water mains is not permitted. No water main shall be constructed under storm boxes. Street grades and elevations of proposed main shall be taken into consideration so that once constructed they will not require regrading or relocation. In areas where grading activities will take place, the water main shall not be installed until final grade has been achieved in the location of the proposed water main. The City shall not be responsible for required relocating or lowering of installed water lines due to insufficient pre-construction grading activities. See details for utilities in the Standard Drawing Details.
- J. A tracer wire shall be provided for all water mains and services per details in Standard Drawing Details. Access boxes for tracer wire splices not corresponding to a valve or other structure shall be provided.
- K. At the termination of all water mains or at locations as specified by the Public Works Director, a fire hydrant, gate valve and plug in accordance with the Construction Specifications shall be provided to allow for future water main extensions.
- L. Fire hydrants shall be provided at intersections, at a minimum of five hundred (500) feet spacings or as required by the Fire Department.
- M. Reaction blocking of adequate size shall be provided at all tees, elbows and bends to resist all resultant thrusts due to hydraulic transient pressures. Horizontal and vertical alignment shall be achieved by appropriate elbows and bends with adequate blocking. Alignment by deflection will not be permitted. All blocking shall conform to the Construction Specifications for Public Improvements and Standard Drawing Details.

N. Ductile iron pipes or PVC shall be used for all water mains constructed in the City.

1. The ductile iron pipe shall conform to ANSI A21.51, AWWA C151, ASTM A536 and Grade 60-42-10. The minimum nominal thickness class for 8" and larger ductile iron pipe shall be Class 50 unless otherwise designated by the Public Works Director.

2. Ductile-iron pipe joints, unless otherwise specified, shall be of the push-on type conforming to ANSI A21.11/AWWA C111, except gaskets shall be synthetic rubber. Natural rubber will not be acceptable. The pipe shall be cement mortar lined, conforming to ANSI A21.4/AWWA C104 and shall be coated inside and out with a bituminous coating.

3. All fittings used on PVC pipe shall be ductile iron. Ductile-iron fittings shall be complete with all accessories and shall be ASTM A536, Grade 70-50-05, conforming to ANSI A21.10/AWWA C110, 350 PSI pressure rating. Joints shall be of the standard mechanical joint type conforming to ANSI A21.10/AWWA C111. All fittings shall be cement mortar lined conforming to ANSI A21.4/AWWA C104 and shall have an exterior bituminous coating.

4. PVC pressure pipe shall be designed to carry potable water at pressures (including surge) up to the maximum class rating. Materials from which the pipe is manufactured shall conform to the latest edition of AWWA C900, pressure class 235 psi with a DR 18.

5. All PVC pipe shall conform to the latest revisions of ASTM D 2241, Department of Commerce PS22-70 (SDR-PR) pressure rated pipe, and National Sanitation Foundation Testing Laboratories (NSF). Pipe ends shall be tapered to accept gasketed coupling. Flexible elastomeric gaskets, meeting the requirements of ASTM F477, shall be synthetic rubber. Natural rubber will not be acceptable.

6. All fittings, and valves shall be ductile iron with mechanical joints. Pipes, fittings, and appurtenances containing more than 0.25 percent lead calculated by weighted average shall not be permitted. Used pipes, fittings, and appurtenances shall not be permitted. Packing and jointing materials used in the pipe joints shall conform to the latest edition of the AWWA standards.

7. Water lines shall not be located in areas that are contaminated with organic chemicals, permeation of organic chemicals.

O. Fire hydrants shall conform to AWWA C502, and shall be either Mueller "Centurion Model A423" or Clow "Medallion Model F2545".

1. Hydrants shall be traffic models with breakaway flanges and shall have one 4-1/2 inch pumper nozzle, two 2-1/2 inch nozzles and 5-1/4" main valve. All hydrants shall be furnished with auxiliary gates valves.

2. Hydrants should be placed at or near each street intersection and at intermediate points when block lengths become long. Hydrants shall be provided within 50' of any lift station, but not within the fenced area. Under no circumstances shall the spacing of fire hydrants exceed five hundred (500) feet in residential areas nor three hundred (300) feet in commercial areas, (measured in street driving distance).

3. Fire Hydrant installations shall conform to the Standard Drawing Details and Construction Specifications for Public Improvements. As a rule, hydrants shall be oriented with the pumper outlet perpendicular to the curb which faces the street. Hydrants shall be protected if subject to mechanical damage. The means of protection shall be arranged in a manner that will not interfere with the connection to, or operation of, hydrants. In poor load-bearing soil, special construction such as support collars may be required.

P. Proposed projects shall include supportive documentation that shows water lines can be adequately flushed while maintaining the minimum required pressures. Provide a hydraulic analysis that evaluates the proposed extension at average design flows and peak flows, including flushing requirements. This analysis needs to include existing lines back to the nearest storage tank or booster pump station. Flushing devices and valves shall be provided to allow every main in the distribution system to be flushed. Flushing devices should be sized to provide flows that will give a velocity of at least 2.5 ft./sec in the water main being flushed. In order to provide increased reliability of service and reduce head loss, dead ends shall be minimized by making appropriate tie-ins whenever practical. Where dead end mains occur, they shall be provided with an approved flushing device. No flushing device shall be directly connected to any sewer. Long runs of transmission mains shall have flushing devices appropriately located so that flushing velocities can be reached and contaminant removal can be achieved with minimal customer impact. Flushing devices shall be sized to provide a maximum flow that does not drop system pressures below 20 PSIG. Throttling valves shall be set on the leads to flushing devices to set the maximum flow of the device so that it will not drop system pressures below 20 PSIG. Flushing devices should be installed at low points of the water main installation, depending on flow rate and pipe profile, where sediment may accumulate.

Q. Sufficient isolation valves shall be provided on water mains to allow a system to be adequately flushed and so that inconvenience and sanitary hazards to customers will be minimized during repairs. The following requirements shall be met when designing system valves. The weight of the valve shall not be carried by the pipe. Valves shall be provided with proper support, such as crushed stone, concrete pads or a well compacted trench bottom. Where new water mains connect to an existing main, a valve shall be installed on the new line. As a rule of thumb, no more than four valves should require closing to isolate a pipe. At a reducer, a valve should be placed in the smaller pipe within 20 feet of the reducer. In municipalities, valves should be located at not more than 300-foot intervals in commercial areas and at not more than one block or 500-foot intervals in residential or other areas.

R. Gate valves shall be of the resilient-seated configuration, non-rising stem and shall conform to the applicable requirements of AWWA C515 and be provided with mechanical joint ends.

1. Acceptable manufacturers are Clow "Model 2638" or Mueller "Model A-2361".

2. Gate valves shall be used in all water mains.

3. Where two lines intersect, a valve should be placed in each pipe on each side of the intersection. Where two water lines intersect, and the use of a tee or cross is required, a gate valve shall be installed on each leg and/or branch of the water line at the intersection. The valves shall be installed adjacent to the tee or cross with Foster Adaptors; however, valves shall not be located within the limits of the street pavement.

4. Extension stems shall be provided for buried valves when the operating nut is more than three feet below finished grade. Each extension stem for a buried valve shall extend to within three

feet of the ground surface, shall be provided with spacers which will center the stem in the valve box, and shall be equipped with a wrench nut.

S. At high points in water mains where air can accumulate, provisions shall be made to remove the air by means of manually operated hydrants or air relief valves. Automatic air relief valves shall not be used. The discharge pipe from a manually operated valve shall be capped with a threaded removable cap or plug and should be extended to the top of the pit. Chambers, pits, or manholes containing valves, blow offs, meters, or other such appurtenances to a distribution system, shall not be connected directly to any storm drain or sanitary sewer, nor shall blow offs or air relief valves be connected directly to any sewer. Such chambers or pits shall be drained to the surface of the ground or provided with sump.

T. Connections to existing piping shall be made with cutting-in fitting and a mechanical joint tee.

U. Tapping sleeves and valves shall be used only where permitted by the Public Works Director.

1. The tapping valves shall be 200 psi, resilient-seated, cast iron body, nonrising stem gate valves conforming to all applicable requirements of AWWA C515. Each tapping valve shall be provided with a flanged inlet end designed, faced and drilled for connection to the outlet end of the tapping sleeve. The outlet end of the tapping valve shall be provided with a tapping flange for attachment of a standard drilling machine and also with a mechanical joint-type bell end for connection of the branch main.

2. Tapping sleeves shall be of the flanged-outlet type designed for attachment to the flanged inlet end of the tapping valve, shall be provided with mechanical joint ends at each end of the run and shall be Mueller "No. H-615" for ductile iron pipe or approved equal.

3. Connections to existing water mains shall be made in such a manner as to provide the least amount of interruption to water service. In the event closing of valves to make a connection will affect a customer who cannot be without service, provision shall be made on the plans for a temporary service at the expense of the developer/applicant.

V. There shall be no physical connection between a public or private potable water supply system and a sewer, or appurtenance thereto, which would permit the passage of any wastewater or polluted water into the potable water supply. No water main shall be located closer than 25 feet to any wastewater disposal facility, agricultural waste disposal facility, or landfill. Water mains shall be separated by a minimum of 25 feet from septic tanks and wastewater disposal areas such as cesspools, subsurface disposal fields, pit privies, land application fields, and seepage.

1. Horizontal Separation:

- a. All sanitary sewers, storm sewers, or manholes shall be laid at least 10 feet, horizontally, from a water main. The distance shall be measured from edge to edge of pipes. In cases where it is not practical to maintain a ten-foot separation, deviation may be allowed on a case-by-case basis, if supported by data from the design engineer. Such a deviation may allow installation of the sewer closer to a water main, provided that the water main is in a separate trench or on an undisturbed earth shelf located on one side of the sewer and at an elevation so the bottom of the water main is at least 18" above the top of the sewer. A request for variance shall be submitted to the MoDNR Public Drinking Water Branch for approval. This request shall include proposed alternate installation configuration.

2. Vertical Separation:

- a. Water mains crossing sanitary sewers, house sewers, or storm sewers shall be constructed to provide a minimum clear distance of 18 inches between the outside of the water main and the outside of the sewer. This clearance is required whether the water main is above or below sewer pipes. The designer shall make every effort to install proposed water lines at sanitary sewer crossing above the sanitary sewer pipe, whenever practical. At crossings, the full length of water pipe shall be located so that both joints will be as far from the sewer as possible but in no case less than 10 feet. Special structural support for the upper pipe may be required. In areas where the proper separation cannot be maintained as stipulated above, either the water main or sewer line must be constructed of mechanical joint pipe or cased in a continuous casing.

W. Surface water crossings present special problems, whether over or under water. Special detail drawings shall be submitted that are scaled and dimensioned to show the approximate bottom of the stream, the approximate elevation of the low and high-water levels, and other topographic features. Mechanical, restrained, or fusion welded joint pipe shall be required in waterways and wet weather streams.

1. Above water crossings

- a. The pipe shall be adequately supported and anchored, protected from damage and freezing and accessible for repair or replacement.

2. Underwater crossings

- a. Flowing streams and water body crossings five hundred feet or less in length shall have a minimum cover of four feet over the pipe. When crossing water courses greater than 15 feet in width, the following shall be provided:
 - (1). The pipe shall be of special construction, having flexible watertight joints. Steel or ductile iron ball-joint river pipe shall be used for open cut crossings. Mechanical or restrained joint or fusion welded pipe may be used for open cut crossings, provided it is encased in a welded steel casing. Mechanical or restrained joint or fusion weld pipe shall be used for bored crossings.
 - (2). Adequate support and anchorage shall be provided on both sides of the stream.
 - (3). Valves shall be provided at both ends of water crossings so that the section can be isolated for testing or repair; the valves shall be easily accessible and should not be subject to flooding.
 - (4). The valve closest to the supply source shall be in an accessible location and installed in a vault, manhole, or meter pit sized to allow the installation of leak detection equipment.
 - (5). Permanent taps shall be provided on each side of the valve within the manhole, vault, or meter pit to allow insertion of a small meter to determine leakage and for sampling purposes.
 - (6). Bank erosion is a major cause of stream crossing failures, and erosion protection measures such as rip rap have limited success. Stream movement and the history of bank erosion must be considered when choosing the length that the crossing pipe or casing shall extend beyond the upper edge of the stream channel.

