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LIST OF DESIGN AIDS

PROCEDURE FOR
PUBLIC IMPROVEMENT PROJECT PLAN SUBMITTAL

A. General. All developers and Engineering consultants submitting plans for public improvement projects to the City for review are required to follow the procedures outlined in this section. No public improvement projects may be constructed in the City of Lansing without prior approval of the Department of Public Works.

The majority of all public improvement projects are funded by either private developer, benefit district, or the City at large. The procedure to follow, and the amount of time involved in approving plans is dependent on the source of funding for the project.

All submittals should be sent to the attention of the Public Works Director.

Prior to final acceptance of the project, the designer shall submit Construction Record Drawings in accordance with section H of Requirements for Public Improvement Project Plan Preparation.

B. Public Improvements Funded by Private Developers. Projects funded by a private developer will require City Council approval of final plans prior to construction. The plan review process for this type of project is as follows:

1. The first submittal should contain two sets of plans, draft easements, stormwater analysis report, geotechnical report, and a preliminary plat prepared by a Registered Land Surveyor in the State of Kansas showing all proposed easements being granted by the plat (the final plat should also be submitted if it is available). This and all subsequent submittals are dated and recorded in a project plan development status log.
2. The plans will be routed through the appropriate City departments and/or divisions to obtain a complete review of all facilities which may be affected by the construction. They will also be reviewed to confirm conformance with City standards and design criteria. In each review, comments and necessary revisions will be noted on the plans (first submittal checkset). Subsequent to the review of the submittals, the consulting Engineer will be notified by telephone that the submittal is ready for return and may be picked up in the Public Works office.
3. The consultant will be required to make all necessary corrections and/or revisions as noted on the checkset of submittals. Upon completion of the corrections and/or revisions the consultant will submit a new set of submittals (second submittal checkset) to the Department of Public Works. Revised sheets shall contain a revision block with identifying notations and date of revisions. Accompanying the second submittal must be the first submittal checkset, any requested Engineering reports or calculations, and copies of any necessary permit application forms such as Kansas Department of Health and Environment sewer extension permit, Kansas Department of Transportation permits, Department of Agriculture channel change permit, NPDES, N.O.I., flood plain fill permits, Storm Water Pollution Prevention Plan, etc. The previous checkset must accompany each resubmittal. If the checksets and permit application are not submitted with the revised plans, they shall be returned to the consultant or held without action until such time as they are included with the submittal.
4. The third and any subsequent submittals shall include the previous checksets, and the mylar of the cover sheet for the City Engineer's and Director of Public Works' signatures. The City reserves the right to charge the designer for all City incurred costs for review and processing of the third and subsequent check sets if the third submittal is not approved as final. Three sets of plans need to be submitted for street and storm sewer projects. Four sets of plans and three extra cover sheets are needed for sanitary sewer plans.
5. Once a submittal is found acceptable for approval, the Director of Public Works will verify that all necessary permits are obtained and all plats and easements are filed and recorded before signing the mylar cover sheet for the plans. This mylar cover sheet with the City Engineer's and Director of Public Works' signatures and dates shall be utilized to produce all further plans for bid documents and construction. One digital copy of the approved plans shall be submitted on compact disc in a format compatible with Auto Cad.
6. Public improvement plans and Engineering reports are approved initially for one year after the date on the signed mylar cover sheet next to the Director of Public Works' signature. After one 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 Public Works Department office in accordance with the foregoing outline procedure and requirements.
7. The Design engineer shall send a "first submittal" set of plans marked "Preliminary" to each of the private and public utility companies having territorial jurisdiction in the area of the improvement when first submittal is made to

the Public Works Department. Upon notification that the plans have been approved, the designer shall send an approved set of plans to the same companies.

C. Public Improvements Funded by Benefit District and/or City at Large. Projects funded by benefit district and/or City at large need City Council approval at various times during the plan approval process. Plan review as outlined in Section B above remains the same up to final approval of the City Engineer and Director of Public Works. Once the City Engineer and Director of Public Works have approved the plans, the following events occur which involve the City Council.

