

**TITLE VIII
ST. ROBERT CODE OF ORDINANCES**

**INFRASTRUCTURE DEVELOPMENT REGULATIONS
OF THE CITY OF ST. ROBERT, MISSOURI**

**A UNIFIED REGULATION
GOVERNING THE DEVELOPMENT OF STREET, WATER, SANITARY SEWER
INFRASTRUCTURE**

(Effective Date: June 25, 2002)

STREET RIGHT-OF-WAY IMPROVEMENTS

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CHAPTER 800: GENERAL PROVISIONS FOR STREET IMPROVEMENTS

SECTION 800.010 PURPOSE

- A. The quality of design of the urban area is dependent on the quality of design of individual plats and subdivisions that compose it. The arrangement of blocks and lots and the street system shall be designed to make the most advantageous use of existing topography and natural physical features, including tree masses and large individual trees. Adjacent properties shall be considered in the plat design and shall not be landlocked.
- B. All street infrastructure design and construction shall comply with the standards and requirements set forth in this Regulation.
- C. All street infrastructure development within residential and nonresidential subdivisions shall integrate with the master street plan delineated in the City Comprehensive Plan to ensure greater accessibility by vehicle and pedestrian traffic, and safely and efficiently transport projected traffic uses throughout the City.
- D. Detailed construction standards for streets, sidewalks, driveways and curbs and gutters shall be based on the design criteria contained in Article IV of this Regulation.
- E. In the event that climatic conditions would delay the completion of any new street improvements, reasonable consideration shall be granted only by approval of the St. Robert Board of Aldermen.

SECTION 800.011 DEVELOPER RESPONSIBILITIES

- A. The developer has the duty of compliance with reasonable conditions laid down by the Planning and Zoning Planning and Zoning Commission and the Aldermen for the design, dedication, improvement and restrictive use of the land so as to conform to the physical and economical development of the city, and to promote the safety and general welfare of the future lot owners in residential and nonresidential subdivisions and of the community at large; the subdivision of land being a privilege conferred through these Regulations.
- B. All successors or assigns, shall be responsible for maintaining all common areas, improvements, infrastructures or facilities required by this Regulation or any permit issued in accordance with its provisions, until such time as the offer of dedication to the public has been accepted by the Board of Aldermen.
- C. All streets and parking areas, curbs and gutters, street lighting, water and sewer lines, and recreational and open space areas must be properly maintained so that they can be used in the manner intended; and any vegetation and trees required by this Regulation for screening or landscaping must be replaced if they die or are destroyed.

SECTION 800.012 BONDS AND OTHER SURETY

- A. A developer shall be required to complete all improvements and utilities required by the City Council, and upon completion shall dedicate such improvements and utilities to the city, free and clear of all defects, liens and encumbrances on the property or public improvements dedicated.

- B. *Performance Contract.* The City Council may require an agreement signed by the developer in which the developer guarantees completion of all required improvements within a period of time not exceed twenty-four (24) months. The obligations of the developer under the agreement shall not be assigned without the express written consent of the City Council. Upon the breach of any part of the agreement by the developer, the City Council may at its option pursue any legal or equitable remedy necessary to ensure completion and payment by the developer for the required improvements and utilities.

- C. *Performance bond.* the City Council may require a performance bond or such other surety, as it may deem appropriate to secure such construction to be completed within a reasonable period specified by the City Council and expressed in the bond or other surety, in an amount and with surety and conditions satisfactory to the City Council.

- D. Upon approval of a preliminary plat by the Board of Aldermen, all new streets, curbs and gutters, sidewalks, streetlights and fire hydrants to be constructed within any new subdivision shall be completed in their entirety prior to the approval of the final plat of subdivision. The St. Robert Board of Aldermen, only upon favorable recommendation by the City Planning and Zoning Commission and by the filing of a performance bond or other form of surety as specified in paragraphs B and paragraph C above, may waive this requirement. No building permit shall be authorized for issue nor shall any certificate of occupancy permit be issued for the occupancy of any building within the subdivision until all platted street improvements are completed and accepted by the City of St. Robert as previously stated herein or the proposed street improvements are guaranteed by the filing of a form of surety accepted by the City of St. Robert.

SECTION 800.020 STREET CLASSIFICATION

- A. All developers shall be required to meet the minimum design and construction requirements of the City of St. Robert regardless of the street classification. Design requirements for all street improvements within the City of St. Robert are set forth in Article IV of this Regulation.

- B. In all new subdivisions, streets that are to be dedicated to public use shall be designed to adequately and safely handle projected traffic loads as provided for, by not limited to, the following:
 - 1. The classification shall be based upon the projected volume of traffic to be carried by the street, stated in terms of the number of trips per day;
 - 2. The number of dwelling units to be served by the street may be used as a useful indicator of the number of trips but is not conclusive;

3. Whenever a subdivision street continues an existing street that formerly terminated outside the subdivision, or it is expected that a subdivision street will be continued beyond the subdivision at some future time, the classification of the street will be based upon the street in its entirety, both within and outside of the subdivision.

C. Streets that are to be dedicated to public use shall be classified as follows:

1. *Local.* A street whose sole function is to provide access to abutting properties. Cul-de-sac and loop streets are considered to be local streets.
2. *Collector.* A major street whose principal function is to connect local streets with collector or arterial streets, but that also may provide direct access to abutting properties.
3. *Arterial.* A major street in the City's street system that serves as an avenue for the circulation of traffic into, out of, or around the City and carries high volumes of traffic.

SECTION 800.030 STREET ACCESS

A. *Access to Lots.* Every lot shall be designed to provide a satisfactory and desirable building site, and shall abut on a public street and a utility easement.

B. *Access to Major Streets.*

1. *Arterial Streets.* Whenever a subdivision that involves the creation of one or more new streets borders on or contains an existing or proposed arterial street, no direct driveway access may be provided from the lots within this subdivision onto the arterial street.
2. *Collector Streets.* Similarly, to the extent practicable, direct driveway access to collector streets shall be minimized to facilitate the free flow of traffic and avoid traffic hazards.

SECTION 800.040 ENTRANCES TO STREET

A. All driveway entrances and other openings onto streets within the City of St. Robert 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 in abutting streets, and
2. Interference with the free and convenient flow of traffic in abutting or surrounding streets is minimized.
3. Perform as an integral component of the curb and gutter system to properly channel all stormwater runoff to the proper inlet collection device, and prevent improper diversion of storm runoff towards any building or structure upon the lot that the driveway provides access to.

- B. Specifications for driveway entrances are set forth in Article II and Article IV this Regulation. If driveway entrances and other openings onto streets are constructed in accordance with the foregoing specifications and requirements, this shall be deemed as satisfactory compliance with the standard set forth in Subsection (A).

SECTION 800.050 GENERAL LAYOUT OF STREETS

- A. All subdivision streets shall be designed and arranged to provide for the continuation of existing streets in adjoining subdivisions and, to the extent possible, the anticipated projections of streets through adjoining unsubdivided or undeveloped property to allow for convenient movement of vehicular traffic and the orderly development of adjoining property and shall adhere to the City's master street plan where applicable.
- B. *Major Streets.* Arterial and collector streets through plats shall conform to the major street plan incorporated in the City of St. Robert Comprehensive Plan and the design criteria set forth in Chapter 804 of this Regulation. Major streets shall be continuous, and in alignment with existing, planned, or platted streets with which they are to connect. Wherever a plat abuts or is divided by a major street designated by the City Plan, whether any part thereof has or has not been dedicated or used by the public, the developer shall dedicate any lands within such plat that are necessary to provide conformity with the major street plan. Such dedication shall be shown on the plat, and the developer shall receive no compensation for such dedication.
- C. *Local Streets.* Local streets shall connect with surrounding streets (including existing, planned, or platted streets) where necessary to permit the convenient movement of traffic between residential neighborhoods or to facilitate access to neighborhoods by emergency service vehicles or for other sufficient reasons, but connections shall not be permitted where the effect would be to encourage the use of such streets by substantial through traffic. Local residential streets shall be curvilinear in design, to avoid non-conformity of lot appearance.
- D. Cul-de-sacs, circles and loop streets are encouraged so that through traffic on minor residential streets is minimized. Cul-de-sacs shall be no longer than five hundred (500) feet, and shall terminate in an open circular paved space having a minimum diameter of ninety (90) feet to outside of pavement or curb. No permanent paved surface or curb and gutter shall be required on the circle of a temporary cul-de-sac for a period of twenty-four (24) months where the street is to be dedicated for continuation beyond the temporary turning circle. Cul-de-sacs that are to be longer than 500 feet in length will require the construction of permanent intermediate turnarounds that do not exceed a maximum of 500 feet in spacing.
- E. All permanent dead-end streets (as opposed to temporary dead-end streets, see Subsection (H), below) shall be developed as cul-de-sacs in accordance with the standards set forth in Subsection 800.050 (D). Except where no other practicable alternative is available, such streets may not extend more than 500 feet (measured to the center of the turnaround).
- F. Half-streets shall not be permitted.

- G. *Alleys*. Alleys shall not be approved in residential districts, except where justified by special conditions, such as the continuation of an existing alley in the same block.
1. Where alleys are provided in residential areas, they shall be developed with a minimum right-of-way width of thirty (30) feet and the improved roadway shall be a minimum of eighteen (18) feet. Curb and guttering shall not be required for alleys within a residential area.
 2. Alleys that are necessary for property that is to be developed for nonresidential use shall have a minimum of a forty (40) foot right-of-way, and the improved roadway shall be thirty (30) feet. Curb and guttering must be developed as an integral part of the finished roadway.
 3. Dead-end alleys shall be avoided wherever possible, but if unavoidable, such dead-end alleys may be approved if adequate turnaround facilities are provide at the closed end.
- H. *Frontage Roads*. Whenever a plat abuts or contains an existing or proposed major street, or non-residential land use, the Planning and Zoning Commission may require frontage roads, screen plantings, deep lots, or such other treatment as may be necessary for adequate protection of residential properties and to afford separation of through and local traffic. Construction of all frontage roads will adhere to the same development criteria for public street improvements as delineated in other sections of this Regulation.
- I. Whenever connections to anticipated or proposed surrounding streets are required by this Section, the street right-of-way shall be extended and the street developed to the property line of the subdivided property (or to the edge of the remaining undeveloped portion of a single tract) at the point where the connection to the anticipated or proposed street is expected. In addition, the Planning and Zoning Commission may require temporary turnarounds to be constructed at the end of such streets pending their extensions when such turnarounds appear necessary to facilitate the flow of traffic or accommodate emergency vehicles. Notwithstanding the other provisions of this subsection, no temporary dead end street in excess of 500 feet may be created unless no other practicable alternative is available.

SECTION 800.060 RELATIONSHIP TO TOPOGRAPHY

- A. Streets shall be related appropriately to the topography. In particular, streets shall be designed to facilitate the drainage and stormwater runoff objectives as set forth in Article IV of this Regulation, and street grades shall conform as closely as practicable to the original topography.
- B. Where unusual or exceptional conditions exist, the City Engineer may modify these requirements, however, in no case may streets be constructed with grades in excess of fifteen (10) percent, except that a residential street may have a maximum grade of twelve (12) percent when approved by the recommendation of the City Engineer.

SECTION 800.070 CREATION OF BLOCKS - STREET INTERSECTIONS

A. Block Length:

1. Intersecting streets, which determine lengths, shall be provided at such intervals as to provide adequate access and to meet existing streets in the neighborhood.
2. Where no existing plats are recorded, the blocks shall not exceed one thousand five hundred (1,500) feet in length except where topography or other conditions justify a departure from this maximum.
3. In blocks longer than eight hundred (800) feet, the Public Works Director may require pedestrian ways and/or easements through the interior of the block. Such pedestrian ways shall have a minimum width of ten (10) feet.

B. Block Width:

1. Interior blocks shall have sufficient width to provide for two (2) tiers of lots of appropriate depth.
2. Exceptions to the prescribed block width shall be permitted for exterior blocks that border the plat boundary, or blocks adjacent to highways, major streets, railroads, or waterways.

C. Large Blocks. When a tract is platted for subdividing into lots that are larger than normal building lots or parcels, such lots and parcels shall be arranged so as to permit the continuous extension and openings of future streets, and appropriate resubdivision, with provision for adequate utility connections and easements for such resubdivisions.

1. Streets shall intersect as nearly as possible at right angles, and no two streets may intersect at less than 60 degrees. Not more than two streets shall intersect at any one point.
2. Whenever possible, proposed intersections along one side of a street shall coincide with existing or proposed intersections on the opposite side of such street. In any event, where a centerline offset (jog) occurs at an intersection, the distance between centerlines between of the intersecting streets shall be not less than 150 feet.
3. Local streets shall intersect with surrounding collector or arterial streets at safe and convenient locations.

SECTION 800.080 RIGHT-OF-WAY AND ROADWAY WIDTHS

A. Street rights-of-ways are to be designed and developed to serve the following functions:

1. Carry motor vehicle traffic, and in some cases, allow on-street parking.
2. Provide safe and convenient passageway for pedestrian traffic.

3. Serve as an important link in the development's drainage system.
- B. In order to fulfill these objectives, all public streets shall be constructed to meet the following general design criteria and as further designated by the guidelines set forth in Article IV of this Regulation:
1. *Collector Street.* The right-of-way shall be a minimum of 60 feet wide and the improved roadway surface shall be 36 feet wide (back-of-curb to back-of-curb). No parking shall be permitted for either side of the street.
 2. *Frontage Street.* The right-of-way shall be a minimum of 60 feet wide and the improved roadway surface shall be 30 feet wide (back-of-curb to back-of-curb). No parking shall be permitted for either side of the street.
 3. *Local Street.* The right-of-way shall be a minimum of 50 feet wide and the improved roadway surface shall be 28 feet wide (back-of-curb to back-of-curb). Parking on either side of the street shall be regulated by separate ordinance as adopted by the St. Robert Board of Aldermen.
 4. *Cul-de-sac.* The minimum right-of-way diameter shall be 90 feet wide and the improved roadway surface radius shall be 45 feet wide (back-of-curb to back-of-curb). Parking on either side of the street shall be regulated by separate ordinance as adopted by the St. Robert Board of Aldermen.

SECTION 800.090 CURB & GUTTER

- A. All streets shall be constructed with curb and gutter, and shall conform to criteria set forth in this Regulation.
- B. Street widths shall be measured from back-of-curb to back-of-curb.

SECTION 800.100 SIDEWALKS

- A. All new and existing sidewalks which are to be constructed or reconstructed shall be designed to enable persons with disabilities using wheelchairs to travel freely and without assistance by integrating a ramp into the curbing so that the sidewalk blends with street and driveway crosswalks at a common level.
- B. Sidewalks shall be constructed along one side of local and collector streets. The sidewalks required by this section shall be five (5) feet in width. The grass median between the back-of-curb and the sidewalk edge parallel to the back-of-curb will be a minimum width of 24 inches to allow for sufficient area for the placement of mailboxes and of street lighting.
- C. Sidewalks shall be permitted to terminate at the curb-line of the radius flare within cul-de-sacs.
- D. Sidewalks shall not be required to be constructed within alleys, and will not be permitted along arterial street right-of-ways unless recommended for approval by the City Engineer.

SECTION 800.110 STREET LIGHTS

- A. All public street right-of-ways, and other common areas or facilities in subdivisions shall be sufficiently illuminated to ensure the security of property and the safety of persons using such streets, sidewalks, and other common areas of facilities. All street lighting costs will be borne by the developer.
- B. Street lights shall be constructed within the street right-of-way with a maximum spacing of 400 feet using lighting poles provided by the City of St. Robert and the cost of which shall be paid by the developer's prior to the commencement of any street improvement construction activity.
- C. All street lighting will be connected by underground wiring. The developer shall be responsible for all trenching work and installation of all electric conductors in conduit to the street light, and the City of St. Robert will be responsible for the final electrical connections and testing of said lights to ensure proper operation.
- D. All entrances and exits in off-street parking areas used for nonresidential purposes and in two-family or multifamily residential developments containing more than four dwelling units shall be adequately lighted to ensure the safety of public and the security of the buildings.

SECTION 800.120 FIRE PROTECTION

- A. Every development shall include a system of fire hydrants sufficient to provide adequate fire protection for the buildings located or intended to be located within such development.
- B. The presumption established by this Regulation is that to satisfy the standard set forth in Subsection A:
 - 1. Fire hydrants in residential areas shall not exceed 600 feet between hydrants; and
 - 2. Fire hydrants in non-residential areas shall not exceed 300 feet between hydrants.
- C. Fire hydrants shall be placed within the green space area behind the curb line of publicly dedicated streets that have curb and gutter. All fire hydrants will be provided to the developer by the City of St. Robert at no expense to the developer.
- D. All fire hydrants shall have two 2 ½ inch hose connections and one 4 ½ inch hose connection. The 2 ½ inch hose connections shall be located at least 21 ½ inches from the ground level. All hydrant threads shall be national standard threads.
- E. Water lines that serve hydrants shall be a minimum of six inch (6") lines, and, unless no other practicable alternative is available, no such lines shall be dead-end lines.