The stream crossing pipe or casing shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

(7). Large river crossings require specialized design and shall be considered on a case-by-case basis.

b. For lake, water body, and flood plain crossings greater than 500 feet in length, the design shall consider the ability to access and repair or replace the pipe in these crossings. Consideration shall also be given to the ability to continue service to areas served by the crossing in the event of a submerged leak or pipe break.

(1). Submerged portions of pipe crossing proposed lakes shall not be buried when the submerged pipe is greater than 500 feet in length except for the transition from water to land.

(2). Steel or ductile iron ball-joint river pipe or fusion welded pipe shall be used under water during normal flow conditions. Mechanical, restrained joint, or fusion welded pipe shall be used in flood plains.

(3). Underwater installations shall be tested for leaks prior to installation.

(4). Valves above the high water level shall be provided at both ends of water crossings so that the section can be isolated for testing or repair.

(5). The valve closest to the supply source shall be in an accessible location and installed in a vault, manhole, or meter pit sized to allow the installation of leak detection equipment.

(6). Permanent taps shall be provided on each side of the valve within the manhole, vault, or meter pit to allow insertion of a small meter to determine leakage and for sampling purposes.

c. Intermittent flowing streams

(1). Restrained joint or thermal welded pipe shall be used for all stream crossings.

(2). The pipe shall extend at least 15 feet beyond the upper edge of the stream channel on each side of the stream.

(3). Adequate support and anchorage shall be provided on both sides of the waterway.

X. An approved backflow prevention device shall be installed on each service line to a consumer's water system serving premises where, in the judgment of the Public Works Director, actual or potential hazards to the public potable water system exist. Use only double check valve assemblies or reduced pressure principle assemblies included on the current Missouri Department of Natural Resources approved assemblies list. Use on commercial or industrial applications. Backflow preventers and their installation shall conform to Missouri Department of Natural Resources Regulations 10 CSR 60-11.010. Backflow prevention devices for fire lines shall be located in an appropriate vault as close to the water main as is reasonably practical. Backflow prevention devices for domestic water services shall be located on the consumer's side of the water meter. In certain cases, the domestic water service may be supplied from the fire line with the approval of the Director of Public Works. The fire line would remain the responsibility of the property owner. The City of Rogersville Code book, section 705.115 shall be referenced for additional backflow prevention details.

Y. Water services and plumbing shall conform to the applicable local plumbing codes. Pipes and pipe fittings containing more than a weighted average of 0.25 percent lead shall not be used. Solders and flux containing more than 0.2 percent lead shall not be used. Plumbing fittings and fixtures not in compliance with standards established in accordance with 42 U.S.C. 300g-6(e) shall not be used.

Z. A service connection shall be provided for each lot between the water main and the meter setter. The service line shall be a minimum 1-inch diameter, (single setter), 200 PSI, SDR-9 PE 3408, ASTM-D2737, CTS-OD pipe. For new systems, each service connection shall be individually metered. For existing systems, each new service connection shall be individually metered.

AA. Single family units, each unit of a townhome, duplex, triplex and four-plex shall normally be provided with separate water meters for each living unit unless otherwise approved by the City. Multi-family apartment units shall be provided with one water meter for the entire facility. A separate commercial water meter shall be provided for each separate commercial unit unless otherwise approved by the City. Irrigation systems may be provided with separate water meters.

BB. The following requirements shall be met in the design of water loading stations.

1. An appropriate backflow prevention arrangement shall be incorporated in the piping so there is no backflow to the public water supply. A filling device shall be used so the hose does not extend into the water vessel to prevent contaminants being transferred from a hauling vessel to others subsequently using the station. Hoses shall be short enough that they do not contact the ground or any constructed platform. Hanging brackets or rope and pulley hoist is acceptable.

CC. Water meters shall be furnished by the City for installation in developer-installed boxes and setters as part of the lot development building permit issuance.

DD. Existing private wells shall be abandoned in accordance with the requirements of Missouri Department of Natural Resources prior to acceptance of construction of the infrastructure improvements.

ARTICLE V

STORM WATER DESIGN STANDARDS

PART I – GENERAL PROVISIONS

Section 5.1 General Requirements

5.1.1. All development shall be provided with an approved system for stormwater in accordance with this Article and subsequent sections of this Ordinance.

5.1.2. All stormwater system and appurtenances shall be designed and constructed in accordance with the most current regulation of the MoDNR's rules, regulations, and Statutes of the State of Missouri.

5.1.3. All stormwater system plans, including all systems within the City, shall be submitted to the Building Department, for approval.

5.1.4. Any review by the City or its review agency, or approval of construction shall not relieve the developer or the developer's engineer from complying with all rules, regulations, ordinances, laws or statutes that are in effect at the time of design or construction.

5.1.5. In addition to the rules, regulations and state statutes specified in Section 4.1.2, the City will require conformance with the following design guidelines and with the Constructions Specifications.

Section 5.2 Approvals and Permits Required

5.2.1. National Pollutant Discharge Elimination System (NPDES) Storm Water Permit

A. Provisions of the 1987 Clean Water Act require that certain storm water discharges obtain an NPDES storm water permit. In Missouri, these permits are administered by MoDNR.

B. Federal rules for NPDES storm water discharges are contained in 40 CFR Parts 122, 123, and 124 of the Code of Federal Regulations.

C. State NPDES storm water regulations are contained in 10 CSR 20-6.200 of the Code of State Regulations.

D. Additional provisions for NPDES storm water permits for land disturbance activities and information are contained in Part VI of this Article.

E. Copies of any submittals and approvals of the NPDES Storm Water Permit shall be provided to the Building Department.

5.2.2. "404" Permit

- A. For certain activities that involve the discharge of dredged or fill materials into the waters of the United States, a Department of the Army permit may be required as set forth in Section 404 of the Clean Water Act. Rules for 404 permits are contained in 33 CFR Parts 320 through 330 of the Code of Federal Regulations.
- B. The Little Rock District office of the Corps of Engineers generally makes determination of applicability for Section 404 requirements.
- C. A brochure regarding the Corps of Engineers regulatory program may be obtained from the Corps offices.
- D. Copies of any submittals and approvals of the "404" Storm Water Permit shall be provided to the Building Department.

Section 5.3 Missouri One Call

5.3.1. No grading or construction of storm drainage facilities may commence without prior notification of the Missouri One Call utility warning system at 1-800-DIG-RITE, as required by law.

Section 5.4 Ownership and Maintenance

5.4.1. Improvements on Public Road Right-of-Way

A. Storm drainage improvements on public right-of-way shall, upon acceptance of the constructed improvements by the Board of Aldermen, become the property of and shall be maintained by the City.

5.4.2. Improvements on Private Property

A. Storm drainage improvements on private property shall be maintained by the owner of the lot upon which the improvements are located or by the homeowners' association for improvements located in common areas. Maintenance of such improvements shall be identified on the final plat, in the subdivision covenants, and in the homeowner association's bylaws.

B. All such improvements that serve a drainage area of five (5) acres or more shall be located in drainage easements as defined in Article V and the public shall have such rights of access to repair or maintain such facilities.

Section 5.5 Drainage Easements

5.5.1. All areas subject to inundation during a major storm must be included in drainage easements. Specific standards for drainage easements to be provided for storm sewers, open channels, and detention facilities are set forth in Article V.

Section 5.6 Design Guidelines

5.6.1. In addition to the rules, regulations and state statutes specified in Section 5.1.2, the City will require conformance with the following standards, specifications and design guidelines:

PART II - STORM WATER RUNOFF CALCULATIONS

Part II outlines acceptable methods of determining storm water runoff.

Section 5.7 Guidelines

5.7.1. The design storm runoff shall be analyzed using an approved hydrograph method.

Section 5.8 Hydrograph Methods

5.8.1. Methodologies

A. The Corps of Engineers HEC-1 Flood Hydrograph Package and NRCS computer models are the preferred runoff models. Other models may be used with approval from the Building Department.

B. The runoff model must include the entire drainage basin upstream of the proposed development. The model shall be prepared in sufficient detail to ensure that peak runoff rates are reasonably accurate.

C. The runoff model shall be developed for the following cases:

Case 1: Existing conditions in the drainage basin prior to development of the applicant's property.

Case 2: Existing conditions in the drainage basin with developed conditions on the applicant's property.

Case 3: Fully developed conditions in the entire drainage basin.

5.8.2. Rainfall

A. Rainfall estimates shall be determined from the Point Precipitation Frequency Estimates data from NOAA Atlas 14 for the City of Rogersville, Missouri. Source data can be found at:
https://hdsc.nms.noaa.gov/hdsc/pfds/pfds_map_cont.html?bkmrk=mo

B. Rainfall shall be distributed in time using the Huff's Distribution or the Pilgrim-Cordery Distribution adapted to local rainfall data (Reference NOAA Atlas 14 for Rogersville, Missouri) as shown in the following table.

**Pilgrim-Cordery Method
Synthetic Rainfall Mass Curves**

Cumulative Fraction of Storm Duration	Cumulative Fraction of Depth				
	1-Hour	2-Hour	3-Hour	4-Hour	6-Hour
.00	.00	.00	.00	.00	.00
.05	.03	.03	.03	.02	.05
.10	.07	.05	.05	.03	.09
.15	.11	.10	.06	.05	.14
.20	.14	.17	.09	.06	.20
.25	.17	.22	.11	.08	.28
.30	.23	.25	.13	.14	.35
.35	.29	.27	.19	.20	.41
.40	.35	.29	.31	.27	.43
.45	.41	.30	.39	.33	.46
.50	.47	.31	.44	.38	.49
.55	.56	.41	.47	.47	.60
.60	.65	.51	.54	.56	.70
.65	.73	.60	.64	.64	.80
.70	.82	.69	.70	.74	.86
.75	.91	.78	.73	.83	.89
.80	.93	.82	.81	.87	.93
.85	.95	.87	.89	.90	.96
.90	.97	.92	.94	.93	.97
.95	.99	.96	.98	.97	.98
1.00	1.00	1.00	1.00	1.00	1.00

PART III - STORM WATER DRAINAGE STRUCTURES

Section 5.9 Inlets

5.9.1. Inlet Locations

A. Inlets shall be provided at locations and intervals and shall have a minimum inflow capacity such that maximum flooding depths set below are not exceeded for the specified storm; at all sump locations where ponding of water is not desired, and where drainage cannot be released at the ground surface. It is recommended that inlets be provided at street intersections upstream of pedestrian cross-walks.

5.9.2. Inlet Interception Capacities

A. Inlet capacities shall be determined in accordance with the Federal Highway Administration HEC-12 Manual (Reference 5).

B. Nomographs and methods presented in the Neenah Inlet Grate Capacities report (Reference 12) may also be used where applicable.

C. The use of commercial software utilizing the methods of HEC-12 is acceptable. Software used shall be pre-approved by the Building Department.

D. Clogging Factors – Clogging factors are not required to be considered in curb inlet capacities.

5.9.3. Interception and Bypass Flow

A. It is generally not practical for inlets on slopes to intercept 100% of the flow in gutters. Inlets must intercept sufficient flow to comply with street flooding depth requirements. Bypass flows shall be considered at each downstream inlet, until all flow has entered approved storm sewers or drainage ways.