1. Approval of final plans by the City Council and authorization to advertise for bids at a regular or special City Council meeting.
2. Once bids are received for a project, if they are in order, the Director of Public Works will make a recommendation to the City for award of the bid at a regular or special City Council meeting.

A pre-construction meeting shall be held prior to construction. At least one week's notice shall typically be given to notify all parties involved, including utility companies, of the date, time and location of the meeting.

GENERAL PLAN REQUIREMENTS FOR PUBLIC IMPROVEMENT PROJECTS

A. General. All plans and reports submitted shall be prepared by, or under the direction of, a professional Engineer, licensed in the state of Kansas, and shall be reviewed by the City for compliance with the minimum design requirements as established in the Design Criteria Manual for Public Improvement Projects of the City of Lansing and with all other applicable City codes and standards. All Public Land Survey System monuments and accessories, and all property line information shown on plans shall be prepared by or under the direct supervision of a Kansas Registered Land Surveyor.

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.

The City of Lansing 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 Lansing, 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.

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

Sanitary Sewers

1. Development plans are approved initially for one (1) year after which they automatically become void and must be updated and reapproved by the City Engineer before any construction will be permitted.
2. The City of Lansing plan review is only for general conformance with City of Lansing Design Criteria and the City Code. The City is not responsible for the accuracy and adequacy of the design, or dimensions and elevations which shall be confirmed and correlated at the job site. The City of Lansing, through approval of this document, assumes no responsibility other than that 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 Lansing) with a state approval stamp on the title sheet and one (1) copy of the appropriate Design and Construction Standards and 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, all required and properly executed bonds and contract agreements are received and approved by the Director of Public Works, and a Notice to Proceed is issued by the Director of Public Works.
5. The City of Lansing Technical Specifications, latest edition, along with any specifications referenced therein, shall govern construction of this project.
6. All existing utilities indicated on the drawings are according to the best information available to the Design 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. The contractor shall abide by all provisions of the Kansas One Call law.
7. All backfill shall be accomplished in accordance with the City of Lansing Technical Specifications, except where otherwise stated in the plans or contract documents.
8. All stublines shall be laid perpendicular to the mainline, on 1.00% grade unless approved otherwise.
9. 0000.00 denotes Minimum Serviceable Floor Elevation (MSFE).
10. Contractor shall not be allowed to work on Sundays. Holiday or Saturday work shall be as approved by the Engineer at least forty-eight (48) hours prior to the weekend or Holiday.
11. Relocation of any utility required for the construction of this project shall be the responsibility of the contractor at his expense and shall be subsidiary to other contract items.

12. The contractor shall install and properly maintain a mechanical plug at all terminus points where inflow is possible and in the outgoing pipe from the first manhole upstream of the existing connecting manhole until such time that the new line is tested and approved.
13. To prevent damage to main sewer line, all blasting required for lateral stub lines shall be performed during blasting for the main line.
14. A pre-blast survey shall be approved by the Fire Marshall prior to the initiation of blasting operations.
15. Siltation and erosion control measures shall be in place prior to the disturbance of the site. If the siltation or erosion control measures are to be removed or altered, the responsible party shall notify the Department of Public Works at least twenty-four (24) hours in advance for approval.
16. The contractor shall provide at least one (1) chemically treated, portable toilet unit, "Satellite" as manufactured by the Satellite Corporation, or equal, for every 20 workmen on the job site. (In no case shall less than one (1) be provided). The unit(s) shall remain on the site during all active phases of construction of the sanitary sewers. The contractor shall enforce the use of the facilities by all personnel at the site. The unit shall be obscured from public view to the greatest extent practicable.
17. The Contractor shall obtain all end of stub line elevations and location and shall submit copy of same to the construction observer prior to project acceptance.
18. All rock, concrete, asphalt, trees, brush, etc. to be removed as a part of this project shall be disposed of by the contractor as directed by the field engineer and shall be a subsidiary obligation of the contract. The clean excess dirt material will be wasted along the trench. The Contractor shall leave all disturbed areas on site in a "mowable" condition as a subsidiary obligation to the contract.
19. Magnetic locator tape shall be placed on top of the granular embedment for the full length of each line and each stub line.
20. Temporary construction easements and/or construction limits shall be staked and temporary fencing installed along the temporary construction easements nearest to all existing dwellings when sanitary sewer crosses a platted lot.
21. All lines shall be air tested to ASTM F-1417 requirements.
22. A City representative will be notified 24 hours in advance of any and all performance testing. A City inspector will be onsite for all performance testing. Testing performed without a City representative will not be acceptable.
23. Manholes shall be vacuum tested with grade rings and frames installed. Service lines that originate from a manhole shall be vacuum tested as part of the manhole performance test.
24. Three-inch magnetic sewer tape shall be installed with all main and lateral pipe on top of the granular bedding. Tape shall extend to the top of the lateral location marker.
25. Lateral location markers shall be constructed of a 4-inch diameter PVC pipe of sufficient length to extend four (4) feet from finished grade out of the ground. The depth of the lateral shall be written in permanent ink on the marker for easy identification.
26. The end of pipe openings shall be plugged at the end of each work day with an approved mechanical pipe plug.