SECTION 800.130 UTILITIES AND APPURTUNENCES

- A. All sanitary sewer and water improvements and appurtenances to be constructed within public right-of-ways and dedicated easements shall conform to the requirements of this Regulation.
- B. In addition to the specific criteria stipulated herein, the following additional regulatory guidelines are set forth as standard policy of the City of St. Robert Public Works Department:
 - 1. All sanitary sewer mains constructed by the City shall terminate at the property line of the subdivision or land to be developed. Continuance of service mains shall be the responsibility of the developer/owner, and the cost of such extensions to provide service shall be borne solely by the developer. All plans, specifications and construction permits shall be reviewed and approved by the City prior to the commencement of any improvements legally taking place.
 - 2. All water service mains constructed by the City shall terminate at the property line of the subdivision or land to be developed. Continuance of service mains shall be the responsibility of the developer/owner, and the cost of such extensions to provide service shall be borne solely by the developer. All plans, specifications and construction permits shall be reviewed and approved by the City prior to the commencement of any improvements legally taking place.
 - 3. All buildings and structures requiring water and/or electrical service shall be individually metered. No multiple tenancy commercial plazas shall be authorized one meter for the entire structure, and all two-family and multiple-family units shall be individually metered without exception.
 - 4. All pole mounted and pad mounted electrical transformers shall be constructed at the property line of the development, as determined by the Department of Public Works.
- C. Any waiver of the requirements set forth in subparagraph B above, shall be made only by the authorization of the City of St. Robert Board of Aldermen.
- D. Final acceptance of any sanitary sewer or water infrastructure improvements will be considered only when all inspection, testing and as-built drawings are completed as required by these Regulations.

SECTION 800.140 STORM WATER CONTROL

All right-of-way developments shall provide a storm water drainage system that is designed in conformance with the Land Development Regulations, and Chapter 804 of this Regulation.

SECTION 800.150 MAINTENANCE OF PUBLIC RIGHT-OF-WAY

- A. The developer shall be responsible for maintaining all improvements required by this Regulation or any permit issued in accordance with its provisions, until such time as the offer of dedication to the public has been accepted by the Board of Aldermen. This means that streets and parking areas, water and sewer lines must be properly maintained so that they can be used in the manner intended.

- B. All pavement, surfacing, driveways, curb, walks, buildings, utility poles, guy wires, and other surface structures affected by construction operations in connection with the performance of the development, together with all sod and shrubs in yards, parks, and parking, shall be maintained and if removed, or otherwise damaged, shall be restored to the original condition by the developer.
- C. The Developer shall be responsible for, including any damage caused by settlement of backfill placed beneath pavements, street, road, and driveway surfacing, and drainage and other structures, and beneath sod in yards, parking lots, and parks, which may occur at any time prior to, and during a period of one (1) year from and after the date of final acceptance of the work by the City of St. Robert; during such period the Developer shall at his own cost and expense refill all excavations where backfill damage to structures, pavements, surfacing, and sod caused by such settlement, to the satisfaction of the City. Should the Developer fail to repair settlement that may occur as described above within thirty (30) days after being given notice thereof, the Owner shall have the right to repair such settlement and charge the cost of such repairs to the Developer.
- D. The Developer will be held responsible for all damage to roads, highways, shoulders, ditches, embankments, bridges, culverts and other property, caused by him or any of his subcontractors in hauling or otherwise transporting materials to and from the several sites of the work, regardless of the location of such damage. The Developer shall make arrangements relative to the payment for, or repair or replacement of, such damage or damaged surfaces or structures which are satisfactory and acceptable to the Owners or Owner of such damaged surfaces or structures, or to their legally responsible officers, agents or other representatives, at the Developer's own cost and expense.

SECTION 800.160 ACCEPTANCE OF DEDICATED RIGHT-OF-WAYS

- A. Approval of a subdivision plat does not constitute formal acceptance by the City of St. Robert the offer of dedication of any streets, sidewalks, sanitary sewers, storm sewers, other utility infrastructures, parks, or other public facilities shown on a plat.
- B. The aforementioned offer of dedication will only be considered for acceptance by the Board of Aldermen when the developer submits a formal written request petitioning for acceptance of the street right-of-way to the Director of Public Works after all dedicated areas have been constructed in their entirety.
- C. An affidavit, from a registered engineer in the State of Missouri, must accompany the developers written request which shall affirm that all public improvements have been constructed in accordance with the standards and specifications of the original approved engineered plans, and that all new streets have in fact been constructed within the platted right-of-ways and dedicated easements of the development. Any infrastructure improvements found to be constructed outside the duly platted right-of-way or easements areas will require the submittal of a duly recorded easement showing the Pulaski County Records of Deeds certification. Request will no be processed or considered unless all necessary easements are duly filed and a copy of such is filed with the Director of Public Works.
- D. *As-built Construction Drawings.* The developer shall submit construction (as-built) drawings to the Director of Public Works upon completion of the project and prior to final acceptance of the project by the City Council. The design engineer shall provide the City with one (1) set of prints for all

infrastructure improvement projects corrected to show the project as constructed and shall accurately and completely denote all changes made during the course of the work. Each sheet within the plans shall be clearly marked as “Conforming to Construction Records” and shall include the date of revision and certifications by the engineer. Failure to provide the required documentation delineating the “as-built” construction of the improvements will delay the processing of the developers request until compliance with this requirement is met. As-built plans shall contain the following graphical infrastructure improvements that were constructed to support the development:

1. Original platted street right-of-ways and dedicated easement alignments, and
 2. “As-built” locations of all completed street roadways, curbs and gutters, sidewalks and driveway entrances; and
 3. “As-built” locations of all completed sanitary sewer mains and service lines, water mains, natural gas lines and Stormwater conveyances; and
 4. “As-built” locations of all water meters and valves, gas valves, manholes, stormwater inlets, fire hydrants, street lights
 5. “As-built” finished road grade profiles and original profile grades.
- E. The Public Works Director shall submit a copy of the developer’s request and the engineer’s affidavit to the Land Use Administrator for the purpose of scheduling the request with the Planning and Zoning Commission as is required by Chapter 89 of the Revised Statutes of Missouri. A written recommendation from the Director of Pubic Works shall accompany the documentation and shall summarize the acceptability of the plans, construction methods, testing and inspection results that are required by this Regulation.
- F. The recommendations of the Planning and Zoning Commission shall be forwarded to the Board of Aldermen for their final review and approval of the offer of dedication by the developer. Upon the acceptance of the offer of dedication by the City Council, the bond may be released back to the developer in whole or in a portion thereof as determined by the City Council.
- G. The developer shall remain, and be held responsible, for the abatement of any and all defects of the accepted dedicated areas for a period not to exceed twelve (12) months.

CHAPTER 802: PLAN REQUIREMENTS FOR STREET IMPROVEMENTS

SECTION 802.010 SCOPE

- A. For the purpose of this Chapter, infrastructure improvements shall be designated as those streets, curbs and gutters, sidewalks, street lights, water mains, sanitary sewer lines, stormwater conveyances, natural gas lines, and any other utility services and appurtenances that are necessary for the functional development of all residential and nonresidential land uses in the City of St. Robert.
- B. All plans, project specifications 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 this Regulation and with all other applicable City codes and ordinances.
- C. 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 will be required.
- D. The City of St. Robert 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). The City of St. Robert, through the approval of the plans and/or report, assumes no responsibility for the completeness and/or accuracy of the public improvement plan or report.
- E. All developers and engineering consultants submitting plans for infrastructure improvement projects to the City for review are required to follow the procedures outlined in the following. No infrastructure improvements may be constructed in the City of St. Robert without the prior approval of the office of the Director of Public Works.
- F. 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 of St. Robert and, as such, an appropriate note shall be included on the drawings.

SECTION 802.020 PLAN REVIEW AND APPROVAL

- A. Three (3) complete sets of prints of engineered plans and specifications shall be submitted to the office of the Director of Public Works for review. The normal time for review shall be 15 working days. In the case of abnormally large sets of prints or of extremely complicated drawings, a longer time may be required for review.
- B. The project plans will be routed through appropriate City departments to obtain a complete review of all facilities that may be affected by the proposed construction. In each review, comments and necessary revisions will be noted on the project plans.
- C. Subsequent to the review of the plans, the design engineer, consultant or his representative shall be notified by telephone that the submittal is ready for return.

- D. The design engineer or consultant will be required to make all necessary corrections or revisions as noted on the project plans. Upon completion of the revisions and/or corrections the plans will again be submitted to the Director of Public Works office for further review. Revised sheets submitted shall contain a revision block with identifying notations and date of revisions. All previous project plans must accompany each re-submittal. If the project plans are not submitted with the revised drawings, the plans shall be returned to the consultant without action until such time as they are included with the submittal.
- E. Plans will not receive final approval until all supplemental easements, if necessary, have been duly recorded and a copy has been provided to the City. Additionally, and in conjunction with submittal of final plans, all permits and/or application for permits, shall be submitted to the appropriate agency for approval prior to final approval of the plans by the Director of Public Works (i.e., Department of Transportation, Department of Natural Resources, etc.).
- F. The length of time for final plan approval will normally be within 5 working days. Upon notification of final approval of the plans by the Director of Public Works, the number of sets of plans as specified in the appropriate section of this Appendix shall be submitted for signing and distribution.
- G. Public improvement plans and engineering reports are approved initially for one (1) year after the date noted on the returned cover sheet. After one (1) year, the plans or report shall become null and void and must be resubmitted prior to approval of construction of that project. Such plans and/or reports shall be resubmitted to the office of the Director of Public Works in accordance with the foregoing outlined procedures and requirements.
- H. The Design Engineer shall send one set of plans to each of the private and public utility companies having territorial jurisdiction in the area of the improvement upon notification that the drawings have been approved.

SECTION 802.030 MANDATORY GENERAL NOTES – STREET PLANS

- A. The following general notes shall be included on all plan submittals for street improvement projects. These notes are not meant to be all-inclusive, and in certain situations the Director of Public Works may require the use of additional notes.
 - 1. 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 Director of Public Works before any construction will be permitted.
 - 2. The City of St. Robert plan review is only for general conformance with the design criteria delineated in the Infrastructure Development Regulations and other applicable City Codes. The City is not responsible for the accuracy and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City of St. Robert through approval of this document assumes no responsibility other than that as stated above for the completeness and/or accuracy of this document.

3. The developer shall have one (1) signed copy of the plans (approved by the City of St. Robert) and one (1) copy of the appropriate project specifications at the job site at all times.
4. Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the Director of Public Works is notified of such intent, and all required and properly executed bonds and permit fees are received and approved by the Director of Public Works.
5. 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 developer to obtain the location of same shall be repaired or replaced by the developer at his expense.
6. All backfill shall be tamped.
7. 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 1,000 feet of street construction. Laboratory technicians shall collect soil samples for such tests. The developer shall pay for all testing laboratory expenses.
8. All materials and workmanship associated with this project shall be inspected by the City of St. Robert. The City of St. Robert reserves the right to accept or reject any such materials and workmanship that does not conform to the standards set forth in the City of St. Robert Infrastructure Development Regulations and other codes and ordinances.
9. The Developer shall notify the City of St. Robert Public Works Department twenty-four (24) hours prior to the beginning of construction.
10. Relocation or extension of any street, stormwater line or service line thereof required for the construction of this project shall be the responsibility of the developer and shall be at his expense.

SECTION 802.040 SIGNATURE BLOCK – STREET PLANS

A signature block shall be required on the title sheet of all plans and reports submitted for review and approval. All plans require the signature of the Director of Public Works and the date of such signing for formal approval by the City.

SECTION 802.050 PLAN CONTENT

- A. The following criteria are established to provide a uniform system of plan preparation that will aid the Engineer in preparing plans for infrastructure improvements within the City of St. Robert. It is not intended that the criteria be an ironclad set of rules that would restrict the Engineer from utilizing imaginative design; however, all items as described below shall be shown on the plans in some manner.

- B. All plans and specification for the construction of infrastructure improvements within either publicly-financed or privately-financed developments shall be prepared by a professional engineer licensed in the State of Missouri and submitted to the office of the Director of Public Works for review. Subsequent to the review, the Engineer will be notified of approval of the plans as submitted, or of any necessary changes.
- C. Upon completion of the review and approval of the plans by the Director of Public Works, three (3) sets of plans (as approved) must be submitted for signing and distribution.
- D. In addition, one set of approved plans shall be sent to each of the utility companies providing service in the proposed construction area.
- E. The suggested plan sheet size is 24" X 36" with all sheets in a given set of plans being of the same size. 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 ten (10) feet vertical, unless otherwise approved by the Director of Public Works for special cases.
- F. All engineered street improvement plans shall consist of the following minimum requirements that have been developed in accordance with standard engineering practice:
 - 1. *Title Sheet.* The following items shall be included on the title sheet.
 - (a) Name of project.
 - (b) Index of sheets included in plans.
 - (c) A vicinity map adequately showing project location of the project area.
 - (d) General description of project area (by Township, Range, and Section).
 - (e) A summary of plan quantities of principal items, such as:
 - Length of curb and gutter, sidewalks, square yardage or tonnage of asphaltic concrete pavement.
 - Pipe sizes and material, lengths, number of inlets, etc. (storm sewers)
 - (f) Additionally, a separate column shall be provided for listing of "as-built" quantities once the project has been completed and accepted by the City.
 - (g) The project control benchmark shall be identified as to location and elevation.
 - (h) Name, address and telephone number of consulting engineer and owner/developer.
 - (i) List containing name and telephone number of each utility company and public agency listed below;

- Electric Power
- Gas
- Water & Sewer
- Telephone
- Cable television
- Public streets
- Highway Department (District Office)

(b) Director of Public Works signature block.

(c) Project engineer's name and seal.

(d) Revision schedule.

2. *General Layout Information.* The following items shall be included for all improvement projects.

(a) A legend of symbols and abbreviations shall be shown which shall apply to all sheets.

(b) North arrow and graphic scale. Scale of the general layout map shall be one (1) inch equals one hundred (100) feet, unless otherwise approved.

(c) 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.

(d) An un-platted tract shall have an accurate tie to at least one (1) quarter section corner.

(e) Boundary line of project area.

(f) A list of the mandatory general notes to the contractor

(g) Location of all existing and proposed streets and roadways within and adjacent to the project area.

3. *Site Grading Plan.* The following items shall be included on the general layout sheet for all street and/or drainage improvement projects.

(a) Property lines identified as to existing or proposed lot and block number.

(b) Elevation and location of nearest datum.

(c) Existing and final grading contours drawn at intervals not to exceed five (5) feet. The Director of Public Works dependent on the character of the topography may require intervals of less than five (5) feet.

- (d) Location of all existing and proposed drainage system improvements.
 - (e) Drainage calculation summary table containing the following information.
 - Pipe size and slope
 - Pipe capacity
 - Velocity (design and at capacity)
 - Time of concentration
 - Runoff coefficient
 - "K" factor (antecedent precipitation)
 - Design storm (return frequency)
 - Incremental tributary acreage
 - Accumulative acreage
 - Rainfall intensity
 - Rainfall runoff
4. *Plan and Profile Sheets.* The following items shall be included on the plan and profile sheets for all improvement projects
- (a) North arrows and graphic scale.
 - (b) Elevation and location of all applicable bench marks (USGS datum).
 - (c) Existing and proposed streets with names and widths.
 - (d) Property lines properly identified as to existing or proposed lot, block and subdivision.
 - (e) 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.
 - (f) All existing and known proposed improvements within seventy-five (75) feet each side of centerline 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.
 - (g) All existing easement and right-of-way information recorded with the county.
 - (h) All proposed easement and right-of-way information.
 - (i) Minor construction notes shall appear on the proper plan and profile sheets.
 - (j) Locations and widths of existing and proposed sidewalks.

(k) In addition, the following items shall be included on the plan and profile sheets for street and storm drainage improvements:

Streets

- Station and critical elevation (flow-line, invert of pipe, etc.) of all utility or drainage appurtenances, existing and proposed.
- 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 course table data.
- Centerline stations of all non-single family residential driveways and all intersecting roadways.
- Basis of plan view and profile elevations shall be the same, i.e., flow-line and flow-line, 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 flow-line (preferred) for 6" vertical curb and gutter; or lip of gutter, or flow-line (preferred) for combination curb, gutter and walk. The basis for as-built information shall be the same as the design (both flow-line or both top of curb, etc.).
- Stationing continuous for the entire portion of the roadway shown in the plan view (100 feet minimum stationing), with the centerline station of all non-single family residential driveways and all intersecting roadways clearly labeled.
- 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 P.C.R.'s, horizontal P.C.'s, P.C.C.'s, etc; existing and proposed.
- Station and elevation of all vertical grade breaks, existing (as-built) and proposed. (The use of grade breaks with proposed construction is discouraged.)
- Distance and grade or slope between grade breaks.
- Vertical curves, where necessary, with VPI, VPC, and VPT, 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.
- Design speeds and stopping sight distances for all vertical and horizontal curves.
- Existing and proposed utilities. Field verified elevations and locations are required to be indicated on the plans for all utilities (existing or proposed) that will potentially affect the design and construction of the improvement.