5.9.4. Allowable Street Depths

A. Urban streets are a necessary part of the City of Rogersville drainage system. The design for the collection and conveyance of storm water runoff is based on a reasonable frequency and degree of traffic interference. Depending on the street classification, (i.e.: local, collector, etc.) portions of the street may be inundated during storm events. Drainage of streets is controlled by both minor and major storm events. The minor system is provided to intercept and convey nuisance flow. Flow depths are limited for the major storm to provide for access by emergency vehicles during most flood events.

B. When the depths of flow exceed the criteria presented in this section a storm sewer or open channel system is required.

C. General Design Guidelines

1. Flow from new commercial developments shall not be discharged onto public streets.
2. Allowable Flow Depth for new subdivisions. Flow is permitted with allowable depths of

flow as follows:

- a. Local streets: no crown overtopping for a five (5) year rainfall, maximum of top of curb for a twenty-five (25) year event.
- b. Collector streets: the equivalent of one ten-foot driving lane must remain clear of water for the five (5) year storm, maximum of top of curb for the twenty-five (25) year storm.
- c. Arterials: two ten-foot lanes must remain clear of water, one in each direction for the five (5) year storm, maximum of top of curb for the twenty-five (25) year storm.
- d. For all classifications, for on grade, one-hundred (100) year storms shall be limited to the right-of-way and twenty-five (25) year storms shall be limited to the top of curbs. For in sumps, twenty-five (25) year storms shall be limited to the right-of-way. For one-hundred (100) year storms, the maximum depth shall be 12” at the face of curb for both on grades and in sumps.
- e. Parking Lots & Private Drives: No requirements for five (5) year storms. Depth shall be limited to 18” measured from the top of the grate or from the bottom of a vertical inlet opening for twenty-five (25) year storms.
- f. Where allowable depths are exceeded a storm sewer system must remove the excess water.

3. Cross Flow for new subdivisions. Cross flow at intersections is permitted up to the depths in the following table:

Street Classification	5-Year Storm Allowable Depth	25-Year Storm Allowable Depth
Local	3"	6" at gutter flow line
Collector	3"	6" at gutter flow line
Arterial	No cross flow permitted	No cross flow permitted

D. Hydraulics

1. The allowable storm capacity of each street section with curb and gutter is calculated using the modified Manning's formula for both the 5-year and 25-year storm event (G.O. 021111, 11/11/02).

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

Where: Q = discharge in cubic feet per second
 Z = cross slope of the street in feet per foot
 d = depth of flow at the gutter in feet
 S = longitudinal slope of the street in feet per foot
 n = Manning's roughness coefficient

5.9.5. Types of Inlets Allowed

A. Public Streets

1. Curb Opening Inlets

a. Standard curb opening inlets as shown on details in the Standard Drawing Details shall be used for public streets with curb and gutter.

2. Grated Inlets

a. In general, the use of grated inlets in streets will not be permitted.

b. Where conditions are such that curb inlets cannot intercept the required rate of flow, necessary to control street flooding depth or to provide diversion of flow to detention, sedimentation or infiltration basins, "trench inlets" with vaned grates may be specified with approval of the Public Works Department.

c. Other types of inlets will not be permitted unless approved by the Public Works Department.

B. Outside of Public Right-of-Way

1. The type of inlets specified outside of public right-of-way is left to the discretion of the designer provided the following criteria are met:

a. Maximum flooding depths for the major or minor storm as set forth above are not exceeded.

b. General safety requirements as set forth below are met.

c. All inlets shall be depressed a minimum of two (2) inches below the surrounding grade to allow proper drainage to the inlet and prevent inadvertent ponding in the area around the inlet.

d. Inlets in pavements shall be provided with a concrete apron.

5.9.6. General Safety Requirements

A. All inlets openings shall:

1. Provide for the safety of the public from being swept into the storm drainage system; the maximum allowable opening shall not exceed six (6) inches in height.

2. Be sufficiently small to prevent entry of debris that would clog the storm drainage system;

3. Be sized and oriented to provide for safety of pedestrians, bicyclists, etc.

Section 5.10 Storm Sewers

5.10.1. Design Criteria

A. Design Storm Frequency: The storm sewer system, beginning at the upstream end with inlets, is required when the 5-year peak flow in the street exceeds five (5) cfs or when allowable street depths are exceeded. Allowable street depths are specified above.

B. Construction Materials: Storm sewers under public roadways and where the storm piping trench is within 2'-0" of the back of curb shall be reinforced concrete pipe. The concrete pipe material and appurtenances shall meet one or more of the following standards:

<u>Material</u>	<u>Symbol</u>	<u>Standard</u>
Reinforced concrete round pipe	RCP	ASTM C76, Class III
Reinforced concrete elliptical pipe	RCEP	ASTM C507
Reinforced concrete pipe-arch	RCPA	ASTM C506
Joints for concrete pipe		ASTM C443
Precast concrete flared end sections	FES	ASTM C76
Cast-in-place reinforced concrete box culverts	RCB	MoDOT Specification
Precast concrete box culvert	RCB	ASTM C1433

Detailed information on structural and hydraulic properties of the type of pipe referred to above can be found in the Concrete Pipe Design Manual.

C. Vertical Alignment

1. The recommended minimum slope for storm drain piping is 0.5% (five-tenths percent). Pipe grades may not be less than the minimum friction slope required to convey the design flow, unless specifically approved. Maximum recommended grade is 10% (ten percent). Properly designed anchorage may be required for grades above 10% (ten percent) and will be required for grades above 20% (twenty percent).
2. When changing pipe diameters, the inside tops of the pipes shall be set at the same elevation. Pipe size shall never be reduced downstream even though pipe slope and theoretical capacity may increase. A minimum vertical drop of 0.2' (two-tenths feet) shall always be provided across a junction structure, unless otherwise approved.
3. Under or within two feet (2') of streets or paved areas, the top of the pipe shall be located a minimum of twelve inches (12") below the pavement or curb subgrade, or greater if required to meet minimum cover and strength requirements for the type of pipe specified to withstand an AASHTO HS-20 loading. Outside of paved areas, the top of the pipe shall be located a minimum of twelve inches (12") below finished earth grade. Box culverts or other relatively wide and flat conveyance structures may be required to have additional cover if deemed necessary to support grass or other vegetative cover.
4. Siphons or inverted siphons are not allowed in the storm sewer system.
5. The minimum clearance between storm sewer and sanitary sewer, shall be 18". If the separation distance cannot be achieved, then the sanitary sewer shall be concrete encased for a minimum distance of 10 feet on each side of the storm sewer crossing.

D. Horizontal Alignment:

1. Storm sewer alignment between manholes, junction boxes and curb inlets shall be straight except when approved by the Public Works Department. Curved alignments are not allowed.

2. Storm sewer crossings shall be perpendicular to the street.
3. The permitted locations for storm sewer within a street right-of-way are behind the curb. The outside edge of the pipe shall be located a minimum of 6' behind the back edge of curb. Except for crossings, storm sewers shall not be located under streets.
4. Storm sewers located on private property shall be located within drainage easements and shall be aligned parallel with property lines unless otherwise approved. Where storm drains exit the street right-of-way between residential lots, the pipe shall be extended to within 10' of the rear property line. The outside edge of the pipe shall be located a minimum of five feet (5') from the easement line.

E. Bends and Junctions:

1. A manhole or junction structure must be provided at each change in direction or grade of the piping, except that bends may be located at junction structures in order to provide a perpendicular connection. Bends must be provided at junction structures if the angle of entry is less than sixty (60) degrees. Pipes shall be aligned such that the direction of flow of any incoming pipe is not less than perpendicular to the direction of flow of the outflow pipe (i.e. flow "against the grain" shall be avoided). Manholes or junction structures shall not be located within pavement area on public streets.
2. Access manholes for junction structures shall not be located within the pavement area for public streets. Junction structures shall be located such that the outside edge of the access manhole is twelve inches (12") minimum behind the curb or from the edge of a retaining wall or other obstruction.
3. Access manholes shall be provided at a maximum of five hundred feet (500') spacing along the pipe.
4. Precast circular manholes, square cast-in-place or precast junction boxes, or inlets may be used for junction structures.

F. Clearance from Other Utilities:

1. Horizontal Clearance:

Utility	Minimum distance from outside edge of pipe to outside edge of pipe
Storm sewer	Inside diameter of largest pipe*
Water.....	Ten feet (10') from outside edge of pipes

* or greater, if needed to allow proper placement and alignment of flared end sections

2. Vertical Clearance: A minimum clear distance of eighteen inches (18") from any other utility line shall be maintained above or below the storm drain pipe, unless otherwise approved by the Public Works Department.

G. Pipe Size: The minimum allowable pipe size for storm sewers is dependent upon a diameter practical from the maintenance standpoint. For storm sewers in public right-of-way or public drainage easement less than fifty feet (50') in length, the minimum allowable diameter is fifteen (15) inches. All pipe over fifty feet (50') shall have a minimum diameter of eighteen (18) inches. The maximum allowable diameter is six feet (6') unless otherwise approved.

H. Storm Sewer Capacity and Velocity

1. Storm sewers should be designed to convey the design storm (25-year) flood peaks without surcharging the storm sewer. The sewer may be surcharged during larger floods and under special conditions when approved by the City. However, new public improvements shall be designed to detain the 100-year storm in a detention basin. Therefore, the 100-year storm must be conveyed to the detention basin.

2. The maximum full flow velocity shall be less than fifteen (15) fps. The City may approve higher velocities if the design includes adequate provisions for uplift forces, dynamic impact forces and abrasion. The minimum velocity in a pipe based on full flow shall be 2.5 fps and the minimum slope shall be 0.50% to avoid excessive accumulations of sediment.

3. The energy grade line (EGL) for the design flow shall be no more than six (6) inches below the final grade at manholes, inlets, or other junctions. To insure that this objective is achieved, the hydraulic grade line (HGL) and the energy grade line (EGL) shall be calculated by accounting for pipe friction losses and pipe form losses. Total hydraulic losses will include friction, expansion, contraction, bend, manhole, and junction losses. The methods for estimating these losses are presented in the following sections.

I. Storm Sewer Outlets; All storm sewer outlets into open channels shall be constructed with a headwall and wingwalls or a flared-end-section. Flared end sections and headwalls shall have a toewall extending a minimum of eighteen inches (18") below grade at their downstream end to prevent undercutting. Approved energy dissipation material shall be provided at all outlets.

5.10.2. **Easements**

A. Drainage easements shall be provided for all public drainage flowing across any proposed development that are not located within public rights-of-way. In some cases, additional drainage improvements and easements may be required upstream or downstream of a new development to address potential impacts of the development. The required easement widths are as follows, but shall not be less than 15' width. These requirements are assuming that the storm sewer is centered within the easement. Additional width may be required as determined by the Public Works Department:

1. For pipes forty-two (42) inches or less in diameter or width, the required minimum easement width is fifteen (15) feet.

2. For pipes and boxes greater than forty-two (42) inches in width, the required minimum easement width is fifteen (15) feet plus one half the width of the proposed storm sewer, but shall not be less than 20' width.

3. Storm sewers greater than eight (8) feet in depth to the flow line require additional easement width at a rate of two (2) feet in width for every vertical foot greater than eight (8) feet.

4. All easements required for construction of storm sewers, which are not included on the final plat, shall be recorded and a copy of such recorded easement filed with the City prior to approval of the engineering design plans.

Section 5.11 Design Standards for Culverts

5.11.1. Horizontal Alignment. Culverts shall be positioned to match the alignment of the existing watercourse to the greatest degree practical. Relocating existing stream channels to match the culvert alignment shall be avoided unless specifically approved.