<u>Streets and Storm Drainage</u>

1. Development plans and drainage reports are approved initially for one (1) year, after which they automatically become void and must be updated and reapproved by the Engineer before any construction will be permitted.
2. The City of Lansing plan review is only for general conformance with City of Lansing Design Criteria and the City Code. The City is not responsible for the accuracy and adequacy of the design, or dimensions and elevations which shall be confirmed and correlated at the job site. The City of Lansing, through approval of this document, assumes no responsibility other than 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 Lansing) and one (1) copy of the appropriate Design and Construction Standards and 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, all required and properly-executed bonds and contract agreements are received and approved by the Director of Public Works, and a Notice to Proceed is issued by the Director of Public Works.

5. The City of Lansing Technical Specifications, latest edition, along with any specifications referenced therein, shall govern construction of this project.
6. All existing utilities indicated on the drawings are according to the best information available to the Design 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. The contractor shall abide by all provisions of the Kansas One Call law.
7. All backfill shall be accomplished in accordance with the City of Lansing Technical Specifications.
8. Sidewalks shall be built as a part of this project as shown unless otherwise noted on the plans. If plans indicate sidewalk not constructed as part of this project, the contractor shall still be responsible for sidewalk ramp construction.
9. Contractor shall not be allowed to work Sundays. Holiday or Saturday work shall be as approved by the Engineer, and no request will be considered unless it is received at least forty-eight-(48) hours prior to the weekend or Holiday.
10. Relocation of any utility required for the construction of this project shall be the responsibility of the contractor and shall be at his expense.
11. If precast concrete storm sewer structures are to be used on this project, the contractor at his own expense, shall submit shop drawings and have them approved by the Design engineer prior to fabrication of the structures. Failure to do so shall be cause for rejection.
12. Monument boxes conforming to Standard Detail 21-10 shall be installed at all quarter section corners as involved in the street construction. PLSS corners endangered by construction shall be referenced and reset by a Kansas Registered Land Surveyor in accordance with state law.
13. 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 depth where sound material is found. If full depth pavement removal is required, the subgrade shall be recompacted to 95 percent of standard maximum density.
14. Siltation and erosion control measures shall be in place prior to the disturbance of the site. If the siltation or erosion control measures are to be removed or altered, the responsible party shall notify the Department of Public Works at least twenty-four (24) hours in advance for approval.
15. By use of these plans the Contractor agrees that he shall be solely responsible for the safety of the construction workers and public. The Contractor will furnish flagmen and other personnel necessary to provide required traffic control which shall include adequate signs, barricades, warning lights and all other equipment in accordance with the current Manual on Uniform Traffic Control Devices and Procedures.
16. The street construction contractor shall be responsible for any settlements, damage or deformation of the curb or pavement during the two-year maintenance period.
17. All inspections of public improvements require forty-eight (48) hours' notice.
18. All rock, concrete, asphalt, trees, brush, etc., to be removed as a part of this project shall be disposed of by the Contractor as directed by the field engineer and shall be a subsidiary obligation of the contract. The clean excess dirt material will be wasted along the trench. The Contractor shall leave all disturbed areas on site in a "mowable" condition as a subsidiary obligation to the contract.