Storm drainage

- 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.
 - 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.
 - Roadway section and grade including type of curb and gutter and gutter flow directions.
 - Erosion control and energy dissipation devices.
 - Proposed out-fall point for runoff from the project area along with required easement information.
 - Routing and cumulative flows at various critical points along storm runoff.
 - Critical minimum finished floor elevations of all buildings adjacent to the project for protection from major storm runoff.
 - Distances between storm sewer system components and other existing or proposed utilities within the right-of-way or drainage easement.
5. *Cross-Section Sheets.* The following items shall be included on the cross-section sheets for all street and storm drainage improvement projects:
- 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, flow-line, top curb, lip of gutter, etc.), roadway width, right-of-way, type of curb, gutter, and walk, pavement cross slope, etc. Cross-sections to show existing grade lines a minimum of ten (10) feet beyond right-of-way lines.
 - Cross-sections shall be shown at all intersecting streets and driveways.
 - Channel cross-sections shall be shown for all drainage channel improvements.
 - Additional cross-sections shall be shown as required by the Director of Public Works to clearly describe the extent of the grading operations.
6. *Standard and Special Detail Sheets.* Detail sheets shall be included to show all details of appurtenances, materials and construction. Details shall be drawn clearly and neatly with proper identifications, dimensions, materials, and other information necessary to insure the desired construction.
7. A summary of plan quantities of principal items, shall be included in the plans that are submitted for review and approval. The following information shall be provided as a minimum requirement:
- (a) Length of curb and gutter, square yardage or tonnage of asphaltic concrete pavement, etc.
 - (b) Pipe sizes and material, lengths, number of inlets, of storm sewers
 - (c) Length of sidewalks and cubic yards of concrete

(d) Pipe size and material, lengths, number of manholes, of sanitary sewers.

(e) Pipe sizes and material, lengths, number of valves, of water lines.

G. Street improvement plans shall depict the location of the all street lights and all related appurtenances shall be submitted with the street improvement drawings for review. Such review shall be for the purpose of verifying easement locations to be indicated on the final plat. Plans for street light installation shall conform to all applicable standards of the City of St. Robert.

H. Storm sewer construction plans shall be incorporated into street construction drawings and shall include the following design elements:

1. 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.
2. 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.
3. Roadway section and grade including type of curb and gutter and gutter flow directions.
4. Erosion control and energy dissipation devices.
5. Proposed out-fall point for runoff from the project area along with required easement information.
6. Routing and cumulative flows at various critical points along storm runoff.
7. Critical minimum finished floor elevations of all buildings adjacent to the project for protection from major storm runoff.
8. Distances between storm sewer system components and other existing or proposed utilities within the right-of-way or drainage easement.

CHAPTER 804: STREET DESIGN SPECIFICATIONS

SECTION 804.010 GENERAL CRITERIA

- A. Proposed street improvements within the City shall conform to the pattern established in the Major Street Plan as adopted by the City of St. Robert.
- B. 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 of St. Robert. Plans for said improvements shall be submitted to the Director of Public Works for approval and shall include all information as may be required or described hereinafter.
- C. Deviations and/or alternatives from the established design criteria set forth herein shall be authorized upon final approval of the Director of Public Works, and only after a review of the submitted plans and written justification for said design alternative is provided from the project’s design engineer.

SECTION 804.020 DESIGN CLASSIFICATION CRITERIA

- A. The classification of streets shall be generally defined as follows:
 1. *Local Streets.* A street designed to provide access to abutting property from collector and arterial streets.
 2. *Collector/Frontage Streets.* Streets, which, in addition to serving abutting properties, intercept local streets, connect with community facilities and carry neighborhood traffic to the arterial street systems. Commercial streets serve areas predominately zoned for commercial or industrial uses.
 3. *Arterial Streets.* A street or road of considerable continuity which serves or is intended to serve as a principal traffic-way between separated areas or districts and which is the main means of access to the collector street system, highways, or expressways.

SECTION 804.030 STREET DESIGN STANDARDS

A. *Design Table.*

	Collector*	Local	Frontage
Minimum Right-of-way Width (feet)	60 feet	50 feet	40 feet
Minimum Number of Lanes	2	2	2
Minimum Lane Width (feet)	12 feet	12 feet	12 feet
Street Width (BOC to BOC) (feet)	36 feet	28 feet	30 feet
Minimum Streetlight Spacing (feet)	300 feet	400 feet	300 feet
Minimum Compacted Subgrade Depth (inches)	6 inches	6 inches	6 inches
Minimum Aggregate Base Course Depth Type 1 or Type 2 (inches)	8 inches	6 inches	8 inches

Minimum Asphaltic Concrete Pavement Depth (inches)	4 inches	4 inches	4 inches
Volume Range (trips per day)	1,000-4,500	Less than 1,000	1,000-4,500
Design Speed (mph)	30 mph	20 mph	30 mph
Maximum Road Grade	8%	10%	8%
Minimum Road Grade	0.5%	0.5%	0.4%
Minimum Interior Corner Radius of Pavement (feet)	50 feet	25 feet	25 feet
Minimum Stopping Sight Distance (feet)	300 feet	250 feet	200 feet
Minimum Intersection Spacing (feet)	500 feet	150 feet	200 feet
Maximum Intersection Spacing (feet)	N/A	1400 feet	N/A feet
Minimum Horizontal Curve Radii	300 feet	280 feet	200 feet
Minimum Length of Vertical Curve (feet)	100 feet K = 40	100 K = 30	100 feet K = 40
Minimum Driveway Entrance Spacing (feet)	150 feet	One per property	150 feet
Minimum Sidewalk Width (feet)	5 feet (One Side)	5 feet (One Side)	N/A
Parking Permitted	No	One Side Only	No
Storm Sewers	Yes	Yes	Yes
Curb and Gutter Type	Barrier	Roll Back	Barrier

- B. *Off-Center Street Intersections.* A minimum centerline-to-centerline dimension of one hundred and fifty feet shall separate off-center street intersections.
- C. *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.
- D. *Minimum Angle of Intersection.* All intersections shall meet at approximately a 90-degree angle. Skewed intersections should be avoided, and in no case will the angle be less than 60 degrees.
- E. *Maximum Gradient.* The maximum gradient for streets as noted in Section C 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.
- F. *Grading Gradients.* 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.
- G. *Tangent Length.* The minimum tangent length between reverse curves shall be fifty feet for local streets and one hundred feet for collector and arterial streets, except that no tangent will be required

for radii longer than five hundred feet.

- H. *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 re-compacted to 95% to standard density.
- I. *Storm Drainage.* All storm drainage works constructed in connection with street improvements shall be designed in accordance with the design criteria for storm sewers and appurtenances.
- J. *Cul-de-sacs.* At locations where streets are to be terminated and a vehicular connection between adjacent streets is not required a cul-de-sac may be required. Such cul-de-sac shall be constructed with a minimum radius of forty-five (45) feet to the back of the curb.
- K. *Temporary Turnarounds.* 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 five (5) lots, a temporary cul-de-sac shall be constructed with a minimum radius of forty-five (45) feet. The temporary cul-de-sac shall be constructed of asphaltic concrete with a minimum depth of six (6) inches. Curb and gutter will not be required. The cul-de-sac shall be constructed within the limits of a permanent construction right-of-way.
- L. *Monument Boxes.* Monument boxes conforming to the standard drawings shall be installed at all quarter section corners as involved in the street construction.
- M. *Other Design Criteria.* The American Association of State Highway and Transportation Officials (AASHTO) or other applicable AASHTO design guides shall in accordance with the most current edition of "A Policy on Geometric Design of Highways and Streets" author all other street design elements not contained within this criteria.
- N. *Driveway Elevations.* Driveways shall attain top of curb elevation within the right-of-way. Driveway grades within right-of-way shall be 8% maximum until curb height is reached. Break-over grades for crest drives shall be 8% maximum and sag drives shall be 12% maximum. Driveway elevation shall be not more than 6" above or below the normal shoulder elevation at the right-of-way line, to allow for a smooth sidewalk profile.

SECTION 804.040 STORM DRAINAGE DESIGN STANDARDS

- A. This section sets forth the minimum technical criteria for the analysis and design of drainage systems. All development plans submitted for approval to the City of St. Robert must be accompanied by an adequate storm drainage system analysis and design in accordance with the criteria as hereinafter described and shall be performed by a licensed professional engineer in the State of Missouri.
- B. The criteria set forth in this section shall apply primarily to that element of the drainage system outside the limits of the 100-year regulatory flood plain unless otherwise noted. Improvements within the limits of the 100-year floodplain shall conform to requirements set forth in applicable City

codes and ordinances and the regulations of any other agency having jurisdiction over such area.

C. *Minimum Standards of Analysis.* Unless otherwise approved by the Director of Public Works, the following criteria will be utilized to determine the adequacy of any storm drainage facility design submitted for approval.

1. *Methodology of Analysis.* In determining the amount of stormwater runoff resulting from a development and the amount of flow at various points throughout the drainage system, it is important for the designer to relate the methodology to be utilized in his calculations to the proportionate size of the tributary watershed areas. In developments where the area contributing runoff is one hundred (100) acres or less, the Rational Method of calculating the quantity of runoff shall be utilized. Developments where the area contributing runoff exceeds one hundred (100) acres shall be designed using the unit hydrograph method (SCS) or other methodologies approved by the City Engineer.
2. *Criteria for Drainage System.* All calculations relating to runoff analysis shall be based upon the proposed land use and shall take into consideration any contributing runoff from areas adjacent to the development site. Storm water runoff analysis from adjacent existing developed areas shall be based upon current land usage and topographical features. Property adjacent to the study area that is undeveloped shall be considered as fully developed in accordance with the most probable anticipated future land use. Such land use shall be determined from the City Comprehensive Plan and the City zoning map. In the event that the future land use of a specific undeveloped property cannot be adequately projected from available information, the average runoff coefficient © to be used shall not be less than 0.65 for use in the Rational Method or an appropriate equivalent value as approved by the Director of Public Works for any other method. The most likely flow pattern to be utilized for an undeveloped area shall be based upon existing natural topographical features.
3. Average land slopes in both developed and undeveloped areas may be utilized to calculate runoff rates. The exception to this shall be in areas with existing well-defined drainage patterns and slopes; in which case the actual slope shall be used.
4. Existing runoff flow rates and velocities at locations of discharge from adjacent upstream developments shall be utilized in the drainage system design. Drainage facilities shall be designed to minimize the velocity of overland flow so as not to cause erosion damage. In areas where excessive velocities exist, adequate dissipating structures shall be provided as required to result in velocities appropriate for the type of erosion control to be utilized or as specified in this criteria.
5. The primary function of roadways within a development shall be reserved for the conveyance of traffic. The use of these facilities as a storm runoff facility shall be restricted to the requirements established and set forth in these design criteria.
6. The utilization of onsite or on-stream detention and natural drainage ways is recommended and encouraged where feasible. Relocation of existing natural drainage ways will not be approved unless such relocation has been substantiated as a result of a thorough and complete analysis of

the resultant consequences.

7. The designer shall consider all problem areas of his design and analysis to prevent the transfer of these problems from one location to another. All points of drainage outfall shall be designed to preclude creation of downstream flooding problems and hazards to the public. Approval will not be given to any project that involves the construction of any structure or the placement of fill material that will hinder or impair surface or subsurface drainage from surrounding areas.

SECTION 804.050 STORMWATER DETENTION REQUIREMENTS

- A. Commercial areas shall be designed based on a 25-year storm. Residential areas may use a 10-year storm.
- B. Stormwater shall be retained such that the rate of run-off leaving the post-developed site is no greater than the pre-development run-off rate. The difference between the two runoff rates is the amount that should be detained.
- C. Any formula may be used – HEC-1, etc. or Rational equation, etc. Developments over 100 acres must use the unit hydrograph (SCS) or similar method. Calculations must be submitted to the City Engineer for review.
- D. Detention may be accomplished in nearly any method viable on the project site. This can include detention ponds, tanks, below ground systems or even parking lot or landscape island detention. Discharge may be by use of V-notch walls or small pipe. Innovative solutions are usually acceptable depending upon City staff review. Open basins must be soil lined and have soil placed on interior and exterior side slopes. Soil must be seeded and mulched. Riprap or rock lined basins and berms will only be allowable under unusual circumstances and with special permission from the City.
- E. Discharge velocities must not be erosive. The follow channel linings are required:

Velocity (feet per second)	Lining Type
Less Than 3 fps	Seeded
3 to 5 fps	Staked Sod
5 to 10 fps	15” Depth of Stone Rip-Rap
10 to 15 fps	Grouted Stone Rip-Rap, Gabion Revetment, or Concrete Paved
Greater Than 15 fps	Concrete Paved or Bedrock

Note: Velocities must be reduced prior to exiting the appropriate lining.

- F. All storm sewers under street pavement must be concrete unless a specific waiver is granted from the Director of Public Works. Flared end-sections are required on all CMP and RCP and concrete aprons and wing walls are required on all concrete box culverts.
- G. Drainage easements must be dedicated to the City where appropriate.

- H. An erosion control plan must be developed and implemented prior to beginning any land disturbance. The plan can include such items as silt fencing, staked straw bales or silt retention ponds to control the run-off during the construction.
- I. *Minimum Acceptable Standards of Design.* Storm water runoff shall be carried by enclosed systems or open channels on the basis of criteria established in this section and subject to the final approval of the Director of Public Works.
1. *Open Channels.* Open channels, natural or improved, may be placed to the rear or side of properties upon approval of the Director of Public Works where the design provides adequate protection to the adjacent property and structures. Such protection shall be through the provision of a 50-year flood plain setback and a minimum clearance from the top of bank to any building of 30 feet.
 2. *Enclosed Systems.* Runoff from drainage areas outside of established or proposed right-of-ways greater than 3 acres in size shall be collected and transported in an enclosed system. Enclosed systems shall also be utilized within the limits of established or proposed right-of-way for roadways and streets. The drainage system shall remain enclosed until the flow rate is such that the runoff from the design storm for a development can no longer be contained within a 72-inch R.C.P. equivalent conduit and an open channel can be entered without negative impact.
 3. At the point of intersection and discharge with the receiving open channel, an energy dissipating structure acceptable to the Director of Public Works shall be provided to limit the discharge velocity from the enclosed system to not more than 5 fps.
 4. Where storm drainage facilities are located along side property lines, such systems shall be enclosed to a point at least 30 feet beyond the rear corner of adjacent buildings unless otherwise directed or approved by the Director of Public Works. A surface swale shall be designed over this area to contain additional run-off from a 50-year storm.
 5. Complete side and rear drainage systems meeting the criteria established previously shall be provided along the boundaries of new subdivisions or developments by the developer or property owner.
 6. *Design Storm Frequencies.* The minimum rainfall event to be utilized in determining the intensity of rainfall for storm flow calculations shall be based on the following land uses:

Table of Storm Return Frequency

Storm Return	Land Use/Zoning Frequency
Residential	10 year
Commercial	25 year
Industrial	25 year
Parks, Open Space, etc.	10 year
Open Channels	25 year
Flood Plains Crossing Arterial Streets and with 40	100 year

Acres or more	
Tributary	50 year

7. Storm drainage systems having more than one land use or zoning classification tributary to the system, shall be designed on the basis of the highest runoff producing land use comprising thirty (30) percent or more of the total tributary area.
8. *Runoff Computation.* The rational method of calculating storm water quantities, $Q = KCiA$, shall be used with the following definitions of terms and arbitrary values:
 - (a) Where “**Q**” is the quantity of runoff in cubic feet per second and is the basis for design of the storm drainage system.
 - (b) Where “**K**” is a dimensionless coefficient to account for antecedent precipitation.
 - (c) Where “**C**” is the weighted coefficient of runoff from the tributary area. Coefficient of runoffs are specified in the “Table of Coefficient of Runoff”.
 - (d) Where “**I**” is intensity of rainfall in inches per hour and shall be determined for the yearly frequency or as derived from intensity duration curves to support this criteria.
 - (e) Where “**A**” is the area in acres contributing to the drainage system. All upstream tributary areas are to be considered as fully developed as zoned or planned at the time of design.