5.11.2. Vertical Alignment. Culverts shall be placed such that the vertical alignment of the invert matches the slope of the existing water course to the greatest extent practical. The recommended minimum slope for culverts is 0.5% (five-tenths percent). Culvert grades may not be less than the minimum friction slope required to convey the design flow, unless specifically approved. Maximum recommended grade is 10% (ten percent). The top of the culvert pipe shall be located a minimum of twelve inches (12") below the pavement or curb subgrade, or greater if required to meet minimum cover and strength requirements to withstand an AASHTO HS-20 loading for the type of pipe specified. A reduction in minimum clearance may be allowed when necessary in order to minimize rock excavation or to provide clearance from existing utilities, with written approval by the Public Works Department. Where necessary to minimize rock excavation, cast-in-place reinforced concrete box culverts may be designed such that the top slab serves as a bridge deck. In these cases, the top slab grade shall be designed to match the vertical alignment of the roadway. Top slab thickness shall be increased by two inches (2") to provide a wearing surface. If asphalt pavement is specified, top of the slab may be located two inches (2") below finished pavement grade to allow for placement of an asphalt wearing surface. Structural design of the culvert shall include allowance for the wearing surface weight.

5.11.3. Bends and Junctions. Changes in direction, grade, size or material are not allowed within the culvert barrel, unless approved in writing by the Public Works Director.

5.11.4. Clearance from Other Utilities. Clearance from other utilities shall be the same as specified for storm sewers.

5.11.5. Allowable Sizes. The minimum allowable inside diameter or least dimension for any culvert is fifteen inches (15").

5.11.6. Construction Materials. Culverts under public and private roads shall be constructed of any of the materials allowed for storm sewers.

5.11.7. Design Capacity. Culverts shall be designed to pass the 25-year storm with one (1) foot of freeboard prior to overtopping the road or driveway.

5.11.8. Headwater. The maximum headwater for the major storm design flow shall be 1.5 times the culvert diameter for round culverts or 1.5 times the culvert rise dimension for shapes other than round.

5.11.9. Inlet and Outlet Requirements. Culverts are to be designed with protection at the inlet and outlet areas as provided in Part VI of these criteria. A cast-in-place concrete headwall or a pre-fabricated flared end section of the same type of material as the culvert pipe shall be provided at the inlet and outlet ends of all culverts. Headwalls or end sections are to be located a sufficient distance from the edge of the shoulder or the

back of walk to allow for a maximum slope of 3H:1V to the back of the structure. Flared end sections and headwalls shall have a toewall extending a minimum of eighteen inches (18") below grade at the downstream end to prevent undercutting. The type of outlet protection required is as follows:

$V < 7 \text{ FPS}$	$7 \text{ FPS} < V < 15 \text{ FPS}$	$V > 15 \text{ FPS}$
Minimum Channel protection	Channel protection or Energy dissipator	Energy Dissipator

5.11.10. **Velocity Limitations.** The maximum allowable discharge velocity is fifteen (15) feet per second.

5.11.11. **Culvert Hydraulics.** It is recommended that the procedures outlined in the publication "Hydraulic Design of Highway Culverts" (Reference 4) be used for the hydraulic design of culverts. Backwater calculations demonstrating the backwater effects of the culvert may be required.

Section 5.12 Design Standards for Bridges

5.12.1. **Structural Design.** All bridges shall be designed to withstand an HS-20 loading in accordance with the design procedures of AASHTO "Standard Specifications for Highway Bridges" (Reference 13). The designer shall also check the construction loads and utilize the most severe loading condition.

5.12.2. **Design Capacity.** Bridges shall be designed to pass the 100-year storm with one (1) foot of freeboard between the water surface elevation and the bridge low chord.

5.12.3. **Backwater.** Backwater is defined as the rise in the water surface due to the constriction created by the bridge approach road fills. The maximum backwater for the 100-year storm design flow shall be one (1) foot.

5.12.4. **Velocity Limitations.** Discharge velocities through bridge openings shall be limited to fifteen (15) feet per second. Abutment and channel scour protection shall be provided at all bridges.

5.12.5. **Bridge Hydraulics.** All bridge hydraulics shall be evaluated using the procedures presented in the publication "Hydraulics of Bridge Waterway" (Reference 14). Backwater calculations demonstrating the effects of the bridge and approach fills compared to the existing flood stages shall be submitted for all bridges.

Section 5.13 Design Standards for Open Channels

5.13.1. General Design Guidelines

A. Natural or Existing Manmade Channels;

1. The stream channel of perennially flowing streams or intermittent streams which are blue lined streams on the United States Department of the Interior Geological Rogersville or Oak Grove Heights Quadrangles shall not be modified or channelized except where unavoidable to construct road crossings or to repair erosion and stabilize the stream channel. A 404 permit or determination is required to place any fill in a blue lined stream to construct a road crossing.
2. Trees and vegetation shall not be removed within twenty-five feet (25') of the stream bank of a blue lined stream. If the stream banks are not defined, then the twenty-five feet (25') shall be taken from the invert of the blue lined stream. Clearing of brush and undergrowth shall be minimal. It is preferred that existing vegetation remain within one hundred feet (100') of the stream bank.

3. Any work within a Federally designated floodplain requires a Floodplain Development Permit. A Conditional Letter of Map Revision (CLOMR) must be obtained for any filling within the floodway. Work within the stream channel may require a Department of the Army "404" permit.

4. Watercourses in which flow is broad and shallow, and which have no defined channel should not be modified or channelized. Removal of trees and vegetation within the watercourse should be avoided as much as practical.

5. The area inundated by the peak flow from the 100-year (1% AEP) storm is considered to be the flooding area for any watercourse, whether or not it is designated on the Flood Insurance Rate Maps. An implicit drainage easement is considered to exist along the area inundated by the peak flow from the 1% AEP (100-year) storm.

6. For the purpose of preliminary planning and design, the approximate limits of the floodplain can be determined using approximate methods.

7. In determining the capacity and depth of flow in watercourses, they shall be analyzed by selecting the most restrictive channel section for each reach and determining the normal depth by analyzing the channel as an irregular section using representative "n" values for each segment of the channel cross-section

8. Where the effects of increased frequency of flow or increased velocity may significantly effect the stability or the stream channel, measures such as grade checks, check dams or bank stabilization may be required.

B. Grass Lined Channels:

1. Grass lined channels are the most desirable of the artificial channels. The channel storage, lower velocities and the greenbelt multiple use benefits obtained create significant advantages over other artificial channels. Unless existing development restricts the availability of right of way, channels lined with grass should be given preference over other artificial types. The minimum slope in a grass-lined channel shall be 1.0% unless a concrete low flow channel is installed. Maximum side slopes shall be 3:1 with 4:1 preferred.

C. Low Flow (Trickle) Channels

1. Trickle channels shall be provided in constructed grass channels (not natural channels) where base flow or perennial flow prevents the establishment or re-establishment of a sod bottom. Types of trickle channels are as follows:

a. Concrete Trickle Channels

(1). Trickle channel capacity shall be approximately five percent (5%) of the design flow rate.

(2). Concrete trickle channels may be unreinforced up to a total width of (5') five feet. For total widths of (5') five feet to (10') ten feet the trickle channel shall be reinforced with a minimum of 6 X 6-10-10 welded wire mesh. For widths greater than (10') ten feet, the Engineer of Record shall design the necessary reinforcement.

- (3). Trickle channel alignment shall be the same as the overall channel alignment. Radii at changes in direction shall be the minimum radius required based upon the channel top width.
- (4). Capacity of grass channels with trickle channels may be determined as a composite cross-section, or the additional capacity of the trickle channel can be ignored.
- (5). Erosion potential at the grass/concrete interface should be checked. Shear stress or tractive force shall be determined and shall be limited to the maximum values set forth below:

Maximum Allowable Shear Stress for Various Lining Types

<u>Lining Type</u>	<u>Maximum Shear Stress</u>
Grass, sod	0.60 psf
Jute fiber net	0.40 psf
Straw erosion control blanket with attached netting	1.45 psf
Excelsior (wood fiber) erosion control blanket with netting	1.55 psf
Synthetic erosion control blanket	2.00 psf

Foregoing values were obtained from Table 9.5 of the ASCE Design Manual
Manufacturer's data shall be submitted for erosion control blankets specified.

b. Other Types of Trickle Channels

- (1). Trickle channels of porous pavers, gravel filled Geoweb, submerged flow wetlands, natural stone and other materials can be specified, and are encouraged to improve aesthetics and water quality. However, assurance must be given that quality control will be maintained during construction and that adequate maintenance will be provided after construction.

D. Composite Channels

1. Many different channel shapes and lining types are possible. Different shapes and lining types can be combined in a composite design. In determining the capacity and depth of flow in composite channels, they shall be analyzed as an irregular section using representative "n" values for each segment of the channel cross-section.

E. Concrete Channels

1. Concrete lined channels are sometimes required where right of way restrictions within existing development prohibit grass-lined channels. The lining must be designed to withstand the various forces and actions that tend to overtop the bank, deteriorate the lining, erode the soil beneath the lining and erode unlined areas. The minimum slope in a concrete lined channel shall be 0.50%.

F. Rock Lined Channels

1. Rock lined channels are constructed from ordinary riprap or wire enclosed riprap (gabions, etc.). The rock lining permits higher design velocity than for grass lined channels. Rock linings will normally be used only for erosion control at culvert/storm sewer outlets, at sharp channel bends, at channel confluences and at locally steepened channel sections.

G. Other Lining Types: The use of fabrics and other synthetic materials for channel linings has increased over the past several years. Proposed improvements of this type will be reviewed on an individual basis for applicability and performance.

5.13.2 **Restrictions.** Open channels shall not be allowed in backyards of residential areas where runoff flow exceeds 10 CFS.

5.13.3. Hydraulics

A. An open channel is a conduit in which water flows with a free surface. The calculations for uniform and gradually varied flow are relatively straight forward and are based upon similar assumptions (e.g. parallel streamlines). The basic equations and computational procedures are presented in this section.

B. Uniform Flow

1. Open channel flow is said to be uniform if the depth of flow is the same at every section of the channel. For a given channel geometry, roughness, discharge and slope, there is only one possible depth, the normal depth. For a channel of uniform cross section, the water surface will be parallel to the channel bottom for uniform flow.

2. The computation of normal depth for uniform flow shall be based upon Manning's formula as follows:

$$Q = (1.49/n)AR^{2/3}S^{1/2}$$

Where

Q	=	Discharge in cubic feet per second (cfs)
n	=	Roughness coefficient (Table I)
A	=	Cross sectional flow area in square feet
R	=	Hydraulic radius, A/P, in feet
P	=	Wetted perimeter in feet
S	=	Slope of the energy grade line (EGL) in feet/foot

For channels with a uniform cross section the EGL slope and the bottom slope are assumed to be the same.

C. Critical Flow

1. The design of earth or rock channels in the critical flow regime (Froude numbers from 0.9 to 1.2) is not permitted. The Froude number is defined as follows:

$$F = V/(gD)^{0.5}$$

Where

F	=	Froude number
V	=	Velocity in feet per second (fps)
g	=	Acceleration of gravity, 32.2 ft/sec ²

- D = Hydraulic depth in feet = A/T
- A = Cross sectional flow area in square feet
- T = Top width of flow area in feet

The Froude number shall be calculated for the design of all open channels.

D. Gradually Varied Flow

1. The most common occurrence of gradually varied flow in storm drainage is the backwater created by culverts, storm sewer inlets or channel constrictions. For these conditions the flow depth will be greater than normal depth in the channel and the water surface profile must be computed using backwater techniques.
2. Backwater computations can be made using the methods presented in Chow (Reference 1). Many computer programs are available for computation of backwater curves. The most widely used program is HecRas, Water Surface Profiles, developed by the U.S. Army Corps of Engineers (Reference 2) and is the program recommended for backwater profile computations. Another program by the Federal Highway Administration is WSPRO and is acceptable for use in backwater computations.

5.13.4. Design Standards

A. Flow Velocity

1. Maximum flow velocities shall not exceed the following:

Channel Type	Maximum Velocity
Grass lined*	5 fps
Concrete	15 fps
Rock Lined	10 fps

* Refer to item F. below

B. Maximum Depth

1. The maximum allowable channel depth of flow is three (3) feet for the design flow.

C. Freeboard requirements

1. Freeboard is defined as the vertical distance between the computed water surface elevation for the design flow and the minimum top of bank elevation for a given cross section.
2. For all channels, one-foot minimum of freeboard is required. Freeboard shall be in addition to super elevation.

D. Curvature

1. The minimum channel centerline radius shall be three (3) times the top width of the design flow.

E. Super Elevation

1. Super elevation shall be calculated for all curves. An approximation of the super elevation h may be calculated from the following formula:

$$h = V^2T/(gr)$$

Where h	=	Super elevation in feet
V	=	Velocity in fps
T	=	Top width of flow area in feet
g	=	Acceleration of gravity, 32.2 ft/sec ²
r	=	radius of curvature in feet

2. Freeboard shall be measured above the super elevated water surface.

F. Grass Channels

1. Side slopes shall be 3 (horizontal) to 1 (vertical) or flatter. Steeper slopes may be used subject to additional erosion protection and approval from the Public Works Director.

2. For design discharges greater than 50 cfs, grade checks shall be provided at a maximum of 200 feet horizontal spacing.

3. Channel drops shall be provided as necessary to control the design velocities within acceptable limits.

4. Vertical drops may be used up to three feet in height. Drops greater than three (3) feet shall be baffled chutes or similar structures.

5.13.5. Easements

A. Easements shall be provided for all open channels constructed in the City that are not located within public rights-of-way. The minimum easement width for open channels is the flow width inundated by a 100-year event plus fifteen (15) feet. Additional width may be required as determined by the Public Works Director.

B. All easements required for construction of open channel drainageways, which are not included on the final plat, shall be recorded and a copy of such recorded easements filed with the City prior to approval of the construction drawings.

PART IV - STORM WATER DETENTION DESIGN

Section 5.14 Purpose

5.14.1. The primary goal of the City's storm water management program is the prevention of flood damage to residential, commercial and public property.

Section 5.15 Methods of Analysis

5.15.1. Detailed analysis will be required for the design of detention facilities including, but not limited to:

- A. In areas where residences or other structures located downstream of a development can be shown to have an imminent flooding hazard.
- B. Residences or other structures will be defined as having an imminent flooding hazard when the lowest point, at which surface runoff may gain entry, is located at or below the estimated flooding level which would result from a storm with an annual probability of one percent (1%) or greater under conditions existing in the basin prior to development of the applicant's property (i.e., affected by the "100-year" storm).
- C. Consideration of downstream flooding problems will be limited to the area which may reasonably be expected to be significantly affected by runoff from the applicant's property.

5.15.2. Alternatives to Detention

- A. Provisions to provide detention may be waived in part or in whole provided one or more of the following are met:
 - 1. Development is to discharge within a Federal Insurance Study defined as 1% AP floodplain
 - 2. Developer provides downstream improvements to meet the tributary area peak discharge requirements to the satisfaction of the City Engineer.
 - 3. Development cannot be fully and/or practically served by surface or underground facilities.
 - 4. It is shown that construction of detention facilities will result in an increase of peak flow in the drainageway.
- B. A "fee in lieu of detention" is not automatic and will be considered on a case-by-case basis. If detention requirements are waived for one of the above reasons, a "fee in lieu of detention" will be considered.
 - 1. If detention requirement is waived for one on the above reasons, a fee in accordance with the following schedule will be applied.

<u>Volume of Detention</u>	<u>Payment Rate</u>
0 – 24,000 c.f.	\$1.50 per c.f.
24,001 c.f. – 100,000 c.f.	\$0.75 per c.f.

Greater than 100,000 c.f. \$0.50 per c.f.

2. The fee may be offset by the construction of downstream improvements. The downstream improvements must be approved by the City. Cost of the downstream improvements will be determined by the City Engineer.

C. For the following development, detention is not required:

1. Additions to, improvements, and repair of existing single-family and duplex dwellings.
2. Construction of any buildings, structures, and/or appurtenant service roads, drives and walks on a site having previously provided stormwater control as part of a larger unit of development.
3. Additions, remodeling, repair replacement and improvements to any existing structure or facility and appurtenances that does not cause an increased area of impervious surface on the site in excess of 1,000 square feet of that previously existing.

5.15.3 Innovation in Design

- A. It is the desire of the City that detention facilities be designed and constructed in a manner to enhance aesthetic and environmental quality of the City as much as possible.
- B. The City therefore encourages designs, which utilize and enhance natural settings and minimize disturbance and destruction of wooded areas, natural channels and wetlands.

5.15.4 Interpretation

- A. The Public Works Director or City Engineer will make interpretations of the detention policy. Appeals of the decisions of the Public Works Director may be made to the Board of Aldermen.

Section 5.16 Design Criteria

5.16.1 General

- A. Detention facilities shall discharge into a drainage easement or public right-of-way. The detention facility and all required energy dissipation at the discharge shall be located within the proposed development. The discharge point of the detention facility, including area for energy dissipation and erosion control shall not be located within 20' of the development's property line.
- B. One (1) foot of freeboard shall be provided between the maximum water surface elevation (maximum stage for a 1% annual probability event) and the minimum top of berm or wall elevation.
- C. Embankment slopes steeper than three horizontal to one vertical (3H:1V) are not permitted.
- D. Concrete walls shall not be substituted for earth berms unless otherwise approved by the Public Works Director.
- E. Dry detention basins shall maintain a minimum bottom slope of one foot per hundred feet (1%).
- F. Any detention basin or channel shall not be located closer than twenty (20) feet horizontally from any building and the maximum water surface elevation shall be at least three (3) feet below the lowest sill

plate elevation of any building. For this application the horizontal limits of the detention basin shall be defined as the outside face of the crest of the berm.

G. Trickle channels shall have a minimum slope of one-half foot per hundred feet (0.5%) for paved channels. Channels shall be a minimum 4'-0" in width.

H. The maximum allowable depth of ponding for parking lot detention is twelve (12) inches.

I. Parking lot detention may not inundate more than ten (10) percent of the total parking area.

1. All parking lot detention areas shall have a minimum of two (2) signs posted identifying the detention pond area. Any suitable materials and geometry of the sign are permissible, subject to approval by the Public Works Director. The signs shall have a minimum area of 1.5 square feet and contain the following message: "WARNING This area is a storm water detention pond and is subject to periodic flooding to a depth of 12 inches". Signs shall be reflective and have a minimum height of forty-eight (48) inches from the bottom of the sign to the parking space finished grade.

J. In certain instances, such as when the existing development conditions runoff from a watershed would exceed the capacity of the existing downstream facilities, the City may require a detention basin with a release rate at the capacity of the downstream facilities to be constructed.

5.16.2. Detailed Analysis

A. Detailed analysis shall be performed using hydrograph methodologies and reservoir routing techniques. The most common techniques are those developed by the Corps of Engineers and the Natural Resources Conservation Service (NRCS) formerly the Soil Conservation Service. These methods are preferred; however other proven techniques will be accepted.

B. Detention basins designed by detailed methods shall be designed on the basis of multiple storm recurrence frequencies to ensure that they function properly for both frequent storms and large infrequent storms.

1. A minimum of four (4) recurrence frequencies, the 50%, 25%, 10% and 1% annual probability storms (the "2-year, 10-year, 25-year and 100-year" storms) must be considered.

C. The runoff model must include the entire drainage basin upstream of the proposed detention pond. The model shall be prepared in sufficient detail to ensure that peak runoff rates are reasonably accurate. The runoff model shall be developed for the following cases:

1. Case 1: Existing conditions in the drainage basin prior to development of the applicant's property.

2. Case 2: Existing conditions in the drainage basin with developed conditions on the applicant's property.

3. Cases 1 & 2 are utilized to determine the required detention volume and the type of outlet structure to be provided, and shall be analyzed for the storm recurrence frequencies required above.

4. The detention facility shall be designed such that peak outflow rates from the facility for Case 2 are no greater than the rates determined in Case 1 for each of the storm recurrence frequencies required.
5. The storage volume provided shall not be less than the difference in total runoff volume between Case 1 and Case 2.
6. The overflow spillway shall be sized for the one percent (1%) annual probability (100-year) event, assuming the primary spillway is clogged.
7. The overflow spillway will, in most cases, be combined with the outlet structure.

5.16.3. Submittals

A. The following information must be submitted for detention ponds designed by detailed methods:

1. Information regarding analytical methods and software to be used, including:

- a. Name of software to be used.
- b. Type and distribution of precipitation input.
- c. Method for determining precipitation losses.
- d. Type of synthetic hydrograph.
- e. Method for routing hydrographs.
- f. Method used for reservoir routing.

B. Map(s) showing sub-basin delineation, topography, presumed flow routes, and pertinent points of interest; soil types; existing basin development conditions used in the model; fully developed conditions used in the model.

C. Routing diagram for the runoff model.

D. A summary of sub-basin characteristics used for program input.

E. Stage-area or stage-storage characteristics for the basin in tabular or graphic form.

F. Stage-discharge characteristics for the outlet structure and overflow spillway in tabular or graphic form; hydraulic data for weirs, orifices, and other components of the control structure.

G. A printout of the input data file.

H. A summary printout of program output, including plots of hydrographs (these are intended to be the printer plots generated by the software).

I. A computer generated soil survey should be provided from the USDA following site; (<http://websoilsurvey.sc.egov.usda.gov/App/HomePage.htm>). The soils data should be submitted as a Hydrologic Soil Group report. Submitting data from the old USDA soils survey books is not permitted as the soils data is not updated on the website.

J. Time of Concentration

1. NRCS Method. The preferred method of determining time of concentration shall be the method set forth in Chapter 3 of the Soil Conservation Service Technical Release No. 55, "Urban Hydrology

for Small Watersheds”, 2nd Edition.

2. Time of concentration shall be determined based upon existing conditions.
3. Time of concentration may also be calculated by other accepted methods providing reasonable results.

K. Control Structures

1. Detention facilities designed by the simplified analysis shall be provided with obvious and effective outlet control structures. These outlet structures may be v-notch weirs or rectangular weirs, as well as pipe(s). Plan view and section of the structure with adequate detail shall be included in the plans.
2. Sizing of the low-flow pipe shall be supported with calculations shown for the pipe rating curve and tailwater considerations.
3. Low-flow pipes shall not be smaller than four (4) inches in diameter to minimize maintenance and operating problems, except in parking lot and roof detention where minimum size and configuration of opening shall be designed specifically for each condition.
4. Overflow spillways will be required on all detention facilities.

5.16.4. Easements

A. All detention basins serving more than one (1) lot or property shall be located within a drainage easement. At a minimum, the easement shall include the area of the dam, the area downstream of the dam to a point twenty feet (20') downstream of the end of the outlet structure, including the area provided for erosion control or energy dissipation; and the area covered by the reservoir including freeboard, plus an additional twenty feet (20') around the perimeter. Detention basins for a development may be located on adjoining property downstream from the development provided that a drainage easement is obtained and adequate means of maintenance access (including ingress/egress easements where necessary) is provided. The easement shall be granted to the developer or to property owners' association. Where the detention basin does not immediately adjoin the development, a drainage easement covering the area inundated by the peak flow from the 1% AEP (100-year) storm shall be provided to connect the development site with the detention basin.

5.16.5. Construction Requirements

A. Dams shall be constructed of properly compacted earth fill and shall be keyed a minimum of two feet, (2') into existing ground.

B. Minimum embankment width at top of dam shall be three feet, (3')

C. Concrete retaining walls used at outlet structures or spillways that exceed 3'-6" in height shall be provided with four foot, (4') high chain link or solid fence.

D. Spillways and outlet structures shall be provided with toewalls extending eighteen inches, (18") below finish grade at upstream and downstream ends to prevent undercutting.

E. Where wet ponds are specified; the pond lining must be designed to retain water. Site soil conditions shall be evaluated by a soils engineer and an appropriate lining to be provided.