Coefficient of Runoff Table

Land Use/Zoning Classification	Runoff Coefficient (“C”)	Average Percent	Impervious Surface	Use Percent
<i>Commercial:</i>				
Business Areas		0.90	95%	5%
Neighborhood Areas		0.80	85%	15%
<i>Residential:</i>				
Single-family Areas		0.50	35%	65%
Multi-family Areas & Mobile Home Parks		0.65	60%	40%
Churches and Schools		0.75	75%	25%
<i>Industrial:</i>				
Light Areas		0.65	60%	40%
Moderate Areas		0.80	80%	20%
<i>Public Use:</i>				
School Areas		0.75	75%	25%
Church Areas		0.75	75%	25%
Parks and Cemeteries		0.35	10%	90%
Playgrounds		0.35	10%	90%
<i>Agricultural:</i>				
Open Space Areas		0.30	0%	100%
Permanent Unimproved Areas		0.30	0%	100%

9. As an alternate to the above coefficients or for areas not specifically listed above, a composite runoff coefficient based on the percentage of the different types of surfaces involved shall be used.
10. Coefficients with respect to surface type shall not be less than those listed in the following table:

Surface Coefficient Table

Surface Type	Coefficient (“C”)
Asphalt	0.90
Concrete	0.90
Roof Areas	0.90
Turf	0.30

11. Time of concentration (“TC”) equals the overload flow time to the most upstream inlet or other point of entry to the system plus the time of flow in the system upstream from the point under construction. ($TC = Ti + Tt$)
- (a) Inlet time “Ti” shall be calculated utilizing the following formula but shall not be less than 5.0 minutes or greater than 15.0 minutes:

$$Ti = \frac{1.8 \times (1.1 - C) \times D^{1/2} \text{ minutes}}{S^{1/3}}$$

- (b) Travel time (“Tt”) shall be calculated as the length of travel in the channelized system divided by the velocity of flow. Velocity shall be calculated by Manning’s equation assuming all system elements are flowing full without surcharge.
- (c) When the upstream channel is unimproved, it shall be assumed that future construction of drainage system improvements will increase the velocity of flow. Velocity used for calculating “Tt” shall be:

Velocity Table

Average Channel Slope (percent)	Velocity (fps)
Less than 2%	7 fps
2% to 5%	10 fps
Greater than 5 %	15 fps

12. *Antecedent Precipitation*. “K” represents the frequency factor used to account for antecedent precipitation and shall have the following values. The product of $K \times C$ shall not exceed 1.0

Antecedent Precipitation Factors

Storm Return Period (years)	Frequency (“K”)
10 years	1.00
25 years	1.10

50 years	1.20
100 years	1.25

13. Pipe Sizing. Pipe sizes in integrated underground systems shall be determined in accordance with the Manning Formula $Q = \frac{A(1.486)}{n}$

- (a) Manning’s Roughness Coefficient’s shall be used for the values of “n” in the Manning Formula.
- (b) The minimum size storm sewer size shall be twelve (12) inches in diameter (fifteen (15) inches for CMP).
- (c) Storm sewers and inlets shall be of sufficient capacity to adequately carry the anticipated runoff from the design storm. Capacity shall be rated at either inlet or outlet control, whichever condition indicates the least capacity. The drainage system and appurtenant storm inlets shall commence at all locations where the allowable street capacity for the conveyance of storm water runoff is exceeded or where there is a possibility of ponding.

14. All storm drainage systems shall be designed so as to maintain a minimum velocity of flow of three (3) feet per second and a maximum velocity of fifteen (15) feet per second when flowing full. All systems discharging at a velocity in excess of five (5) feet per second shall be designed with an acceptable energy dissipating structure.

- (a) *Depth.* All storm drainage lines shall have a minimum cover of eighteen (18) inches where practical. Cover may be decreased to avoid conflicts or on short laterals, as approved by the Director of Public Works. Special bedding and backfill may be required where cover is less than eighteen (18) inches.
- (b) *Curb Inlet, Junction Boxes and Other Points of Entry.* In general, curb inlets shall be installed at intersections and as required at intermediate points to limit gutter flow width during runoff occurring from the design peak discharge from the tributary watershed area to that which will not encroach on the following center width of streets:

Arterial Streets	24 feet
Collector/Commercial Streets	14 feet
Local Streets	10 feet

15. Because of the potential for street debris to clog inlets and to reflect potential cross section changes due to resurfacing, inlet capacity shall be rated at 80 percent of the theoretical inlet capacity unless otherwise approved by the Director of Public Works.

16. Design shall provide that the hydraulic gradient at any opening through which surface water may enter (or backflow from) the system is 0.5 foot or greater below the opening elevation.

- (a) The hydraulic gradient elevation shall be calculated at the entrance to the outlet line of each structure.
- (b) The crown(s) of pipe(s) entering a structure shall be at or above the crown of the pipe exiting from the structure to provide a minimum fall of the invert in the structure of 0.2 feet for straight flow through the structure or 0.5 feet fall for all other types of flow (bends more than 22.5 degrees deflection angle, multiple lines entering, enlargement transition, etc.) through the structure.

17. Open Channels. Unless in a 100-year designated floodplain or a critical area as determined by the Director of Public Works, open channels shall be designed for the 25-year frequency storm. Open channels shall be sized to adequately carry the design rate of flow without damage. Whenever practical, the channel shall be characterized as slow flowing, be wide and shallow, and be natural in its appearance and functioning.

- (a) Channel capacities shall be computed using the Manning Formula for uniform flow.
- (b) Design flow rates shall be carried within the confines of the open channel with a minimum allowable freeboard of 1.0 foot measured from the water surface to the top of bank.
- (c) Pipe culverts, box culverts, and other structures entering channels shall not project into the normal waterway area.
- (d) Channel design shall include lining or treatment of the invert and sides as required to minimize erosion. Minimum treatment shall including seeding.
- (e) Channel inverts and sides shall be lined in accordance with the following table:

Channel Lining Table

Mean Flow Velocity (fps)	Type of Channel Lining
Less than 3 fps	Seeded
3 to 5 fps	Staked Sod
5 to 10 fps	Stone Rip-Rap (15" minimum depth)
10 to 15 fps	Grouted Stone Rip-Rap, Gabion Revetment or Concrete
Over 15 fps	Concrete or bedrock

- (f) Lining materials having equivalent erosion control properties to those shown in the foregoing table may be used in lieu thereof with the approval of the Director of Public Works.
- (g) Channel sections shall be compatible with the type of lining and maintenance practical to be used. Side slopes shall be as flat as practical. Side slopes of 3:1 shall be considered a normal maximum. Under special circumstances where acceptable lining material is to be utilized, slopes of 2:1 may be considered. Such use in the channel design shall be only where approved the City Engineer. Friction factors used in the design shall consider the type of lining.

(h) Alignment changes shall be achieved by curves having a minimum radius of:

$$R = \frac{VW}{8D}$$

R = Minimum radius of centerline in feet.

V = Average velocity of flow in feet/sec.

D = Depth of flow in feet.

(i) Lining height on the outside (concave) side of curves shall be increased by:

$$y = \frac{D}{4}$$

y = Increased vertical height of lining in feet.

(j) Increased lining height shall be transitioned from y to zero feet over a minimum distance of:

30 (y) feet downstream from the point of tangency (p.t.)

10 (y) feet upstream from the point of curvature (p.c.)

18. *Natural Channels.* Shall conform to the criteria for improved channels except:

(a) Mean flow velocity may be 5 feet/sec without lining.

(b) Freeboard requirements may be satisfied by dedication of an easement to the freeboard elevation plus 1.0 foot vertically.

19. *Culvert.* Culverts under major and minor arterials shall have sufficient capacity to pass the runoff from the appropriate design storm considering 20% of the inlet opening plugged.

(a) The culvert including inlet and outlet structures shall properly take care of water, bed-load and debris at all stages of flow.

(b) *Inlet.* Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall be provide with either flared-end sections or headwalls with wingwalls. Projecting ends will not be acceptable. For large structures, provisions shall be made to resist possible structural failure due to hydrostatic uplift forces.

(c) *Outlets.* Culvert outlets shall be designed to avoid sedimentation, undermining of the culvert, and erosion of the downstream channel. Outlets shall be provided with either flared-end sections or headwalls with wingwalls. Projecting outlets will not be acceptable. Additional

outlet control in the form of riprap, channel shaping, etc., may be required where excessively high discharge velocities occur.

- (d) *Slopes*. Culvert slopes should be such that neither silting nor excessive velocities and scour occur. Generally, the minimum slope of culverts shall be limited to 0.005.
- (e) *Headwater*. Generally, the headwater to diameter ratio (**HW/D**) should not exceed those recommended as follows:

<u>Storm Frequency</u>	<u>HW/D</u>
10 year	< 1.0
25 year	< 1.2
50 year	< 1.5
100 year	< 1.5

- (f) *Tailwater*. The depth of tailwater at the outlet shall be subject to the criteria set forth for headwater.
- (g) *Hydraulic Design*. Culverts shall be analyzed to determine whether discharge is controlled by inlet or outlet conditions for design storm discharge.
- (h) *Structural Design*. The structural design of culverts, whether pipe or concrete box, shall be sufficient for the situation anticipated to be encountered at the site of the proposed work. Such design shall conform fully to all requirements set forth in this criteria and in the technical specifications of the City of St. Robert and shall be as approved by the Director of Public Works.

K. Permanent drainage easements are required to provide adequate access for construction, inspection, and maintenance of all storm drainage system components. All easements shall be dedicated to the City. For new subdivisions, all required easements and setbacks shall be shown on the final plat recorded with the Register of Deeds.

1. Drainage easements shall have minimum widths as described below. A wider easement width may be required at structures or if the easement is shared with other utilities or as determined by the Director of Public Works.
 - (a) *Storm Sewer*. Easements for storm sewers shall be either 20 feet wide or the outside dimension of the conduit plus 10 feet (centered on the conduit), which ever is greater. A wider easement may be required if the depth of cover exceeds 4 feet.
 - (b) *Improved Open Channel*. Easements for improved open channels shall be as wide as the top bank width plus 10 feet on each side, and shall be continuous to the end of the channel.
 - (c) *Natural Open Channel*. Easements for natural open channels shall be the areas between the high bank lines of the channel, plus additional width on each side of the channel as deemed

necessary by the City to allow access for maintenance equipment. The minimum width for a natural open channel easement is 30 feet.

CHAPTER 806: STREET CONSTRUCTION STANDARDS

SECTION 806.010 SCOPE

- A. The developer whose intent is the creation of new streets in the development of any residential or nonresidential subdivision shall adhere to the construction standards set forth in this Article.
- B. The developer shall be responsible for addressing each of the areas in the projects construction specification documents.
 - 1. The design plans and construction specifications shall be approved by the Director of Public Works prior to any work taking place.
 - 2. The developer will coordinate all necessary inspections prior to the commencement of any work.
 - 3. All expenses that relate to required tests of concrete, gradation, compaction or special inspections shall be born solely by the developer. Any costs associated with the relocation or modification of existing utility infrastructure to support the developer’s project shall be the sole responsibility of the developer.
- C. Development of all street infrastructure will be guided by strict compliance of the approved design plans and specifications. Until reviewed and approved by the City Engineer, no changes or modifications shall be authorized and not deviations permitted from the originally approved design plans and project specifications. Change orders and design modifications will be submitted by the developers project engineer only, and no other person.

SECTION 806.020 CLEARING AND GRUBBING

- A. *Clearing and Grubbing.* Clearing and grubbing shall consist of removing, cutting and disposing of all brush, vegetation, logs, stumps, rubbish and other materials occurring within the limits of the improvement which will interfere with the excavation or which are unsuitable to be left in the roadway foundation. This shall also include the cutting, removing and disposing of all trees and stumps except those that will not interfere with the construction and not shown on the plans. The Developer shall exercise due care in his construction operations to prevent marring or scarring of trees that are to remain.
- B. Stumps and roots in excavated or fill areas where depth of excavation or fill does not exceed three (3) feet shall be removed to a depth of eighteen (18) inches below subgrade.
- C. In fill areas where more than three (3) feet of embankment is required, trees and stumps shall be cut off at the surface of the ground.

SECTION 806.030 STRIPPING

Where excavation, including borrow areas, or fill occurs, topsoil shall be stripped to a depth of 6 inches. Topsoil shall be spread on areas at locations directed, indicated, or specified, or spread uniformly in borrow areas.

SECTION 806.040 EXCAVATIONS

- A. The developer shall perform excavation of every type of material encountered within the limits of the project, to the lines, grades, and elevations indicated and as specified in this Section. Satisfactory excavated materials shall be transported to and placed in fill or embankment areas within the limits of the work. Unsatisfactory materials encountered within the limits of the work shall be excavated below grade and replaced with satisfactory materials as directed. Such excavated material and the satisfactory material ordered as replacement shall be included in excavation. Surplus satisfactory excavated material not required for fill or embankment or unsatisfactory excavated material shall be uniformly spread within the work area. During construction, excavation and filling shall be performed in a manner and sequence that will provide proper drainage at all times. Material required for fill or embankment in excess of that produced by excavation shall be obtained from the borrow areas off of construction limits at the Developer's responsibility. Excavations below indicated depths will not be permitted except to remove unsatisfactory material.
- B. *Classification of Excavation.* No Consideration will be given to the nature of the materials, and all excavation will be designed as unclassified excavation.
- C. *Preparation of Ground Surface for Embankments.* Ground surface on which fill is to be placed shall be stripped of live, dead or decayed vegetation, rubbish, debris, and other unsatisfactory material. The prepared ground surface shall be scarified and moistened or aerated as required just prior to placement of embankment materials to assure adequate bond between embankment material and the prepared ground surface.
- D. *Earth Embankments.* Earth embankments shall be constructed from satisfactory materials free of organic or frozen material and rocks with maximum dimensions greater than 3 inches. The material shall be placed in successive horizontal layers of loose material not more than 8 inches in depth. Each layer shall be spread uniformly on a prepared surface, i.e., a soil surface that has been moistened or aerated as necessary and scarified or otherwise broken up in such a manner that the fill will bond with the surface on which it is placed. Areas under proposed structures and areas to be surfaced shall be compacted to at least 90 percent maximum density for cohesive materials or 95 percent maximum density for cohesion less materials. All other areas shall be compacted to 85 and 90 percent respectively. Method of tests shall be in accordance with ASTM Standard D 1556.
- E. *Stepped Fill.* Everywhere there is new fill adjacent to existing soil, the new fill shall be "stepped." Stepping involves placing the new fill in six (6) inch compacted lifts where the existing soil or fill has been "stepped" by the removal of a variable amount of soil. The step shall be a minimum of twelve (12) inches vertical and will provide a bench of soil to place the new lift onto. The resulting fill will then be a cohesive unit that inhibits slippage.

1. *Maximum Density.* Areas under proposed structures and areas to be surfaced shall be compacted to at least 90 percent maximum density for cohesive materials or 95 percent for cohesion's materials. All other areas shall be compacted to 85 and 90 percent respectively.
 2. *Method of Tests.* Tests shall be in accordance with ASTM Standard D 1556. Copies of all density test results shall be submitted to the City of St. Robert Public Works Department upon the completion of each test.
- F. *Rock Embankments.* Rock embankments shall be placed in successive horizontal layers of loose material not more than 24 inches in depth. Pieces of rock larger than 24 inches in greatest dimension shall not be used. Each layer of material shall be spread uniformly and compacted until the interstices are filled with well-compacted materials and the entire layer is a densely compacted mass. Each successive layer of material shall adequately bond to the material on which it is placed.

SECTION 806.050 SUBGRADES

- A. Subgrades shall be shaped to line, grade, and cross section, and compacted as specified in this Section. This operation shall include plowing, disking, and any moistening or aerating required to obtain proper compaction. Soft or otherwise unsatisfactory material shall be removed and replaced with satisfactory excavated material or other approved material as directed
- B. *Finishing.* The surface of all excavations, embankments, and sub-grades shall be finished to a reasonably smooth and compact surface substantially in accordance with the lines, grades, and cross sections or elevations shown on the drawings. This process shall be repeated until all irregularities are removed. Extreme care shall be taken in shaping the subgrade, so that at no place will the completed pavement vary from the specified thickness. All soft and yielding spots shall be removed to a depth of not-to-exceed two (2) feet, and all vegetable substances or unsuitable material shall be removed, and the resulting spaces shall be refilled with approved material. All large rocks or boulders encountered shall be removed or broken off to a depth of not less than six (6) inches below the finished surface of the subgrade, and the space shall be refilled. The surface of areas to be turfed shall be finished to a smoothness suitable for the application of turf materials.
- C. *Restoring Subgrade to Acceptable Condition.* If the subgrade is disturbed in any manner after the work, described in the preceding paragraph, has been completed, it shall be brought to an acceptable condition by reshaping and rolling, or with macadam.
- D. *Determination of Density.* Testing shall be the responsibility of the Developer. Testing shall be performed by an approved commercial testing laboratory. Tests shall be performed in sufficient number to ensure to the satisfaction of the City that the specified density is being obtained. Not more than 10 passing in-place density tests will be required.
1. Moisture density relations shall be determined in accordance with ASTM D698. Copies of all density test results shall be submitted to the City of St. Robert Public Works Department upon the completion of each test.

- E. *Protection.* Settlement or washing that occurs in graded areas prior to acceptance of the work shall be repaired and grades reestablished to the required elevations and slopes.
- F. *Disposal of Excess Excavated Materials.* All excess excavated materials shall be disposed of away from the site of the work at the expense and responsibility of the developer. Broken concrete and other debris resulting from pavement or sidewalk removal, excavated rock in excess of the amount permitted to be and actually installed in trench back fill, junk, and debris encountered in excavation work, and other similar waste materials shall be disposed of away from the site of the work.
- G. *Settlement.* The developer shall be responsible for all settlement of back fill, fills, and embankments that may occur within one year after final completion of the street development under which the work was performed. The developer shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after notice from the City.

SECTION 806.060 AGGREGATE BASE MATERIAL

- A. *Type 1 Aggregate (Rolled Stone).* Aggregate for Type 1 base shall be essentially limestone. The crushed stone shall not contain deleterious material such as shale or disintegrated stone in excess of fifteen percent (15%). Any silt, any clay, and any deleterious material shall be uniformly distributed throughout the mass. The aggregates shall conform to the following gradation requirement:
 - 1. Passing 1 inch sieve 100%
 - 2. Passing 1/2 inch sieve 60-90%
 - 3. Passing No. 4 sieve 40-60%
 - 4. Passing No. 40 sieve 15-35%
- B. *Type 2 Aggregate (Compacted Granular Base).* Aggregate for Type 2 base shall consist of crushed stone, limestone screening, sand and gravel, sand, chat, or sandstone, or combinations of these materials, with or without soil binder as may be required. The material shall conform to the following gradation requirements and in addition shall be so graded that it will readily compact to the specified density and withstand construction traffic without distortion and displacement.
 - 1. Passing 1 1/2 inch sieve 100%
 - 2. Passing No. 40 sieve 15-50%
 - 3. Passing No. 200 sieve, not more than 35%
- C. If flint chat or tuff chat is used, it shall meet the requirements of this section and in addition shall have at least twenty percent (20%) passing the No. 40 sieve. Soil binder shall consist of soil or similar fine material with such cohesive properties as to impart the desired plasticity to the finished product.

SECTION 806.070 AGGREGATE BASE COURSES

- A. Aggregate base shall consist of a uniform mixture of properly graded materials placed on a prepared subgrade as shown on the plans. The type of aggregate used shall be as specified in the specifications. This work consists of furnishing and placing aggregate base material in one or more courses to a depth of six (6") inches on a graded and compacted subgrade surface in conformance with the lines, grades, and thickness and cross sections shown on the drawings and compacting the material in accordance with this Section.
- B. *Placement.* Aggregate base material shall be placed and spread uniformly on the prepared subgrade. All work on any section of the subgrade on which the base is to be constructed shall be completed prior to the placing of any base material on that section. Material shall be placed so that the thickness of the course after compaction will not exceed 6 inches. Should the total required base course thickness exceed 6 inches, the material shall be placed in two or more equal lifts. Each lift shall be compacted before the next lift is placed.
- C. *Spreading, Shaping and Compacting.* In no case will the Developer be permitted to place the mixture or manipulate it on muddy or frozen subgrade. Also, any mixture containing frost or frozen particles shall not be placed on the subgrade or compacted. After the subgrade has been properly prepared, the mixture shall be uniformly spread by blades, or other approved equipment, in successive layers of courses to such depth that, when compacted, the base will have the minimum thickness shown on the typical cross section.
- D. *Compaction.* Shaping and compacting shall be performed until a true, even, and uniform surface of proper grade, cross section, and density is obtained.
1. *Maximum Density.* Types 1 aggregate used for shoulders adjacent to Portland cement concrete pavement, and Type 2 aggregate shall be compacted to not less than 95 percent of standard maximum density.
- E. *Testing.* All testing shall be performed by the developer as a part of his quality control program. The developer shall bare all costs associated with the testing. Copies of all test results shall be submitted to the City of St. Robert Public Works Department upon the completion of each test.
1. The Standard Compaction Test will be made in accordance with ASTM D 698-70, Method C.
 2. Field density will be determined in accordance with ASTM D 1556-64, Sand Cone Method.
 3. If nuclear density test methods are used, moisture content will be determined in accordance with AASHTO T239, except that a moisture correction factor will be determined for each aggregate in accordance with MHTD Test Method T35.
 4. Aggregate gradation tests will be performed in accordance with ASTM C117, C136, and D422. Services shall conform to ASTM E11. Tests shall be performed on each 500 cubic yards of material delivered, but not less than one test shall be made each day that material is delivered.

- E. The surface of the aggregate base shall be well drained at all times. If at any time the compacted aggregate base or sub-grade becomes unstable, it shall be the developer's responsibility to restore, at his expense, the earth subgrade and the aggregate base to the required grade, cross section, and density.
- F. The base shall be considered complete when it has the required density with a uniform surface of the proper grade and final template section. Lateral ditches shall be constructed through shoulders where possible to insure adequate surface drainage.

SECTION 806.080 BITUMINOUS PRIME COAT SURFACE

- A. This work shall consist of treating an existing surface with bituminous material in accordance with the project specifications and in conformity with the lines shown on the drawings or established by the City.
- B. The prime coat shall be cutback asphalt type RC Grade 30 and shall meet the requirements of ASTM 2028.
- C. *Weather Limitations.* Bituminous material shall not be applied when either the air temperature or the temperature of the surface to be primed is below 60 F or when weather conditions prevent the proper construction of the prime coat.
- D. This work shall consist of all aggregate, filler if needed, and asphalt cement mixed in a stationary bituminous mixing plant in such proportions that the resulting mixture meets the grading requirements of the job-mix formula for the construction of arterial streets. The mixture shall be placed, spread, and compacted in conformity to a thickness of no less than five (5) inches black base.

SECTION 806.090 PLANT MIX BITUMINOUS PAVEMENT

- A. A hot-mix bituminous pavement shall be placed over a bituminous base or over a aggregate base course in accordance with the approved project specifications. Type C Asphalt Concrete shall be placed to a thickness of no less than the minimum depth required for the classification of street to be constructed and in accordance with the design plans and specifications submitted to the City for approval.
- B. The finished courses shall have the thickness shown on the plans and shall be free from waves or irregularities and shall not vary from a ten (10) foot straight-edge, applied parallel to the center line, by more than one-half (1/2) inch on the first or intermediate courses and not more than one-eighth (1/8) inch on the surface course.

SECTION 806.100 CURBS & GUTTERS

- A. *Curb & Gutter Concrete.* Portland Cement concrete shall be placed in 6-inch layers in curb. Concrete shall be thoroughly consolidated by tamping and spading or with approved mechanical vibrators. Placement of curbs and gutters by mechanical means is authorized.

- B. Concrete curb and gutter shall consist of Portland cement concrete, placed with or without reinforcement on a prepared subgrade. The type and dimensions shall be as shown on the construction plans. The construction of curbs using asphaltic cement shall be strictly prohibited.
- C. Curb and gutter shall not be less than six (6) inches thick and shall not be less than a minimum of twenty-four (24) inches wide, including the six (6) inch vertical curb. Contraction joints shall be installed every 10 feet.
- D. Concrete used in the construction of curb and gutter shall be Class "A" concrete, unless otherwise specified; and all materials, proportioning, air-entraining, mixing, and transporting for Portland cement concrete shall be in accordance with Portland Cement Concrete.
- E. Slump tests will be made in accordance with ASTM Specifications C 143. Concrete for concrete Curbs and gutters shall have a slump of two (2) to four (4) inches.
- F. The subgrade shall be graded, compacted and rolled to insure maximum density to the exact cross section and elevations shown on the plans. The subgrade shall be moistened in advance of depositing concrete, but shall not be muddy or excessively wet.
- G. The forms for this work shall be metal or wood of full depth of the concrete, straight, free from warp and of sufficient rigidity to prevent distortion due to the pressure of the concrete and other loads incidental to the construction operations. The forms shall be substantial and unyielding and shall be so designed that the finished concrete will conform to the proper dimensions and contours. Forms shall be set and maintained true to the line designated until the concrete is sufficiently hardened. Forms shall be thoroughly cleaned, greased or soaped before concrete is placed. Forms shall be joined neatly and tightly for a distance of at least one hundred (100) feet in advance of the point of placing concrete.
- H. Concrete curb and gutter shall be constructed in sections having a uniform length of ten (10) feet maximum. The length of a single section may be reduced to a minimum of four (4) feet where necessary for closure. Expansion joints shall be provided at intervals of ninety (90) feet. All joints in concrete curb and gutter shall receive joint filler in accordance with project specifications. The face and top of the curb and gutter shall be floated smooth and the edges shall be rounded as shown in typical section.
- I. After the concrete has set sufficiently, the spaces back of curbs shall be back-filled to the required elevation with suitable material that shall be compacted in layers of not more than six (6) inches until firm and solid.

SECTION 806.110 SIDEWALKS

- A. *Sidewalk and Entrance Concrete.* Concrete sidewalks shall be constructed to the line, grade and dimensions shown on the plans and specifications. Unless otherwise specifically designated, concrete sidewalks shall be at least five (5) feet wide, and have a cross slope of no more than two percent (2%) or ¼ inch to the foot. Sidewalks shall be not less than 4 inches in thickness and shall be placed

on well-compacted subgrade. Driveways or other points designated on the plans, the depth shall be increased to six (6) inches.

- B. Handicap accessible ramps shall be not less than thirty-six (36) inches wide and shall not have a slope greater than one inch rise per twelve inches length (1:12).
- C. In instances where surrounding buildings or other restrictions make it impossible to conform with the aforementioned slope requirements, then the handicap accessible ramp shall contain a slope with as shallow a rise as possible under the circumstances not to exceed ten (10) percent. All handicap accessible ramps shall be constructed with a gradual rounding at the bottom of the slope.
- D. Concrete sidewalks shall be constructed on a prepared smooth subgrade of uniform density. Large boulders and ledge rock found in the subgrade shall be removed to a minimum depth of six (6) inches below the finished subgrade elevation and the space shall be backfilled with suitable material that shall be thoroughly compacted.
- E. Dummy joints, spaced approximately at five (5) feet intervals, shall be provided for the full width (and length for wider sidewalks) to a depth of one (1) to two (2) inches.
- F. Pre-moulded expansion joint material, one-half (1/2) inch thick, shall be installed in the sidewalk for its full depth wherever it meets another sidewalk, driveway, building, curb, lighting standard, fireplug, or other rigid object. Expansion joints shall be placed on all four (4) sides of the square formed by the intersection of two (2) sidewalks. When the sidewalk fills the space between the curb and a building or wall, an expansion joint shall be placed between the sidewalk and the curb and between the sidewalk and the building or wall.
- G. After the concrete has been brought true to line and grade it shall be finished to a medium rough finish by use of a stiff broom or other approved method to produce an even, gritty texture. All edges shall be rounded with an edging tool to one-fourth (1/4) inch radius.
- H. Concrete for concrete sidewalks shall have a slump of two (2) to four (4) inches.

SECTION 806.120 DRIVEWAYS

- A. Where called for on the plans, non-reinforced concrete driveway pavement shall be constructed to the line, grade and dimensions shown on plans.
- B. The minimum driveway width for residential applications shall not be less than 9 feet in width. Each residential lot shall be limited to the construction of one (1) driveway entrance per property.
- C. The minimum driveway width for nonresidential one-way enter/exit shall not be less than 12 feet in width, and shall not be less than 24 feet in width for nonresidential two-way enter/exit.
- D. The maximum slope of any driveway shall not exceed twenty (20) percent.

CHAPTER 808: PLAN REQUIREMENTS FOR SANITARY SEWER

SECTION 808.010 SCOPE

- G. For the purpose of this Chapter, infrastructure improvements shall be designated as those streets, curbs and gutters, sidewalks, street lights, water mains, sanitary sewer lines, stormwater conveyances, natural gas lines, and any other utility services and appurtenances that are necessary for the functional development of all residential and nonresidential land uses in the City of St. Robert.
- H. All plans, project specifications 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 this Regulation and with all other applicable City codes and ordinances.
- I. 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 will be required.
- J. The City of St. Robert 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). The City of St. Robert, through the approval of the plans and/or report, assumes no responsibility for the completeness and/or accuracy of the public improvement plan or report.
- K. All developers and engineering consultants submitting plans for infrastructure improvement projects to the City for review are required to follow the procedures outlined in the following. No infrastructure improvements may be constructed in the City of St. Robert without the prior approval of the office of the Director of Public Works.
- L. 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 of St. Robert and, as such, an appropriate note shall be included on the drawings.

SECTION 808.020 PLAN REVIEW AND APPROVAL

- I. Three (3) complete sets of prints of engineered plans and specifications shall be submitted to the office of the Director of Public Works for review. The normal time for review shall be 15 working days. In the case of abnormally large sets of prints or of extremely complicated drawings, a longer time may be required for review.
- J. The project plans will be routed through appropriate City departments to obtain a complete review of all facilities that may be affected by the proposed construction. In each review, comments and necessary revisions will be noted on the project plans.
- K. Subsequent to the review of the plans, the design engineer, consultant or his representative shall be notified by telephone that the submittal is ready for return.

- L. The design engineer or consultant will be required to make all necessary corrections or revisions as noted on the project plans. Upon completion of the revisions and/or corrections the plans will again be submitted to the Director of Public Works office for further review. Revised sheets submitted shall contain a revision block with identifying notations and date of revisions. All previous project plans must accompany each re-submittal. If the project plans are not submitted with the revised drawings, the plans shall be returned to the consultant without action until such time as they are included with the submittal.
- M. Plans will not receive final approval until all supplemental easements, if necessary, have been duly recorded and a copy has been provided to the City. Additionally, and in conjunction with submittal of final plans, all permits and/or application for permits, shall be submitted to the appropriate agency for approval prior to final approval of the plans by the Director of Public Works (i.e., Department of Transportation, Department of Natural Resources, etc.).
- N. The length of time for final plan approval will normally be within 5 working days. Upon notification of final approval of the plans by the Director of Public Works, the number of sets of plans as specified in the appropriate section of this Appendix shall be submitted for signing and distribution.
- O. Public improvement plans and engineering reports are approved initially for one (1) year after the date noted on the returned cover sheet. After one (1) year, the plans or report shall become null and void and must be resubmitted prior to approval of construction of that project. Such plans and/or reports shall be resubmitted to the office of the Director of Public Works in accordance with the foregoing outlined procedures and requirements.
- P. The Design Engineer shall send one set of plans to each of the private and public utility companies having territorial jurisdiction in the area of the improvement upon notification that the drawings have been approved.

SECTION 808.030 MANDATORY GENERAL NOTES – SANITARY SEWER PLANS

- A. The following general notes shall be included on all plan submittals for sanitary sewer improvement projects. These notes are not meant to be all-inclusive, and in certain situations the Director of Public Works may require the use of additional notes.
 - 1. Development plans are approved initially for one (1) year, after which they automatically become void and must be updated and re-approved by the Director of Public Works before any construction will be permitted.
 - 2. The City of St. Robert plan review is only for general conformance with the Design Criteria delineated in the Infrastructure Development Regulations and other applicable City Codes. The City is not responsible for the accuracy and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City of St. Robert through approval of this document assumes no responsibility other than that as stated above for the completeness and/or accuracy of this document.

3. The contractor shall have (1) signed copy of the plans (approved by the City of St. Robert) and one (1) copy of the appropriate project specifications at the job site at all times.
4. Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the Director of Public Works is notified of such intent and all required and properly executed bonds and permit fees are received and approved by the Director of Public Works.
5. 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.
6. All backfill shall be tamped.
7. All stub-lines shall be laid on 1.00% grade unless approved otherwise.
8. _____ denotes Minimum Basement Floor Elevation.
9. All materials and workmanship associated with this project shall be subject to inspection by the City of St. Robert. The City of St. Robert reserves the right to accept or reject any such materials and workmanship that does not conform to the City of St. Robert Infrastructure Design Criteria specifications. The contractor shall notify the City of St. Robert Public Works Department twenty-four (24) hours prior to the beginning of construction.
10. Relocation or extension of any sewer line or service line thereof required for the construction of this project shall be the responsibility of the developer and shall be at his expense.
11. 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.

SECTION 808.040 SIGNATURE BLOCK – SANITARY SEWER PLANS

A signature block shall be required on the title sheet of all plans and reports submitted for review and approval. All plans require the signature of the Director of Public Works and the date of such signing for formal approval by the City.

SECTION 808.050 SEWER PLAN CONTENT

- A. The following criteria are established to provide a uniform system of plan preparation that will aid the Engineer in preparing plans for infrastructure improvements within the City of St. Robert. It is not intended that the criteria be an ironclad set of rules that would restrict the Engineer from utilizing imaginative design; however, all items as described below shall be shown on the plans in some manner.