PART V - SINKHOLES AND KARST FEATURES

Section 5.17 General

A. The City is located on the Springfield Plateau of the Ozarks physiographic region. This area is underlain by Mississippian Age limestone which is highly susceptible to solutional weathering. As a result, sinkholes, springs and caves are common.

B. In many areas of the City, special consideration must be given to flood hazards and potential for groundwater contamination due to the presence of sinkholes¹, losing streams, springs, and other features associated with karst geology.

C. The requirements set forth herein are intended to provide specific criteria for design and construction for any site upon which sinkholes or other karst features are located.

D. Interpretations of these requirements shall be made and appeals may be made according to the procedures set forth in section 1.6 of Article I.

Section 5.18 Policy

A. It is the policy of the City to discourage land disturbance, development, and/or construction in or around sinkhole areas. Where sinkholes exist the city will require developers, builders and their design professionals to make the maximum effort to avoid sinkholes. The City recognizes that extreme and/or unique circumstances may occur when living in an area where sinkholes are prevalent. Exceptions will be made only when it can be conclusively demonstrated to the Board of Aldermen, by a Missouri Registered Geologist, that such extreme and/or unique circumstances exist as defined in items "B" and "C" below. Any request for an exception shall clearly prove that no adverse effects on surrounding properties, sensitive biological receptors, or endangered species will occur as a result of said construction proposal.

B. Extreme Circumstance:

1. An underground cavity has caused a collapsed sinkhole to form, after construction drawing approval, and during street or building construction, and the relocation of proposed street, utility or building would render access or utility service to a property impractical or cost prohibitive.
2. An underground cavity has caused a collapsed sinkhole to form under an existing street, utility or building and the relocation of street, utility or building would be impractical or cost prohibitive.

C. Unique Circumstances:

1. In the case of previously altered sinkholes the developer may only propose to use this geologic feature as a private park and his/her design professional shall:

- a. Not alter the sinkhole further until a disturbance plan has been approved by the Board of Aldermen;

- b. Provide information as to when and to what extent the previous disturbance occurred and that such disturbance occurred prior to the submittal of a preliminary plat application;
- c. Show that construction in the sinkhole might be appropriate if it serves to improve structural stability, better protects groundwater quality and/or public health;
- d. Provide the location of said sinkhole rim, as determined by a Missouri Registered Geologist, on all submitted documents;
- e. Provide grading, land disturbance, erosion control, and sinkhole modification plans that minimizes the removal of vegetation and that does not require the use of heavy construction equipment;
- f. Provide a fill plan (if applicable) approved by both a Registered Missouri Geologist and Engineer;
- g. Identify the boundaries of both the sinkhole rim and park boundary on all drawings and label said area as open space/common area to be dedicated to a Homeowners and/or Property Owners Association;
- h. Provide a copy of the sinkhole modification plan to the Missouri Department of Natural Resources-Division of Geology and Land Survey (DGLS) as well as register said sinkhole with the DGLS.

D. In these types of cases, measures that will have minimal impact on the sinkhole or receiving water may be proposed. A sinkhole stabilization plan shall be prepared and sealed by a qualified professional engineer or qualified geologist and submitted to the Public Works Director. Plans for minimal alteration may be approved, provided it is conclusively demonstrated that the proposed plan is the minimum practical alternative

E. In these cases potential impacts of construction on the sinkhole and receiving waters must be studied and assessed, and recommendations made for mitigation of potential impacts upon surface flooding and groundwater quality before the plans can be approved. The degree and sophistication of study required will increase in proportion to the potential impacts.

Section 5.19 Definitions

A. **Sinkhole:** Any depression in the surface of the ground, with or without collapse of adjacent rock that provides a means through which surface water can come into contact with subsurface water.

1. Sinkhole depressions may be gradual or abrupt; they may or may not have a well-defined eye. While most sinkholes can be defined as the area within a "closed contour", some sinkholes such as those located on the sides of hills may not.

2. All sinkholes provide discreet points of recharge to groundwater.

B. **Sinkhole Watershed:** The ground surface area that provides drainage to the sinkhole. This area extends beyond the sinkhole depression, and generally crosses property boundaries.

C. **Unaltered Sinkhole:** A sinkhole that has never been altered or disturbed.

- D. **Altered Sinkhole:** A sinkhole that has been filled, excavated or otherwise disturbed.
- E. **Collapsed Sinkhole:** A subsidence or cave-in of the ground surface caused when soil overburden can no longer be supported by underlying strata due to the presence of subsurface solution cavities.
- F. **Sinkhole Eye:** Generally, a visible opening, cavity or cave in the bottom of a sinkhole, sometimes referred to as a swallow hole.
- G. **Sinkhole Rim:** The perimeter of the sinkhole depression. The sinkhole rim will generally vary in elevation.
- H. **Sinkhole Cluster Area:** An area containing two (2) or more sinkholes located in close proximity, generally interconnected by groundwater conduits.
- I. **Terminal Sinkhole:** The lowest sinkhole in a sinkhole cluster to which any surface water overflowing from other sinkholes in the cluster will flow.
- J. **Sinkhole Flooding Area:** The area inundated by runoff from a storm with an annual exceedance probability of 1% and duration of twenty-four (24) hours.
- K. **Construction in sinkholes:** Those actions necessary to stabilize the sinkhole, preserve groundwater quality and provide suitable support for the street, utility or building.
- L. **Qualified Geologist:** A person registered to practice geology according to the laws of the State of Missouri, who has met or exceeded the minimum geological educational requirement and who can interpret and apply geologic data principles, and concepts and who can conduct field or laboratory geologic investigations (per RSMo); and who by reason of experience and education, has an understanding of local karst geology.
- M. **Qualified Professional Engineer:** A person registered to practice engineering according to the laws of the State of Missouri, and who by reason of technical education and experience has a background in the fundamentals of storm drainage and karst geology.
- N. **Heavy Equipment:** Motorized equipment having a gross weight of more than six (6) tons.
- O. **Light Equipment:** Motorized equipment weighing six (6) tons or less.

Section 5.20 Permits Required

- A. Permits from State or federal agencies may be required, as outlined in Part I of this Article, depending upon the size and nature of the proposed activity.

Section 5.21 General Plan Requirements

- A. General requirements for grading and drainage plans are set forth in Article I.

Section 5.22 Sinkhole Evaluation

A. An evaluation including the following information shall be made for all sites upon which sinkholes are fully or partially located:

B. The site plan for the proposed development must show the following items with respect to location of proposed construction, proposed or existing property lines and existing structures:

1. Sinkholes

a. Location and limits of the area of the sinkhole depression as determined by field surveys or other reliable sources as may be approved. Location of sinkholes based solely upon USGS 7-1/2 Minute Series Quadrangle Maps will not be considered sufficient unless field verified.

b. Location and elevation of the sinkhole eye where visible or known.

c. Topographic contours at maximum intervals of two (2) feet, and spot elevations sufficient to determine the low point on the sinkhole rim and the profile of the potential overflow area. The sinkhole rim shall be identified by a registered geologist.

d. Minimum entry elevations of any existing structures located within the sinkhole rim.

e. Elevation of any roadway located within or adjacent to the sinkhole.

2. Water Supply Sources

a. The approximate location of public or private water supply sources such as springs or wells, as determined from information available from the City and MoDNR.

b. Boundaries of any known recharge areas to wells or springs as determined from information available from the City and MoDNR.

3. Other Geologic Features: Location of caves, springs, faults and fracture trends, geologic mapping units based upon information from the City or other reliable sources.

4. Flooding limits for the sinkholes determined as set below.

C. A drainage area map showing the sinkhole watershed area. Where the site is located in a sinkhole cluster area, this map shall be extended to include the watershed area any sinkholes located downstream of the site which may receive overflow drainage from the site.

D. Assessment of potential impacts on groundwater quality and proposed water quality management measures as set forth below.

Section 5.23 Flooding Considerations

5.23.1. Minimum Flooding Analysis

- A. Maximum estimated flooding elevations shall be determined for each sinkhole for both pre-development and post development conditions, assuming no subsurface outflow from the sinkhole.
- B. Where the estimated volume of runoff exceeds the volume of the sinkhole depression, the depth, spread and path of overflow shall be estimated and shown on the map.
- C. The overflow volume shall be included in determining the maximum estimated flooding elevations in the next downstream sinkhole. This analysis shall continue downstream until the lowest sinkhole of the sinkhole cluster is reached or overflow reaches a surface watercourse.
- D. The volume of runoff considered shall be that which results from a rainstorm with an annual probability of 1% (100-year storm) and a duration of twenty-four (24) hours (8.0 inches for City of Rogersville). The runoff volume shall be determined by the method set forth in Chapter 2 of the SCS TR-55 Manual (Reference 11).
- E. No further flooding analysis will be required provided that:
 - 1. The post-development flooding area of any sinkhole which receives drainage from the site is located entirely on the site.
 - 2. A drainage easement covering the post-development flooding area is provided for any off-site sinkhole or portion of a sinkhole which receives increased peak rates of runoff from the site. If the receiving sinkhole is not contiguous to the site, an easement must also be provided for the waterway which connects the site to the sinkhole.
 - 3. The minimum entry elevation of any existing structure is at least one (1) foot higher than the estimated flooding elevation from the 1% annual probability 24-hour storm.
 - 4. The flooding depth on any existing public road does not exceed the maximum depths set forth in Part III.

5.23.2. Detailed Flooding Analysis

- A. In cases where the conditions set forth above cannot be met, a detailed flooding analysis will be required if any increase in runoff volume is proposed. For detailed flooding analysis a runoff model must be made for the sinkhole watershed and reservoir routing analysis performed using hydrograph techniques as set forth in Part IV.
- B. The following alternative methods may be used singly or in combination to keep flooding levels at pre-development levels:

C. Diversion of Excess Runoff to Surface Watercourses

1. Where feasible, increased post-development runoff may be diverted to a surface watercourse, provided that:
 - a. Increase in peak runoff rate in the receiving watercourse does not create or worsen existing flooding problems downstream; and
 - b. The diverted storm water remains in the same surface watershed.
 - c. Storm sewers, open channels and other appurtenances provided for diversions shall be designed in accordance with applicable sections of these Design Standards.
 - d. The effect of diverted water on downstream watercourses and developments, and requirements for additional detention facilities prior to release of runoff to the surface watercourse shall be determined as set forth in Part IV, Detention Facilities.
 - e. Effects of the diversion shall be shown by reservoir routing analysis. Routing of excess runoff shall be considered satisfactory when it can be demonstrated that the post-development flooding elevation in the sinkhole does not exceed the pre-development flooding elevation within reasonable tolerance (generally 0.1 ft.).

D. Storage of Excess Runoff within the Sinkhole Watershed

1. Where feasible, detention facilities may be constructed within the sinkhole watershed or in perimeter areas of the sinkhole. These detention facilities must be located outside the sinkhole flooding area determined for post-development conditions.
2. The flooding considerations set forth in this section will be met if it can be demonstrated that:
 - a. Inflow rates to the sinkhole can be reduced to a degree that, in conjunction with the observed outflow rate, the post-development flooding elevation in the sinkhole does not exceed the pre-development flooding elevation within reasonable tolerance (generally 0.1 ft.).
 - b. Sediment & erosion control and water quality considerations as set forth elsewhere in this section can be satisfied.

Section 5.24 Water Quality Considerations

5.34.1. Evaluation Factors

- A. Sinkholes provide direct recharge routes to groundwater. As a result, water quality in wells, caves and springs may be affected by discharge of runoff from developed areas.
- B. The Sinkhole Evaluation must consider potential impacts of the proposed construction on receiving groundwaters and propose measures to mitigate such impacts.

C. Four primary factors must be considered:

1. Receiving groundwater use.
2. Relative groundwater contamination hazard associated with the proposed development.
3. Ability to capture pollutants.
4. Management measures to be provided to reduce pollutant levels.