- B. All plans and specification for the construction of infrastructure improvements within either publicly-financed or privately-financed developments shall be prepared by a professional engineer licensed in the State of Missouri and submitted to the office of the Director of Public Works for review. Subsequent to the review, the Engineer will be notified of approval of the plans as submitted, or of any necessary changes.
- C. Upon completion of the review and approval of the plans by the Director of Public Works, three (3) sets of plans (as approved) must be submitted for signing and distribution.
- D. In addition, one set of approved plans shall be sent to each of the utility companies providing service in the proposed construction area.
- E. The suggested plan sheet size is 24" X 36" with all sheets in a given set of plans being of the same size. 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 ten (10) feet vertical, unless otherwise approved by the Director of Public Works for special cases.
- F. All engineered sanitary sewer improvement plans shall consist of the following minimum requirements that have been developed in accordance with standard engineering practice:
 - 1. *Title Sheet*. The following items shall be included on the title sheet.
 - (a) Name of project.
 - (b) Index of sheets included in plans.
 - (c) A vicinity map adequately showing project location of the project area.
 - (d) General description of project area (by Township, Range, and Section).
 - (e) A summary of plan quantities of principal items, such as:
 - Pipe size and material, lengths, number of manholes, etc.
 - (f) Additionally, a separate column shall be provided for listing of "as-built" quantities once the project has been completed and accepted by the City.
 - (g) The project control benchmark shall be identified as to location and elevation.
 - (h) Name, address and telephone number of consulting engineer and owner/developer.
 - (i) List containing name and telephone number of each utility company and public agency listed below;
 - Electric Power
 - Gas

- Water & Sewer
- Telephone
- Cable television
- Public streets
- Highway Department (District Office)

(e) Director of Public Works signature block.

(f) Project engineer's name and seal.

(g) Revision schedule.

2. *General Layout Information.* The following items shall be included for all improvement projects.

(a) A legend of symbols and abbreviations shall be shown which shall apply to all sheets.

(b) North arrow and graphic scale. Scale of the general layout map shall be one (1) inch equals one hundred (100) feet, unless otherwise approved.

(c) 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.

(d) An un-platted tract shall have an accurate tie to at least one (1) quarter section corner.

(e) Boundary line of project area.

(f) A list of the mandatory general notes to the contractor

(g) Location of all existing (water or sewer) lines properly designated within or adjacent to the project area (list City project name and number if available).

(h) Connection point or points to existing facilities (tied to a known point on existing facility) and the type of connection to be utilized.

(i) Location of all proposed sewer lines and appurtenances with designation and sheet number on which they appear in plan and profile

3. *Site Grading Plan.* The following items shall be included on the general layout sheet for all sanitary sewer projects.

(a) Property lines identified as to existing or proposed lot and block number.

(b) Elevation and location of nearest datum.

(c) Existing and final grading contours drawn at intervals not to exceed five (5) feet.

4. *Plan and Profile Sheets.* The following items shall be included on the plan and profile sheets for all improvement projects

(a) North arrows and graphic scale.

(b) Elevation and location of all applicable bench marks (USGS datum).

(c) Existing and proposed streets with names and widths.

(d) Property lines properly identified as to existing or proposed lot, block and subdivision.

(e) 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.

(f) All existing and known proposed improvements within seventy-five (75) feet each side of centerline 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.

(g) All existing easement and right-of-way information recorded with the county.

(h) All proposed easement and right-of-way information.

(i) Minor construction notes shall appear on the proper plan and profile sheets.

(j) Locations and widths of existing and proposed sidewalks.

(k) In addition, the following items shall be included on the plan and profile sheets for sanitary sewer improvements:

Sanitary Sewers

- 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.
- Proposed piping with all appurtenances plainly labeled.
- Existing or proposed easements and/or tracts through offsite areas.
- Estimated average quantity of wastewater generated offsite that would be tributary to the proposed development, naturally as developed. The “Land Use Plan”, which is a part of

the Comprehensive Plan for the City of St. Robert shall be the basis for determining the future use of offsite undeveloped land.

- Proposed minimum, maximum, and average design flows at all junction manholes. (Manholes where two (2) or more branches have peak flows in excess of three (3) c.f.s.)
- All design elevations shall be invert of pipe. Top of pipe is acceptable for existing utilities.
- Stationing continuous for the entire length of the utility beginning at the downstream end of the project. Centerline of roadway shall be the basis for stationing whenever possible.
- Existing utilities, particularly where crossed, with “as-built” elevations and stations.
- Detailed alignment of the proposed sewer with the manhole designation, either by station and angle shown at each manhole or dimensioned ties to property lines at reasonably frequent control points to provide unquestionable locations of the sewer within street right-of-way or on private property.
- The channel centerline of waterways within fifty (50) feet either side of centerline of sewer shall be shown.
- All manholes shall be shown with manhole designation station and invert elevations. Drop manholes shall be designated as such. Invert elevations shown shall be the invert of the pipe in and out of the manhole. Proposed finish grade elevation of top of manhole shall be shown. Distance between manholes shall be shown as well as the gradient, pipe size, and type of material.
- Results of all rock borings shall be shown at the proper locations.
- Accurate elevations of either the first-floor surface or the basement floor surface shall be shown, and identified, for all existing and/or proposed structures for all building sites to be served by the proposed sewer system.
- A uniform system of line and manhole designation shall be used subject to the approval of the Director of Public Works office.
- Station, length, and size of each sub-line.
- Profile view shall show existing grade above centerline as a dashed line, proposed finish grades or established street grades by solid lines, and shall show the flow line of any drainage channel, either improved or unimproved, within fifty (50) feet either side of centerline. Each line shall be properly identified. The proposed sewer shall be shown as double solid lines properly showing the height of the pipe.

CHAPTER 810: SANITARY SEWER DESIGN SPECIFICATIONS

SECTION 810.010 DESIGN CRITERIA FOR SANITARY SEWERS AND APPURTENANCES

A. *Design Factors.* Sanitary sewers should be designed for the ultimate tributary population. Due consideration should be given to current zoning regulations and approved planning and zoning reports where applicable. Sewer capacities should be adequate to handle the anticipated maximum hourly quantities of sewerage and industrial waste together with reasonable consideration given to infiltration/inflow.

B. *Sewer Design* Sewers shall be designed for the total tributary areas using the following minimum criteria: (Note: Using this criteria all pipes are to be sized flowing full)

Interceptors and trunk lines	0.01 CFS/Acre
Laterals and sub-mains	0.02 CFS/Acre

C. *Maximum Size.* The diameter of sewers proposed shall not exceed the diameter of the existing or proposed outlet; whichever is applicable, unless otherwise approved by the Director of Public Works.

D. *Minimum Size.* No public sewer shall be less than eight (8) inches in diameter. Stub-lines for service connections shall not be less than four (4) inches in diameter and shall be extended at a 90-degree angle to the main sewer line.

E. *Materials of Construction.* 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 that 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 of St. Robert. Vitriified clay, HDPE and fiberglass reinforced pipe may be used for special applications only after review and approval of the design drawings and specifications by the City Engineer.

PVC Composite Wall Pipe	ASTM D2680, Minimum pipe stiffness shall be 200 p.s.i.
Ductile Iron Pipe	ASTM A21.51; ASTM A536, Grade 60-42-10; thickness Class 50, unless otherwise required by the City.
PVC Pipe	ASTM D3034, Type PSM Polyvinyl (Chloride), SDR 35; PVC Material shall conform to ASTM D and shall have a cell classification of 12454-B, 12454-C, or 13364-B. The

minimum pipe stiffness for pipe used for stub-lines shall be SDR 35.

2. The use of thermoplastic pipe shall be limited to residential or commercial areas as approved by the Director of Public Works and shall not be used for pipelines exceeding 15 inches in diameter unless otherwise approved.

F. *Minimum Slope.* All sewers shall be designed to give mean velocities when flowing full of not less than 2.0 feet per second.

1. All velocity and flow calculations shall be based on the Manning Formula using an “n” value of 0.013. The following slopes shall be minimum for the size indicated.

MINIMUM SLOPE IN PERCENT	
<u>SEWER SIZE</u>	<u>FULL AND HALF FULL FLOW</u>
8”	0.40
10”	0.28
12”	0.22
15”	0.15
18”	0.12
21”	0.10
24”	0.08

2. Exceptions to these minimum slopes shall be made at the upper end of the lateral sewers serving fewer than thirty houses. Said sewers shall have a minimum slope of 0.76%.
3. Where lateral sewers serve less than ten (10) houses, the minimum slope shall not be less than 1% unless otherwise approved by the Director of Public Works.

G. *Increasing Pipe Size.* When a sewer joins a larger one, the invert of the larger sewer should be lowered sufficiently to maintain a continuous energy gradient.

H. *High Velocity Protection.* 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.

I. *Alignment.* All sewers shall be laid with straight alignment between manholes.

J. *Manhole Construction.* 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.

K. *Manholes.* The construction of all manholes shall conform to the details shown on the standard drawings.

1. 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 24 inches shall have a minimum inside clear dimension of five (5) feet.
 2. Drop manholes should be avoided as much as possible. However, an outside or 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 outside drop pipe shall be protected against breaking or settling by the use of concrete encasement. The drop pipe shall have the same nominal diameter as that of the incoming sewer. The minimum diameter of an inside drop type manhole must be increased to five (5) feet.
 3. Without utilizing drop manholes, the difference in elevation between the invert of any incoming sewer and the invert of the outgoing sewer should not exceed twenty-four (24) inches except where required to match crowns. When a sewer joins a larger one, the crown of the smaller sewer shall not be lower than the crown of the larger one. The minimum drop through manholes shall be 0.2 feet.
 4. Where manholes are to be built in close proximity to streets, the top of manhole elevation shall be set within the following limits:
 - (a) Minimum Elevation $\frac{1}{4}$ " per foot rise above top back of curb
 - (b) Maximum Elevation $\frac{1}{2}$ " per foot rise above top back of curb
 5. All other sanitary sewer lines (sewer lines across un-platted land, etc.) Shall have the tops of manholes set flush with the existing ground elevation. The top of all manholes shall be located above the 100-year flood plain.
 6. 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 Director of Public Works.
- L. *Sewer Locations.* Sanitary sewers shall be located within street or alley rights-of-way (outside pavement limits) unless topography dictates otherwise. When located in easements on private property, access shall be provided to all manholes. A manhole shall be provided at each street or alley crossing.
1. End lines shall be extended to provide access from street or alley rights-of-way where possible. Imposed loading shall be considered in all locations.
 2. Not less than four (4) feet of cover shall be provided over the top of pipe in street and alley rights-of-way and five (5) feet in all other areas unless otherwise approved by the Director of Public Works.
- M. *Cleanouts and Lampholes.* Cleanouts and lampholes will not be permitted.

- N. *Protection of Water Supplies.* 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.* Sewer mains shall be laid at least 10 feet horizontally from any existing or proposed water main. The distances shall be measured edge to edge. In cases where it is not practical to maintain a 10-foot separation, the Engineer may allow deviation on a case-by-case 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 at such an elevation that the bottom of the water main is at least 18 inches above the top of the sewer.
 2. *Crossings.* Sewers crossing water mains shall be laid to provide a minimum vertical distance of 18 inches between the outside of the water main and the outside of the sewer. This shall be the case where the water main is either above or below the sewer. The crossing shall be arranged so that the sewer joints will be equidistant and as far as possible from the water main joints. Where a water main crosses under a sewer, adequate structural support shall be provided for the sewer to prevent damage to the water main.
 3. *Special Conditions.* When it is impossible to obtain proper horizontal and vertical separation as stipulated above, the sewer shall be designed and constructed equal to water pipe, and shall be pressure tested to assure water-tightness prior to backfilling.
 4. No water pipe shall pass through, or come in contact with, any part of a sewer or a sewer manhole.
- O. *Aerial crossings.* Adequate support shall be provided at all joints in pipes utilized for aerial crossings. Only ductile-iron pipe with restrained joints shall be used unless otherwise approved by the Director of Public Works.

CHAPTER 812: SANITARY SEWER CONSTRUCTION STANDARDS

SECTION 812.010 STANDARDS

- A. Sanitary sewer construction shall consist of furnishing all labor, materials and equipment for the complete installation of sewers and appurtenances in accordance with the approved design plans and specifications and all regulatory requirements of the City of St. Robert.
- B. When reference is made to a Standard Specification (ASTM, AWWA) the specification referred to shall be understood to mean the latest revision of said specification.
- C. Development of all sanitary sewer infrastructure will be guided by strict compliance of the approved design plans and specifications. Until reviewed and approved by the City Engineer or Director of Public Works, no changes or modifications shall be authorized and no deviations permitted from the originally approved design plans and project specifications. Change orders and design modifications will be submitted by the developers project engineer only, and no other person.

SECTION 812.020 PIPE LAYING AND CONNECTIONS

- A. *Installation.* All work shall be in accordance with ASTM D-2321 - Underground installation of flexible Thermoplastic Sewer Pipe.
 - 1. The following tolerances shall be maintained from true alignment and grade:
 - (a) Alignment 3 inches
 - (b) Grade 1 inch
 - 2. Joint deflection shall not exceed the maximum allowable deflection per joint according to ASTM C-425, ASTM C-594 and AWWA C-600. Only one correction for alignment and/or grade shall be made between adjacent manholes.
 - 3. Except where pipe sections are being encased in concrete, no pipe is to be supported by blocks.
 - 4. All transition in sewer main line and grade must be within a manhole.
 - 5. Install pipe of size, material, strength class, and joint type with embedment as shown on the approved plans.
 - 6. Pipes installed on grades in excess of 20% shall be anchored securely with concrete anchors spaced as follows:

<u>Grade</u>	<u>Maximum Anchor Spacing</u>
20% - 35%	36 feet
35% - 50%	24 feet
greater than 50%	16 feet

7. Insofar as possible, commence laying at downstream end of line and install pipe with spigot or tongue end downstream.
 8. Clean interior of all pipe, fittings, and joints prior to installation. Exclude entrance of foreign matter during discontinuance of installation. Close open ends of pipe with snug fitting closures. Do not let water fill trench. Include provisions to prevent flotation should water control measures prove inadequate. Remove water, sand, mud and other undesirable materials from trench before removal of end cap. Install pipe only when weather and trench conditions are suitable. Do not lay in water. Brace or anchor pipe as required to prevent displacement after establishing final position.
 9. The sewer trench shall be carried to a point not less than four (4) inches below bottom of pipe bell. Crushed stone bedding, compacted to full width of trench, shall then be placed and compacted to bottom of pipe with proper allowance for bell joints. After each length of pipe being laid has been shoved "home" and placed in proper alignment, it shall be securely anchored and held in position by crushed stone deposited simultaneously on each side of the pipe. This crushed stone backfill shall extend to a point not less than six (6) inches above the top of the pipe bell. If unstable conditions are encountered and it is determined by the Engineer that the bedding specified will not provide suitable support for the pipe, additional excavation to the limits determined by the Engineer will be required. This additional excavation shall be backfilled with crushed stone material approved by the Engineer.
- B. *Jointing*. Locate joints to provide for differential movements at changes in type of pipe embedment, concrete collars, and structures. Support pipe from wall of manhole to first joint in normal sewer trench with concrete cradle structurally continuous with base slab or footing.
1. Clean and lubricate all joint and gasket surfaces with lubricant recommended by pipe manufacturer.
 2. Utilize methods and equipment capable of fully homing or making up joints without damage.
 3. Check joint opening and deflection for specification limits.
 4. Examine each piece of pipe prior to installation for soundness and specification compliance.
- C. *Cutting*: Cut in neat workmanlike manner without damage to pipe. Observe specifications regarding joint locations. Smooth cut by power grinding to remove burrs and sharp edges. Repair lining as required and approved.
- D. *Plugs*. Provide and install plugs as manufactured by pipe supplier or as fabricated by Contractor if approved.
1. Plugs shall be watertight against heads up to twenty (20) feet of water. Secure plugs in place in a manner to facilitate removal when required to connect pipe.

2. Plugs shall be installed as specified or where shown on Plans. Also the open end of the sewer shall be plugged at the end of the workday with a suitable mechanical plug to prevent entry of foreign material until work is resumed.

E. *Connections to Existing Pipelines and Structures.*

1. Connect pipe to existing structures and pipelines where indicated. Observe pertinent articles of specifications pertaining to joint locations.
2. Prepare structure by making an opening with at least two (2") inches clearance all around fitting to be inserted. Connector gasket shall be placed on pipe. Pipe shall be positioned in manhole wall prior to grouting. Opening between pipe and manhole shall be filled with an expansive grout in such a manner that a watertight condition will result.
3. Manholes to be built on an existing sewer shall be constructed in such a manner as will not disturb services of existing sewer. The manhole base, walls and invert shall be completed before the top half of the sewer pipe is cut or broken away. Rough edges of the pipe thus exposed shall be covered with expansive grout, in such a manner as to produce a smooth and acceptable finish. Any portion of the existing sewer damaged by the Contractor shall be repaired at no expense to the City.
4. Connections between different pipe materials shall be made using proprietary transition coupling unless otherwise specified on the Plans.