5.24.2. **Receiving Groundwater Use**

A. The Sinkhole Evaluation Report shall identify whether the site lies within a critical area based upon information available from the City.

B. Where disagreements may arise over whether a site is located within a particular recharge area, dye tracing may be required for confirmation of the destination of water discharges through a sinkhole.

C. Critical Areas

1. The following areas are classified as critically sensitive to contamination from urban runoff:
 - a. Recharge areas of domestic water supply wells.
 - b. Recharge areas of springs used for public or private water supply.
 - c. Recharge areas of caves providing habitat to rare or endangered species such as the Ozark cavefish.

D. Sensitive Areas

1. All other sinkhole areas will be classified as sensitive to contamination from urban runoff.

5.24.3. **Groundwater Contamination Hazard**

A. The relative potential for groundwater contamination will be classified as low, moderate, or high depending upon the type of land use, development density and amount of directly connected impervious area. The Sinkhole Evaluation shall identify whether the proposed development poses a low, moderate, or high hazard to groundwater uses, as defined below:

B. Low Hazard

1. The following land uses are classified as posing a relatively low hazard to groundwater contamination:
 - a. Wooded areas and lawns.
 - b. Parks and recreation areas.

- c. Residential developments on sewer, provided directly connected impervious areas discharging to the sinkhole are less than one (1) acre.
- d. Low density commercial and office developments, provided directly connected impervious areas discharging to the sinkhole are less than one (1) acre.
- e. Discharge from graded areas less than one (1) acre having required sediment controls per Part VI.

C. Moderate Hazard

- 1. Concentrated discharge from streets and parking lots and roofs and other directly connected impervious areas having an area greater than one (1) acre and less than five (5) acres.
- 2. Multifamily residential developments and higher intensity office developments, provided the directly connected impervious areas discharging to the sinkhole are less than five (5) acres.
- 3. Discharge from graded areas greater than one (1) acre and less than five (5) acres having required sediment controls per Part VI.

D. High Hazard

- 1. Collector and arterial streets and highways used for commercial transport of toxic materials.
- 2. Railroads.
- 3. Concentrated discharge from streets and parking lots and roofs and other directly connected impervious areas having an area greater than five (5) acres.
- 4. Commercial, industrial and manufacturing areas.
- 5. Individual wastewater treatment systems.
- 6. Commercial feedlots or poultry operations.
- 7. Discharge from graded areas greater than five (5) acres having required sediment controls per Part VI.

5.24.4. **Capturing and Filtering Pollutants**

A. The majority of sinkholes drain a limited watershed area. For sinkholes where the surrounding drainage area is small enough that the area draining to the sinkhole flows predominantly as "sheet flow", potential impacts on water quality can be addressed by erecting silt control barriers around the sinkhole during construction and providing a vegetative buffer area around the sinkhole to filter out potential contaminants.

B. When the volume of runoff into the sinkhole increases to the point where flow becomes concentrated, the degree of effort required to capture and filter out contaminants increases significantly.

C. Concentrated inflow occurs naturally when the sinkhole watershed area reaches a sufficient size for watercourses leading into the sinkhole to form. Concentrated surface flows result as urbanization occurs due to construction of roads, storm sewers, drainage channels. Subsurface flows can become concentrated through utility trenches.

D. The Sinkhole Evaluation shall include maps showing any existing watercourse which flows into the sinkhole and location of any proposed concentrated storm water discharges into the sinkhole.

5.24.5. **Water Quality Management Measures**

A. Sediment and Erosion Control

1. Non-concentrated flow (sheet flow)

a. In critical areas, existing ground cover shall not be removed within twenty-five (25) feet of the sinkhole rim and a silt barrier shall be provided around the outer perimeter of the buffer area.

2. Concentrated flow

a. A sediment basin will be required at each point where concentrated flows are discharged into the sinkhole.

(1). Sediment basins shall be designed according to the procedures set forth in Part VI.

B. Minimizing Directly Connected Impervious Area

1. The groundwater contamination hazard category for impervious areas may be reduced by reducing the amount of Directly Connected Impervious Area. This is the area of roofs, drives, streets, parking lots, etc. which are connected via paved gutters, channels, or storm sewers.

2. Directly Connected Impervious Areas can be reduced by providing properly sized grass swales, vegetative filter strips or other Best Management Practices to separate paved areas.

C. Diversion of Runoff

1. Concentrated discharges to sinkholes can be reduced to manageable levels or avoided by diverting runoff from impervious areas away from sinkholes where possible.

2. Diversions shall be done in a manner that does not increase flooding hazards on downstream properties and, generally, shall not be directed out of the surface watershed in which the sinkhole is located.

D. Filtration Areas

1. For areas having a low or moderate groundwater contamination hazard and where flow into the sinkhole occurs as sheet flow, water quality requirements can be satisfied by maintaining a permanent vegetative buffer area with a minimum width of thirty (30) feet around the sinkhole.

2. Use of pesticides and fertilizers will not be permitted within the buffer area. Animal wastes will not be permitted to accumulate in the buffer area.

E. Grassed Swales and Channels

1. For areas having a low groundwater contamination hazard, concentrated flows from directly connected impervious areas of less than one (1) acre may be discharged into the sinkhole through grassed swales and channels.

2. Swales and channels shall be designed for non-erosive velocities and appropriate temporary erosion control measures such as sodding or erosion control blankets provided.

F. Storage and Infiltration

1. Storage and infiltration will be required in the following cases:

a. All areas having a high groundwater contamination hazard.

b. Areas having a moderate groundwater contamination hazard where concentrated inflow occurs.

2. Storage and infiltration basins shall be designed to capture the runoff from storms up to one (1) inch and release runoff over a minimum period of twenty-four (24) hours.

Section 5.25 Development Requirements

5.25.1. Storm water Detention in Sinkholes

A. Where water quality considerations as set forth in Part VI can be met, the volume of runoff storage in sinkholes can be counted toward storm water detention requirements, provided that proper sediment and erosion control measures are provided as set forth in Part VI.

B. The volume of required detention storage shall be determined as set forth in Part IV. Excavation within the sinkhole flooding area to provide additional detention storage will not be allowed.

5.25.2. Modification of Sinkholes to Increase Outflow Rates

A. Increasing outflow rates in sinkholes by excavating the sinkhole eye or installing disposal wells for diverting surface runoff to the groundwater system is prohibited, unless clear and imminent danger to the public health and safety can be demonstrated.

5.25.3. Setbacks and Use Restrictions

A. No new construction of any of the following shall be permitted within twenty-five (25) feet of the sinkhole rim:

1. Residential, commercial or industrial structures.

2. Swimming pools.

3. Streets, highways, or parking lots.
4. Storage yards for materials, vehicles, and equipment.
5. Sanitary sewer lines.

B. No person shall place, or cause to be placed, any substance or objects, other than those approved by the City, in any sinkhole. This specifically precludes any trash, garbage, or refuses material. If an accidental spill of any toxic, petroleum, or hazardous material occurs, it shall be reported to the City and MoDNR immediately.

C. Use of pesticides and fertilizers within thirty (30) feet of the sinkhole rim is prohibited.

D. No waste disposal system of facility which involves storage or handling of hazardous or toxic materials is allowed within one hundred (100) feet of a sinkhole rim.

E. Use of heavy construction equipment in unaltered sinkholes is prohibited.

F. Construction of underground utilities is prohibited within the sinkhole rim.

G. Recreational facilities such as hiking, jogging, and bicycling trails, playgrounds, exercise courses, and grass playing fields are permitted within the sinkhole area provided they are not located within the eye of the sinkhole.

H. Golf courses are permitted subject to approval of a Management Plan for use of pesticides and fertilizers.

I. Clearing and pruning of trees and undergrowth, and limited grubbing of roots is permitted.

J. Landscaping and minor gardening is permitted outside of the sinkhole eye provided erosion and sediment discharge is limited through use of minimum tillage and mulches.

K. Construction of light incidental landscaping and recreational structures such as gazebos, playground equipment, etc. is permitted except in the sinkhole eye.

L. Any property that has a sinkhole present that has been used as a site for dumping of trash, garbage, and refuse will be prohibited from building permits, zoning actions, or land subdivision until the sinkhole has been cleaned out.

5.25.4. Collapsed Sinkholes

A. Collapsed sinkholes may be stabilized and filled using approved techniques. Permits must be issued prior to performing any construction.

B. The probable cause of the collapse and potential adverse impacts of filling the collapse shall be investigated and information submitted with the Permit application.

5.25.5. Altered Sinkholes

A. Filling or altering of sinkholes without a Permit constitutes a violation of these requirements. In such cases corrective measures must be proposed within the time period specified in Article V for enforcement of such violations. No corrective or remedial measures shall be undertaken until the proposed remediation plan has been reviewed by the City and a Permit issued.

B. No Building Permits will be issued, or zoning or subdivision approvals granted until the remedial measures specified in the Permit have been completed and approved.

Section 5.26 Springs & Caves

5.26.1. Springs

A. No new construction will be permitted within one hundred feet (100') of a spring unless a report, prepared by a qualified engineer or geologist verifying that the quantity and quality of the spring flow will not be materially altered by the proposed construction, is submitted and approved by the City.

5.26.2. Caves

A. No new construction will be permitted within one hundred feet (100') of the known alignment of a cave unless a report, prepared by a qualified engineer or geologist verifying that the cave will not be materially altered by the proposed construction and that sound foundations or other support for the proposed construction will not be subject to collapse or undue settling, is submitted and approved by the City.

B. The entrances of caves shall be protected against unauthorized entry, while allowing for the unimpeded flow of groundwater and without disruption to habitat for cave-dwelling animal species. Plans for cave entrance protection must be approved by the City prior to construction.

PART VII - GRADING, SEDIMENT & EROSION CONTROL

Section 5.27 Goals and Objectives

A. The goal of the regulation is to effectively minimize erosion and discharge of sediment by application of relatively simple and cost effective Best Management Practices. This goal can be attained by meeting the following objectives:

1. Minimize the area disturbed by construction at any given time.
2. Stabilize disturbed areas as soon as possible by re-establishing sod, other forms of landscaping, and completing proposed structures, pavements and storm drainage systems.
3. Provide for containment of sediment until areas are stabilized.
4. Provide permanent erosion controls.
5. Require construction to be sequenced whereby all erosion control best management practices, (BMP's), are installed prior to any land disturbance.

Section 5.28 General Design Guidelines

A. The following items shall be considered in preparing a sediment and erosion control plan:

5.28.1. Temporary vs. Permanent Controls

A. The greatest potential for soil erosion occurs during construction. Temporary controls are those that are provided for the purpose of controlling erosion and containing sediment until construction is complete.

B. Temporary controls include straw or hay bale dikes, silt fences, erosion control blankets etc., which are not needed after the area is stabilized.

C. Permanent controls consist of concrete trickle channels, detention basins, etc., which will remain in place through the life of the development.

D. It is possible for the same facility to serve both a temporary and permanent purpose. The difference between temporary and permanent erosion control should be clearly recognized in preparing a sediment and erosion control plan.

5.28 2. Sheet Flow vs. Concentrated Flow

A. In areas where runoff occurs primarily as sheet flow, containment of sediment is relatively simple. In these areas straw or hay bales, silt fences and vegetative filter areas can be very effective.

B. Where concentrations of flow occur, containment of sediment becomes more difficult as the rate and volume of flow increase. In these areas more sophisticated controls such as sedimentation basins must be provided.

5.28.3. Slope

A. Control of erosion becomes progressively more difficult as the slope of the ground increases. Areas with steeply sloping topography, and cut and fill slopes must be given special consideration.

5.28.4. Soils and Geologic Setting

A. Area soils and the geologic setting must be considered in preparing the plan and any special considerations deemed necessary for a particular site provided.