F. *Service Lines and Connections.*

1. Wyes and saddles for service lines shall be installed at a 45 degree angle measured from the horizontal center line of the pipe for pipe sizes eight inches (8") through fifteen inches (15") in diameter. Service lines shall not be installed in pipe sizes 18 inches (18") in diameter or larger unless approved by the City Engineer. Wyes shall be 8" x 4" with DVW branch and shall be installed on new sewer mains as the mains are installed.
2. Service lines under streets shall be installed by the Developer extending from the main to the limits of the street right-of-way and shall be installed prior to construction of the street at a slope not less than one foot per 100 feet (1.0%). Service lines for each building unit shall be connected to the mains by means of a wye or tee and shall extend at least to the street right-of-way, but never less than ten feet (10') from the sewer main. Individual service lines shall not connect directly into manholes unless approved by the City Engineer. Service lines shall be adequately plugged to prevent foreign matter from entering the pipe during construction. All service lines shall be constructed bell to spigot or shall have a solid glued sleeve.
3. Saddles are only to be used to connect to existing sanitary sewers. The saddle shall be installed over a hole sized to fit the saddle opening (4" minimum). Cut shall be made with non-impact rotary equipment.

4. The service line shall terminate at a capped cleanout. The cleanout top shall be maintained 2' above ground or flush at finish grade.
5. The Developer shall maintain an accurate record for the production of the as-built drawings of the location, size and direction of each tee and wye, and location, size and length of each building service line. Locations will be referenced to the pipe line stationing as shown on the plans, or the distance from the first downstream manhole.

SECTION 812.030 MANHOLES AND SPECIAL STRUCTURES

- A. *Scope.* This section governs the furnishing of all labor, equipment, tools and materials, and the performance of all work incidental to the construction of manholes, drop manholes and special sewer structures complete with covers, steps, fittings and appurtenances as required in accordance with the approved plans.
- B. *General.* As used herein special structures refers to manholes on large sewers, special junction structures, metering stations, siphons and similar structures constructed on the pipeline. Manholes and special structures may be constructed of precast concrete sections, cast-in place concrete on existing mains or where space does not permit a precast manhole.
- C. *Construction.*
 1. Manholes and special structures shall be constructed at locations indicated and in accordance with details as shown on the Plans.
 2. *Precast Wall and Reducing Cone Sections.* Handle with care to avoid damage to joint ends of each section. Damaged sections may be subject to rejection at the discretion of the Engineer. When using O-ring joints, care shall be exercised in placing the O-ring on the spigot end, and lowering the bell section on to the spigot end so that a watertight seal is obtained.
 3. When using bitumastic joints both spigot and bell ends shall be primed with solvent material compatible to the adhesive in the mastic. Approved bitumastic material shall completely fill the joints so that a minimum of one-fourth inch bead of material is visible after jointing, to be smoothed off after completion of the jointing operation.
 4. When a flexible preformed butyl rubber or bituminous polymer compounded with modifiers is used to seal jointed sections of manholes, the extrusion of sealant from the joint is not required. The vertical spacing between manhole sections shall not exceed one-fourth inch. Preformed joint sealers remain flexible at temperatures as low as 0 degrees Fahrenheit.
 5. All bitumastic materials or preformed flexible joint sealants shall not be applied to wet or damp surfaces.
 6. *Cast-in-Place.* Consolidate concrete with mechanical vibrators to eliminate entrapped air voids and rock pockets. Forms shall be supported in such a manner as to prevent any movement of the

forms while concrete is being cured. Any movement of the forms may be cause for rejection.

7. *Invert Channels.* Alignment of the invert channels shall be as shown on the approved plans. When no specific details and dimensions are given, changes in flow direction shall be smooth, uniform and made with the longest radius possible. The cross section shape of invert channels shall match the lower halves of the entering and exiting pipes. The surfaces of the channels shall be steel-troweled to produce a dense, smooth surface. When filling openings around pipes through manhole walls, mortar and/or masonry units shall be placed so that the resulting joints are watertight. Mortar used in the joint closure shall not interfere with the invert channel.
- H. *Curing.* Cast-in-place concrete shall be adequately protected from freezing and loss of moisture for the first 24 hours. The curing methods and materials to be used shall be approved by the Engineer.
- I. *Manhole Rings* All rings for manhole covers shall be set to match the existing surfaces, except in flood plains where the Plans indicate that the ring is to be set at an elevation higher than existing ground. Each ring shall be set on a full mortar bed of bitumastic material, if approved by the Engineer. If masonry units are used to adjust rings to grade, the masonry work shall conform to Subparagraph I.7. of these specifications.
- J. *Waterproofing.* Two coats of an asphalt or coal-tar pitch waterproof coating shall be applied to the exterior of all structures from base to manhole ring. The coating shall be applied in sufficient quantity so that no bare or thin spots show. The coating shall be applied in sufficient time to permit proper curing prior to backfilling the excavation. Proper methods and materials shall be used during backfilling to prevent damage to the coating. Any damage to the coating that does occur shall be immediately repaired.

SECTION 812.040 BACKFILL

- A. Unless otherwise specified, all sewer trenches and excavation around structures shall be backfilled to the original surface of the ground with earth, earth and rock or other acceptable material. When earth and rock is used it shall be placed and thoroughly consolidated with sufficient earth to completely fill all voids between the rocks. The Developer shall so sort and stockpile the excavated material so that the proper material is available for backfill.
 1. The backfill material shall be compacted to a minimum of 80.0 percent of optimum density as determined by the Standard Proctor Test or shall be compacted to a density equivalent to the density of the immediate adjoining soil. The top six inches of backfill in street right-of-way shall be compacted to a minimum density of 95.0 percent of optimum density as determined by the Standard Proctor Test. Backfill material shall be placed and compacted only when its moisture content is within 2.0 percent of optimum moisture content as determined by Standard Proctor Test.
 2. The combination of the thickness of the layer, the method of compaction and the type of compaction equipment shall be at the discretion of the Contractor subject to obtaining the densities as specified above.

3. The quality of the compactions shall be subject to compaction tests when deemed necessary by the City Engineer. It shall be the Developer's responsibility to make necessary excavation in order to accommodate compaction tests at locations specified by the City Engineer. The compaction tests will be performed at no cost to the City. If the quality of the compaction does not meet the above requirements, the material will be removed and replaced to meet the above requirement, at the expense of the Developer.
4. Commercial sand backfill shall not be used.
5. Backfill material shall be carefully placed to avoid damage or displacement of sewer or structures.
6. Backfill shall not be placed when material contains frost, is frozen, or a blanket of snow prevents proper compaction. Backfill shall not contain waste material, trees, organic material, rubbish, etc.

B. Backfill of Pipe Trenches:

1. The area below a plane six inches above the top of pipe bell shall be backfilled in accordance with the specifications for "Pipe Bedding".
2. Backfill above a plane six inches above the top of pipe bell shall be made with suitable earth, earth and rock, or other acceptable material except that the area below a plane one foot above the pipe bell shall not contain any excavated rock. When earth and rock is used, the maximum dimension of the rock shall not exceed twelve inches.

C. Backfill Around Structure:

1. No backfill shall be placed over or around any structure until the concrete or mortar therein has attained a minimum strength 2000 psi and can sufficiently support the loads imposed by the backfill without damage.
2. The Developer shall use utmost care to avoid any wedging action between the side of the excavation and the structure that would cause any movement of the structure. Any damage caused by premature backfill or by the use of equipment on or near a structure will be the responsibility of the Developer.
3. Backfill shall be placed and compacted on all sides of the structure simultaneously, and operations shall be so conducted that the backfill is always at approximately the same elevation on all sides of the structure.
4. No excavated rock larger than four (4) inches maximum dimension shall be placed within one (1) foot of the exterior surface of any structure.

SECTION 812.050 ACCEPTANCE TESTS FOR GRAVITY SEWERS

A. Visual Inspection:

1. Contractor shall clean pipe of excess mortar, joint sealant and other dirt and debris prior to inspection.
2. Sewer will be inspected by flashing a light between manholes and/or by physical passage where space permits. Determine from illumination and/or physical inspection the presence of any misaligned, displaced or broken pipe and the presence of visible infiltration or other defects.
3. Correct defects as required prior to conducting leakage tests.

B. *Exfiltration Leakage Test.* To be performed on the full length of all lines prior to acceptance.

1. Test all sewer pipe over eighteen (18) inches I.D. after either the completed backfill or partial backfill sufficient to stabilize the position of the pipe in both alignment and grade is accomplished. The Developer may select sections of the project for testing at any time by notifying the Public Works Department 24 hours in advance.
2. Perform at depths of water as measured above centerline of pipe of not less than two (2) feet or more then ten (10) feet (consideration shall be given for water table above said centerline).
3. Maintain test as necessary to locate all leaks but not less than two hours.
4. Repeat as necessary after repair of leaks and defects until leakage, as measured, does not exceed 0.15 gallons per inch of internal diameter per hour per 100 feet of pipe length (200 gal/inch of I.D./day/mile).
5. Protect manholes and other structures by means of bulkheads to prevent bursting pressures from being applied inside the structure.
6. Dewater pipe upon completion of testing.

C. *Air Leakage Test.* To be performed on the full length of all lines prior to acceptance.

1. The pipe plug for introducing air to the sewer line shall be equipped with two taps. One tap will be used to introduce air into the line being tested, through suitable valves and fittings, so that the input air may be regulated. The second tap will be fitted with valves and fittings to accept a pressure test gauge indicating internal pressure in the sewer pipe. An additional valve and fitting will be incorporated on the tap used to check internal pressure so that a second test gauge may be attached to the internal pressure tap. The pressure test gauge will also be used to indicate loss of air pressure due to leaks in the sewer line.
2. The pressure test gauge shall meet the following minimum specifications:

Size (Diameter)	4 ½ inches
Pressure Range	0-15 P.S.I.
Figure Intervals	1 P.S.I. increments
Minor Subdivisions	0.05 P.S.I.

Pressure Tube	Bourdon tube or diaphragm $\pm 0.25\%$ of maximum scale reading
Dial	White coated aluminum with black lettering, 270 degree arc and mirror edge
Pipe Connection	Low male $\frac{1}{2}$ " N.P.T. Calibration data will be supplied with all pressure test gauges. Certification of pressure test gauge will be required from the gauge manufacturer. This certification and calibration data will be available to the Engineer whenever air tests are performed.

3. Test each reach of sewer pipe between manholes after completion of the installation of pipe and appurtenances and the backfill of sewer trench.
4. Plug ends of line and cap or plug all connections to withstand internal pressure. One of the plugs provided must have two taps for connecting equipment. After connecting air control equipment to the air hose, monitor air pressure so that internal pressure does not exceed 5.0 psig. After reaching 4.0 psig, throttle the air supply to maintain between 4.0 and 3.5 psig for at least two (2) minutes in order to allow equilibrium between air temperature and pipe walls. During this time, check all plugs to detect any leakage. If plugs are found to leak, bleed off air, tighten plugs, and again begin supplying air. After temperature has stabilized, the pressure is allowed to decrease to 3.5 psig. At 3.5 psig, begin timing to determine the time required for pressure to drop to 2.5 psig. If the time, in seconds, for the air pressure to decrease from 3.5 psig to 2.5 psig is greater than that shown on the table below, the pipe shall be presumed free of defects.

<u>Pipe Size</u>	<u>Required Time Per 100 LF</u>	<u>Maximum Required Time</u>
8"	70 seconds	227 seconds
10"	110 seconds	283 seconds
12"	158 seconds	340 seconds
15"	248 seconds	425 seconds
18"	356 seconds	510 seconds
21"	485 seconds	595 seconds
24"	634 seconds	680 seconds
27"	765 seconds	765 seconds
30"	851 seconds	851 seconds
33"	935 seconds	935 seconds

5. If air test fails to meet above requirements, repeat test as necessary after all leaks and defects have been repaired. Prior to acceptance all constructed sewer lines shall satisfactorily pass the low pressure air test.
6. In areas where ground water is known to exist, install a one-half inch diameter capped pipe nipple, approximately ten (10") inches long, through manhole wall on top of one of the sewer lines entering the manhole. This shall be done at the time the sewer line is installed. Immediately

prior to the performance of the line acceptance test, ground water level shall be determined by removing pipe cap, blowing air through pipe nipple into the ground so as to clear it, and then connecting a clear plastic tube to pipe nipple. The hose shall be held vertically and a measurement of height in feet of water shall be taken after the water stops rising in this plastic tube. The height in feet shall be divided by 2.3 to establish the pounds of pressure that will be added to all readings.

SECTION 812.060 ACCEPTANCE TESTS FOR PRESSURE FORCEMAINS

- A. A hydrostatic pressure and leakage test shall be performed in conformance with AWWA C-600 procedures as modified herein. Test shall apply to all pressure sewers, and shall be performed after backfilling.
- B. Test separately in segments between sectionalizing valves, between a sectionalizing valve and a test plug, or between test plugs. Select test segments such that adjustable seated valves are isolated for individual checking. Developer shall furnish and install test plugs including all anchors, braces and other devices to withstand hydrostatic pressure on plugs. The developer shall be responsible for any damage to public or private property caused by failure of plugs. Limit full rate of line to available venting capacity.
- C. *Pressure Test.* Conduct at 1.5 times maximum operating pressure determined by following formula:

$$P_{pt} = 0.650 (OP-GE) \text{ in which}$$

P_{pt} = test pressure in psi at gauge elevation

OP = operating pressure in feet as indicated for highest elevation of the hydraulic gradient on each section of the line.

GE = elevation in feet at center line of gauge. Perform satisfactorily prior to determining leakage.

- D. *Leakage Test.* Conduct at maximum operating pressure determined by following formula:

$$P_{lt} = 0.433 (OP-GE) \text{ in which}$$

P_{lt} = test pressure in psi at gauge elevation

OP and GE = as in previous subparagraph

- E. All joints shall be watertight and free from leaks.
- F. *Deflection Test.* Gravity pipeline of flexible materials shall also be tested by pulling a mandrel. The test shall be conducted not less than one (1) month after backfill has been properly installed. The maximum allowable deflection shall not exceed five (5) percent of the pipe's internal diameter.

Mandrel testing shall be performed on a minimum of 25% of the pipeline. The sections tested will be determined by the City.

SECTION 812.070 ACCEPTANCE TESTS FOR MANHOLES

A. All manholes shall be vacuum tested by the contractor at his expense. Appropriate equipment and manpower will be furnished by the Developer for this purpose. When vacuum testing manholes, the following criteria are to be used:

1. This method is applicable to precast manholes only.
2. All lift holes shall be plugged with an approved non-shrink grout.
3. Manholes are to be tested after assembly and before backfilling. No standing water shall be allowed in the manhole excavation that may affect the accuracy of the test.
4. All pipes and other openings into the manhole shall be plugged and securely braced to prevent displacement of the plugs while the vacuum is drawn.
5. Installation and operation of vacuum equipment shall be in accordance with equipment specifications and instructions provided by the manufacturer.
6. The test head may be placed in the cone section of the manhole. The frame-cone joint will be visually inspected by the engineer.
7. A vacuum of 10 inches of mercury shall be drawn and the vacuum pump shut off. The time for the vacuum to drop to 9 inches of mercury shall be recorded.
8. Acceptance for four (4) foot diameter manholes shall be defined as when the time to drop to 9 inches of mercury meets or exceeds the following:

<u>Manhole Depth</u>	<u>Diameter</u>	<u>Time to Drop 1" of HG</u>
10 feet or less	4 feet	60 seconds
10 feet to 15 feet	4 feet	75 seconds
15 feet to 20 feet	4 feet	90 seconds

9. For manholes five (5) foot in diameter, add an additional 15 seconds and for manholes six (6) foot in diameter, add an additional 30 seconds to the time requirements for four (4) foot diameter manholes. If the manhole fails to test, necessary repairs shall be made with a non-shrink grout while the vacuum is still being drawn. Re-testing shall proceed until a satisfactory test is obtained.

CHAPTER 814: PLAN REQUIREMENTS FOR WATER SUPPLY

SECTION 814.010 SCOPE

- A. For the purpose of this Chapter, infrastructure improvements shall be designated as those streets, curbs and gutters, sidewalks, street lights, water mains, sanitary sewer lines, stormwater conveyances, natural gas lines, and any other utility services and appurtenances that are necessary for the functional development of all residential and nonresidential land uses in the City of St. Robert.
- B. All plans, project specifications 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 this Regulation and with all other applicable City codes and ordinances.
- C. 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 will be required.
- D. The City of St. Robert 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). The City of St. Robert, through the approval of the plans and/or report, assumes no responsibility for the completeness and/or accuracy of the public improvement plan or report.
- E. All developers and engineering consultants submitting plans for infrastructure improvement projects to the City for review are required to follow the procedures outlined in the following. No infrastructure improvements may be constructed in the City of St. Robert without the prior approval of the office of the Director of Public Works.
- F. 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 of St. Robert and, as such, an appropriate note shall be included on the drawings.