5.28.5. Environmentally Sensitive Areas

A. Where construction occurs within the vicinity of permanent streams, springs, sinkholes, lakes or wetlands, special attention must be given to preventing discharge of sediment.

Section 5.29 Permits

5.29.1. NPDES Storm Water Permit

A. Construction sites where the area to be disturbed is one (1) acre or more must apply for a storm water discharge permit from MoDNR.

B. Permit requirements are set forth in 10 CSR 20-6.200 of the Missouri Clean Water Laws.

5.29.2. "404" Permit

A. Grading activities in streams or wetlands may require a Department of the Army Permit under Section 404 of the Clean Water Act.

Section 5.30 Design Standards & Criteria

5.30.1. Grading

A. Maximum Grades

1. Cut or fill slopes shall not exceed 3:1.
2. 4:1 slopes are preferred where possible.

B. Maximum Height

1. Cut or fill slopes shall not exceed fifteen (15) feet in vertical height unless a horizontal bench area at least five (5) feet in width is provided for each fifteen (15) feet in vertical height.

C. Minimum Slope

1. Slope in grassed areas shall not be less than 1%.

D. Construction Specifications

1. Construction for streets must comply with specifications set forth in Article II.
2. For all other areas, construction specifications stating requirements for stripping, materials, subgrade compaction, placement of fills, moisture and density control, preparation and maintenance of subgrade must be included or referenced on the plans, or accompanying specifications submitted.

E. Spoil Areas

1. Broken concrete, asphalt and other spoil materials may not be buried in fills within proposed building or pavement areas.
2. Outside of proposed building and pavement areas, broken concrete or stone may be buried in fills, provided it is covered by a minimum of two (2) feet of earth.
3. Burying of other materials in fills is prohibited.

F. Stockpile Areas

1. Location of proposed stockpile areas shall be outlined on the plans and specifications for proper drainage included.

G. Borrow Areas

1. The proposed limits of temporary borrow areas shall be outlined in the plans and a proposed operating plan described on the grading plan. Borrow areas shall not be located closer than 50 feet from a stream bank.
2. Temporary slopes in borrow areas may exceed the maximums set forth above. At the time that borrow operations are completed, the area shall be graded in accordance with the criteria set forth above, and reseeded.

5.30.2. **Sediment Containment**

A. Existing vegetative filter areas may be used where:

1. Un-concentrated sheet flow occurs,
2. An area of existing vegetation a minimum of twenty-five (25) feet in width can be maintained between the area to be graded and a property line, watercourse, sinkhole, spring, wetland or classified lake,
3. Existing ground slope is no greater than 5:1 (20%),
4. The existing vegetative growth is of sufficient density and in sufficiently good condition to provide for filtration of sediment.
5. Vegetative filter areas are a temporary and permanent practice.

B. Hay/Straw Bale Dike or Silt Fence

1. Containment areas constructed of hay or straw bales, or silt fence may be provided in areas where:
 - a. Un-concentrated sheet flow occurs,
 - b. An area of existing vegetation a minimum of twenty-five (25) feet in width cannot be maintained between the area to be graded and a property line, watercourse, sinkhole, spring, wetland or classified lake,
 - c. Existing ground slope is no greater than 5:1 (20%),
 - d. Concentrated flow from an area no greater than one (1) acre occurs and a minimum volume of 1000 cubic feet per acre is contained behind the dike.
2. Either cereal grain straw or hay may be used for bale dikes.
3. Silt fence may be used in lieu of hay or straw bales.
4. Straw bale dikes and silt fences are temporary practices.

C. Temporary Containment Berms

1. Temporary containment berms may be provided for areas where concentrated flow from areas greater than one (1) acre and less than five (5) acres occurs. Temporary containment berms must contain a volume of 1000 cubic feet per acre of drainage area. Containment berms and swales must be installed level, "along the contour". Accumulated sediment must be removed when it reaches one-third (1/3) of the berm height.
2. Temporary containment berms shall have an outlet with a sediment filter or a perforated pipe outlet.
3. Temporary containment berms and accumulated sediment may be completely removed after the tributary area is stabilized, and must be removed prior to final acceptance.

D. Inlet Protection

1. This practice consists of protecting the inlet perimeter or opening with straw bales, silt fence or sandbags. The purpose of this practice is to keep sediment from collecting in storm drains. This practice is also useful when site conditions prevent locating a sediment basin downstream of the storm sewer outfall. Inlet protection described in this paragraph cannot be used where blockage of the inlet opening would result in flooding of residential dwellings, buildings, streets or roads, or off-site property.

2. Curb Inlets

- a. Curb inlets can be protected from sediment entry by placing sand bags over the inlet opening. Sand bags must be replaced when deteriorated and removed when the area has been stabilized.

b. Accumulated sediment must be removed from the street after each rainfall.

3. Area Inlets

a. In paved areas, area inlets can be protected by placing gravel filled sandbags up to two (2) courses high around the perimeter of the inlet.

b. Outside of paved areas or before pavement is placed, area inlets can be protected by installing a silt fence of straw bale dike around the inlet perimeter. Open side drop inlets can be protected by placing sandbags over the openings.

c. Accumulated sediment must be removed prior to final approval.

E. Diversion

1. Where flow must be diverted into sediment basins or other sediment retaining facilities, diversion berms or swales or other approved means of diverting runoff may be specified.

2. Where sediment enters a street which is up-grade from an existing street, means must be provided to divert runoff to a sediment basin before discharge from the site. The method of diversion will vary depending upon the phase of construction. After initial grading, an earth berm can be used. This is no longer possible after the street subgrade is completed and curbs are installed. After the street pavement is completed, sand bags can be used to divert the runoff into inlets for discharge into the sediment basin.

F. Gravel Filter Dam

1. Where concentrated flow occurs and less than two (2) acres of tributary drainage area are graded (i.e. a sediment basin is not required) or where construction of a sediment basin is not feasible, a gravel filter dam shall be provided prior to discharge of runoff from the property.

2. Gravel filter dams consist of a layer of filter fabric and crushed rock covering the upstream side of a riprap dike. Riprap shall be six and twelve inches (6"and12") in size. Filter fabric may be woven or non-woven, Mirafi 500X, Mirafi 150NL, or equal. The purpose of the filter fabric is to remove sediment particles as water flows through it. The layer of crushed rock provides additional filtration protects the filter fabric, and holds it in place.

3. Where gravel filter dams are used as sediment basin outlets, one (1) square foot of filter fabric area shall be provided for each one thousand (1,000) cubic feet of storage. The minimum area provided shall be four (4) square feet.

4. Where gravel filter dams are used as ditch checks in channels, the gravel filter area shall extend throughout the width of the dam.

5. Stilling basins shall be provided downstream of the filter dam where discharge is to a grass channel.

5.30.3. Erosion Protection

A. Seeding and Mulching

1. Permanent Seeding

- a. Permanent seeding fertilizer and mulch shall be applied at the rates set forth in the Constructions Specifications.
- b. Permanent seeding seasons are as designated in the Constructions Specifications.

2. Mulching

- a. Where slopes are less than 4:1, cereal grain mulch is required at the rate of 100 pounds per 1000 square feet (4500 pounds per acre).
- b. Where slopes are 4:1 or greater, Type 3 mulch ("hydromulch") shall be used.

3. Temporary Seeding

- a. Whenever grading operations are suspended for more than thirty (30) calendar days between permanent grass or seeding periods, all disturbed areas must be reseeded with temporary cover. Temporary seeding season runs from May 15 to November 15.

4. Overseeding

- a. During the winter season (November 15 to March 1) temporary seed and mulch shall be placed on all completed areas or areas where grading is suspended for more than thirty (30) calendar days. During this period seed, mulch, and soil amendments shall be applied at the following rates:

Lime:	100% of specified quantity
Fertilizer:	75% of specified quantity
Seed:	50% of specified quantity
Mulch:	100% of specified quantity

- b. Areas seeded during this period shall be reseeded and mulched during the next permanent seeding season according to seeding requirements.

5. Maintenance

- a. Seeded areas must be maintained for one year following permanent seeding.

B. Cut and Fill Slopes

- 1. Cut and fill slopes shall be protected from erosion by construction of straw bale dikes, silt fences, diversion berms, or swales along the top of the slope.

2. Where drainage must be carried down the slopes, pipe drains, concrete flumes, chutes, or other impervious areas must be provided. Suitable erosion control measures such as stilling basins or other approved methods must be provided at the bottom of the slope.
3. Diversions shall be maintained until permanent growth is firmly established on the slopes.

C. Channels and Swales

1. Permanent channels and swales shall be provided with a stabilized invert consisting of one of the following materials:

a. Sod

- (1). Where the average velocity of flow is five (5) feet per second or less and there is no base flow, the channel shall be lined with sod.
- (2). For channels with a bottom width less than fifteen (15) feet, sod shall extend up the side slope to a minimum height of six (6) inches above the toe.
- (3). Channels with a bottom width of fifteen (15) feet or greater, shall be provided with a low flow area, fifteen (15) feet in width lined with sod.

(a). The remainder of the channel slopes shall be seeded and mulched as provided above.

b. Erosion Control Blanket

- (1). Commercial erosion control blankets may be used in lieu of sod provided that samples are submitted and approved by the Public Works Director. The guaranteed maintenance period shall be one year.

c. Non-Erosive Lining

- (1). In grass channels where base flow occurs, a non-erosive low-flow channel of concrete must be provided. Low flow channels shall have a minimum capacity of five (5) cubic feet per second. Other suitable non-erosive materials may be specified with approval of the Public Works Director.
- (2). For channels which have an average velocity of five (5) feet per second or greater a non-erosive lining or other approved material must be provided.

D. Storm Sewer and Culvert Outlets

1. Erosion protection shall be provided at storm sewer and culvert outlets. Minimum erosion protection shall consist of a concrete toe wall and non-erosive lining.
2. Flared end sections or headwalls are required. The required length of non-erosive lining will not be decreased where flared end sections or headwalls are provided unless calculations and data to support the decrease in length are submitted and approved.

3. Non-erosive lining shall extend to the point at which average channel velocity for the peak flow rate from the minor (5-year) storm has decreased to five (5) feet per second maximum.

4. The length of non-erosive lining to be provided shall be as follows:

a. Average outlet velocity less than five (5) feet per second:

L = 3 times the pipe diameter or culvert width.

b. Average outlet velocity less than 5-10 feet per second:

L = length determined.

c. Average outlet velocity greater than ten (10) feet per second:

Use MoDOT standard energy dissipater headwall (Reference 17).

5. The height of non-erosive lining shall not be less than the crown of the pipe.

6. Where headwalls or flared end sections are specified, toewalls must be provided at the downstream end.

E. Curb Openings

1. Where drainage flows from paved areas to grass areas through curb openings erosion protection shall be provided. Curb openings are not allowed on public roadways.

F. Ditch Checks and Drop Structures

1. In grass channels, grades and velocities may be controlled by use of ditch checks and drop structures.

2. Ditch checks may be required in natural channels where average velocity for the peak flow rate from the 5-year storm exceeds five (5) feet per second for post-development conditions.

G. Spillways

1. Erosion protection must be provided at spillways and outlet structures for detention ponds. Erosion protection shall extend to the point where flow has stabilized and average velocity in the outlet channel is five (5) feet per second or less.

5.30.4. **Temporary Construction Entrance**

A. The temporary construction entrances shall be installed prior to any land disturbance. A minimum of one (1) temporary construction entrance is required at each site, but shall be located at every point where construction traffic enters or leaves a construction site. Additional temporary entrances may be provided if approved. The location of each construction entrance shall be shown on the plan.

5.30.5. Cleaning Streets

A. Streets, both interior and adjacent to the site, shall be cleaned of sediment as needed, after each rainfall and at the end of construction and final acceptance by the City.

5.30.6. Dust Control

A. The contractor will be required to use water trucks to wet haul roads and construction areas to minimize dust leaving the site when conditions warrant.