SECTION 814.020 PLAN REVIEW AND APPROVAL

- A. Three (3) complete sets of prints of engineered plans and specifications shall be submitted to the office of the Director of Public Works for review. The normal time for review shall be 15 working days. In the case of abnormally large sets of prints or of extremely complicated drawings, a longer time may be required for review.
- B. The project plans will be routed through appropriate City departments to obtain a complete review of all facilities that may be affected by the proposed construction. In each review, comments and necessary revisions will be noted on the project plans.
- C. Subsequent to the review of the plans, the design engineer, consultant or his representative shall be notified by telephone that the submittal is ready for return.

- D. The design engineer or consultant will be required to make all necessary corrections or revisions as noted on the project plans. Upon completion of the revisions and/or corrections the plans will again be submitted to the Director of Public Works office for further review. Revised sheets submitted shall contain a revision block with identifying notations and date of revisions. All previous project plans must accompany each re-submittal. If the project plans are not submitted with the revised drawings, the plans shall be returned to the consultant without action until such time as they are included with the submittal.
- E. Plans will not receive final approval until all supplemental easements, if necessary, have been duly recorded and a copy has been provided to the City. Additionally, and in conjunction with submittal of final plans, all permits and/or application for permits, shall be submitted to the appropriate agency for approval prior to final approval of the plans by the Director of Public Works (i.e., Department of Transportation, Department of Natural Resources, etc.).
- F. The length of time for final plan approval will normally be within 5 working days. Upon notification of final approval of the plans by the Director of Public Works, the number of sets of plans as specified in the appropriate section of this Appendix shall be submitted for signing and distribution.
- G. Public improvement plans and engineering reports are approved initially for one (1) year after the date noted on the returned cover sheet. After one (1) year, the plans or report shall become null and void and must be resubmitted prior to approval of construction of that project. Such plans and/or reports shall be resubmitted to the office of the Director of Public Works in accordance with the foregoing outlined procedures and requirements.
- H. The Design Engineer shall send one set of plans to each of the private and public utility companies having territorial jurisdiction in the area of the improvement upon notification that the drawings have been approved.

SECTION 814.030 MANDATORY GENERAL NOTES – WATER SUPPLY PLANS

- A. The following general notes shall be included on all plan submittals for water improvement projects. These notes are not meant to be all-inclusive, and in certain situations the Director of Public Works may require the use of additional notes.
 - 1. Development plans are approved initially for one (1) year after which they automatically become void and must be updated and re-approved by the Director of Public Works before any construction will be permitted.
 - 2. The City of St. Robert plan review is only for general conformance with the Design Criteria delineated in the Infrastructure Development Regulations and other applicable City Codes. The City is not responsible for the accuracy and adequacy of the design, or dimensions and elevations that shall be confirmed and correlated at the job site. The City of St. Robert through approval of this document assumes no responsibility other than that as stated above for the completeness and/or accuracy of this document.

3. The contractor shall have one (1) signed copy of the plans (approved by the City of St. Robert) and one (1) copy of the appropriate project specifications at the job site at all times.
4. Construction of the improvements shown or implied by this set of drawings shall not be initiated or any part thereof undertaken until the Director of Public Works is notified of such intent, and all required and properly executed bonds and permit fees are received and approved by the Director of Public Works.
5. 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.
6. All backfill shall be tamped.
7. All materials and workmanship associated with this project shall be subject to inspection by the City of St. Robert. The City of St. Robert reserves the right to accept or reject any such materials and workmanship that does not conform to the Infrastructure Design Criteria specifications.
8. The contractor shall notify the City of St. Robert Public Works Department twenty-four (24) hours prior to the beginning of construction.
9. Relocation or extension of any water line or service line thereof required for the construction of this project shall be the responsibility of the developer at his expense.
10. The proposed water line improvements shown by this set of drawings have been designed to provide the following fire flow requirements as determined by the City of St. Robert:
_____ GPM (Note to be placed on development drawings that contain areas zoned for higher densities than R-1).

SECTION 814.040 SIGNATURE BLOCK – WATER SUPPLY PLANS

A signature block shall be required on the title sheet of all plans and reports submitted for review and approval. All plans require the signature of the Director of Public Works and the date of such signing for formal approval by the City.

SECTION 814.050 WATER PLAN CONTENT

- A. The following criteria are established to provide a uniform system of plan preparation that will aid the Engineer in preparing plans for infrastructure improvements within the City of St. Robert. It is not intended that the criteria be an ironclad set of rules that would restrict the Engineer from utilizing imaginative design; however, all items as described below shall be shown on the plans in some manner.
- B. All plans and specification for the construction of infrastructure improvements within either publicly-financed or privately-financed developments shall be prepared by a professional engineer

licensed in the State of Missouri and submitted to the office of the Director of Public Works for review. Subsequent to the review, the Engineer will be notified of approval of the plans as submitted, or of any necessary changes.

- C. Upon completion of the review and approval of the plans by the Director of Public Works, three (3) sets of plans (as approved) must be submitted for signing and distribution.
- D. In addition, one set of approved plans shall be sent to each of the utility companies providing service in the proposed construction area.
- E. The suggested plan sheet size is 24" X 36" with all sheets in a given set of plans being of the same size. 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 ten (10) feet vertical, unless otherwise approved by the Director of Public Works for special cases.
- F. All engineered water improvement plans shall consist of the following minimum requirements that have been developed in accordance with standard engineering practice:
 - 1. *Title Sheet.* The following items shall be included on the title sheet.
 - (a) Name of project.
 - (b) Index of sheets included in plans.
 - (c) A vicinity map adequately showing project location of the project area.
 - (d) General description of project area (by Township, Range, and Section).
 - (e) A summary of plan quantities of principal items, such as:
 - Pipe size and material, lengths, number of manholes, etc.
 - (f) Additionally, a separate column shall be provided for listing of "as-built" quantities once the project has been completed and accepted by the City.
 - (g) The project control benchmark shall be identified as to location and elevation.
 - (h) Name, address and telephone number of consulting engineer and owner/developer.
 - (i) List containing name and telephone number of each utility company and public agency listed below;
 - Electric Power
 - Gas
 - Water & Sewer
 - Telephone

- Cable television
- Public streets
- Highway Department (District Office)

(h) Director of Public Works signature block.

(i) Project engineer's name and seal.

(j) Revision schedule.

2. *General Layout Information.* The following items shall be included for all improvement projects.

(a) A legend of symbols and abbreviations shall be shown which shall apply to all sheets.

(b) North arrow and graphic scale. Scale of the general layout map shall be one (1) inch equals one hundred (100) feet, unless otherwise approved.

(c) 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.

(d) An un-platted tract shall have an accurate tie to at least one (1) quarter section corner.

(e) Boundary line of project area.

(f) A list of the mandatory general notes to the contractor

(g) Location of all existing water lines properly designated within or adjacent to the project area.

(h) Connection point or points to existing facilities (tied to a known point on existing facility) and the type of connection to be utilized.

(i) Location of all proposed water lines and appurtenances with designation and sheet number on which they appear in plan and profile

3. *Site Grading Plan.* The following items shall be included on the general layout sheet for all street and/or drainage improvement projects.

(a) Property lines identified as to existing or proposed lot and block number.

(b) Elevation and location of nearest datum.

(c) Existing and final grading contours drawn at intervals not to exceed five (5) feet.

4. *Plan and Profile Sheets*. The following items shall be included on the plan and profile sheets for all improvement projects
- (a) North arrows and graphic scale.
 - (b) Elevation and location of all applicable bench marks (USGS datum).
 - (c) Existing and proposed streets with names and widths.
 - (d) Property lines properly identified as to existing or proposed lot, block and subdivision.
 - (e) 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.
 - (f) All existing and known proposed improvements within seventy-five (75) feet each side of centerline 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.
 - (g) All existing easement and right-of-way information recorded with the county.
 - (h) All proposed easement and right-of-way information.
 - (i) Minor construction notes shall appear on the proper plan and profile sheets.
 - (j) Locations and widths of existing and proposed sidewalks.
 - (k) In addition, the following items shall be included on the plan and profile sheets for sanitary sewer improvements:

Water

- Existing water distribution facilities including, but not limited to, pipe size and location, valves, fire hydrants, blow-offs, etc.
- Proposed piping with all appurtenances plainly labeled.
- Existing or proposed easements and/or tracts through offsite areas.
- Stationing continuous for the entire length of the utility beginning at the downstream end of the project. Centerline of roadway shall be the basis for stationing whenever possible.
- Existing utilities, particularly where crossed, with “as-built” elevations and stations.
- Results of all rock borings shall be shown at the proper locations.
- A uniform system of line designation shall be used subject to the approval of the Director of Public Works office.

- Station, length, and size of each sub-line.
- Profile view shall show existing grade above centerline as a dashed line, proposed finish grades or established street grades by solid lines, and shall show the flow line of any drainage channel, either improved or unimproved, within fifty (50) feet either side of centerline. Each line shall be properly identified.
- Alignment of the proposed water line dimensioned from curb lines or right-of-way lines.
- Designation by station of all fire hydrants and line valves.

CHAPTER 816: WATER SUPPLY DESIGN SPECIFICATIONS

SECTION 816.010 DESIGN CRITERIA FOR WATER LINE CONSTRUCTION

- A. *General.* Proposed extensions of the water distribution system shall, in general, follow the pattern established in the Water Facilities Plan as adopted by the City of St. Robert. Deviations from this general policy may be deemed necessary by the Director of Public Works should the provision of adequate service to prospective customer or fire protection needs, existing or anticipated, in the area to be served warrant said deviations. No public water line shall be constructed less than size (6) inches in diameter (except for 2 inch PVC lines permitted on cul-de-sacs).
- B. *Location of Water Mains and Appurtenances.* Proposed water mains shall be so located within street right-of-way to provide the least interference with the location of other utility lines. Street grades and elevations of proposed main shall be taken into consideration so that once constructed they will not require re-grading or relocation.
- C. *Depth.* All water mains shall have a minimum cover of forty-two (42) inches.
- D. *Material of Construction.* Ductile iron pipes pr PVC shall be used for all mains constructed in the City of St. Robert.
1. The ductile iron shall conform to ANSI A21.51; ASTM A536, Grade 60-42-10; AWWA C151. The minimum nominal thickness class for ductile iron pipe shall be 50, unless otherwise designated by the Director of Public Works.
 2. 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. 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 C104, and shall be coated inside and out with a 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, couplings, and fittings are manufactured shall conform to ASTM D1784, Type 1, Grade 1, 2,000 p.s.i design stress. The minimum wall thickness for the pipe shall be SCR 21 (Class 200). 2” PVC pressure pipe shall have a minimum wall thickness for the pipe shall be DR 17 (Class 250) or Schedule 40 (Class 270).
 5. All PVC pipe shall conform to the latest revisions of ASTM D2241, 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 couplings. Flexible elastomeric gaskets, meeting the requirements of ASTM F477, shall be synthetic rubber.

6. The couplings and fittings shall accommodate the pipe for which they are used. The minimum pressure ratings shall be 235 p.s.i for couplings and 250 p.s.i for the fittings.
- E. *Fire Hydrants.* Fire hydrants shall conform to AWWA C502, and shall be Mueller “Centurion” A-423. (Note: Fire hydrants shall be purchased and provided to the developer by the City)
1. Hydrants shall be traffic models with breakaway flanges and shall have one 4 ½ inch pumper nozzle and two 2 ½ inch nozzles. All hydrants shall be furnished with auxiliary gates valves.
 2. Hydrants should be placed at or near street intersections and at intermediate points when block lengths become long. Under no circumstances shall the spacing of fire hydrants exceed six hundred (600) feet in residential areas or three hundred (300) feet in commercial areas.
 3. Fire Hydrant installations shall conform to the Standard Drawings.
- F. *Line Valves.* Gate valves shall be of the resilient-seated configuration and shall conform to the applicable requirements of AWWA C509.
1. Resilient-seat gate valves shall be American-80 “CRS” or Mueller A-2370-20 or approved equal.
 2. Gate valves shall be used in all water mains twelve (12) inches in diameter and smaller.
 3. Butterfly valves shall conform to AWWA C504 and shall be American (Class 150B), Mueller “Line Seal III”, or approved equal. Butterfly valves shall be used in mains larger than twelve (12) inches in diameter or where otherwise approved by the Director of Public Works.
 4. Valves shall be placed in all straight runs of pipe at intervals not to exceed 800 feet. Where two lines intersect, a valve should be placed in each pipe on each side of the intersection. Valves should be so placed that any pipe two (2) blocks long can be cut out of the general circulation without interrupting service in the rest of the system.
 5. 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 that will center the stem in the valve box, and shall be equipped with a wrench nut.
- G. *Tapping Sleeves and Valves.* Tapping sleeves and valves shall be used where required to connect to existing in-service mains.
1. The valves shall be 200 p.s.i, resilient-seated, cast iron body, non-rising stem gate valves conforming with all applicable requirements of AWWA C509 and shall be Mueller “No. A-2307-16” or an approved equal. 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, and 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.
- H. *Connections to Existing Water Mains.* 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, provisions shall be made on the plans for a temporary service.
- I. *Provisions for Future Extensions of Water Mains.* At the termination of all water mains or at locations as specified by the Director of Public Works, a dead end assembly in accordance with the specifications of the City of St. Robert shall be provided to allow for future water main extensions.
1. Flushing assemblies shall be used at locations as required to provide for thorough flushing of all water mains in the project area. Whenever practical, water mains five hundred (500) feet and longer shall be provided with a fire hydrant for flushing.
- J. *Thrust Blocking.* Reaction blocking of adequate size shall be provided at all tees, elbows and bends to resist all resultant thrusts due to hydrostatic pressure. All blocking shall conform to the standard drawings.
- K. *Highway and Railroad Crossings.* All crossings of highways or railroads shall be made by boring or tunneling. The work shall be in conformity with all requirements and regulations and be under the control of the authority owning or having jurisdiction over and control of the right-of-way in each case.
- L. *Street Crossings.* Open cutting of streets shall be allowed only where permitted by the Director of Public Works. 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 unless otherwise approved by the Director of Public Works. All work and materials shall be in conformity with all requirements of the technical specifications of the City of St. Robert. The diameter and length of the casing pipe to be used shall be as determined by the Director of Public Works.
- L. *Fire Flow Requirements.* Public improvement plans for water line projects serving development sites other than single family or duplex subdivisions shall be reviewed for fire protection sufficiency. The City Fire Chief shall determine the amount of water that is required for fire protection based on I.S.O. guidelines for the proposed type of structures to be built within the development. The design engineer shall obtain the flow requirement and then determine if the existing operating conditions. Calculations verifying that the required flows can be met shall accompany the drawings when submitted for approval.

CHAPTER 818: UTILITY EASEMENTS

SECTION 818.010 STANDARDS

- A. If the utility easement is adjacent to a public street, the developer shall provide utility easements that are a minimum of ten (10) feet in width along both sides of the street.
- B. If a utility easement is not next to a public street, the developer shall provide an easement that is a minimum of twenty (20) feet wide for utility construction, service and maintenance. The City of St. Robert may require greater width dimensions along or across lots if engineering design or special conditions make it necessary.
- C. If a utility easement is located parallel to side and rear yard property lines, than the developer shall provide an easement that is a minimum of twenty (20) feet wide, ten (10) feet being established on either side of the property line. When the developer does not own the adjoining property, than a minimum of a twenty (20) foot easement will be required on the developer's side of the property that is being developed.
- D. The developer shall construct all new utilities within designated easements or platted street right-of-ways.
- E. The developer shall not place any parking lot, foundation, slab or other permanent improvement within any dedicated public easement without written authorization from the City of St. Robert. No building or substantial structure may be located any closer than ten (10') feet from the nearest edge of the easement line.
- F. The developer shall provide a public or private drainage easement along all natural and manmade drainage channels and floodways that drain two or more lots or tracts of land according to the following criteria:
 - 1. *Natural Drainage Channels.* The developer shall provide public or private storm drainage easements along existing or proposed open drainage channels with sufficient width for the water course to handle the flow from the frequency storm required in Section 800.00 plus a minimum of twenty (20) feet on each side, for ingress and egress of maintenance equipment, for clearance from fences, for maintenance of the channel bank, and for adequate slopes along the bank.
 - 2. *Enclosed Drainage Systems.* Where a developer provides an enclosed drainage system that is not within or next to a public street, the developer shall provide public or private storm drainage easements of twenty (20) foot or wider and centered on the system. The developer shall provide for easements wide enough to encompass the system and provide ingress and egress for future maintenance operations.