C. Approval Block. Signature blocks shall be required on the cover sheet of all plans or reports submitted for review and approval. All plans require the signature of the City Engineer and the Director of Public Works, and the date of such signing for formal approval by the City. The general form of the approval blocks shall be as follows:

APPROVED

_____ _____
City Engineer Date

APPROVED

_____ _____
Director of Public Works Date

APPROVED FOR ONE YEAR FROM THIS DATE.

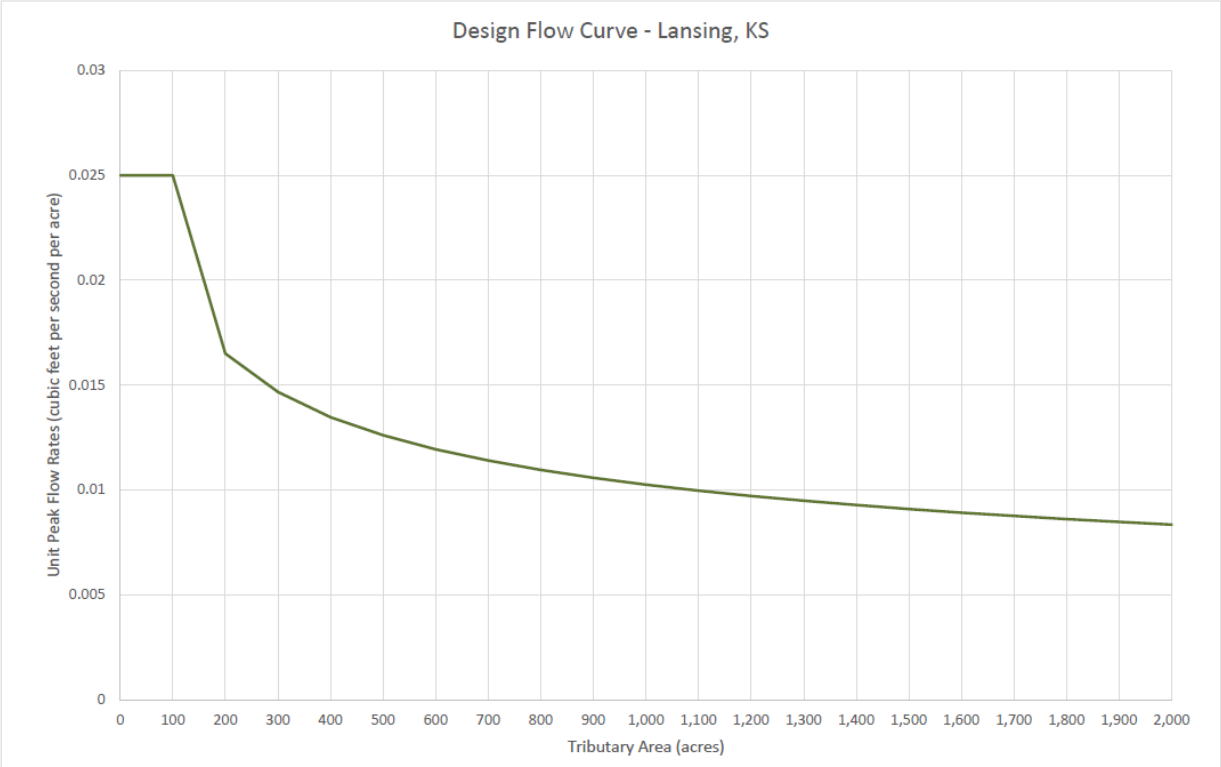
D. Private Improvements. Private improvements, if any, shown on public improvement plans, shall be clearly defined and marked as such. These improvements will not be maintained by the City of Lansing and, as such, an appropriate note shall be included on the drawings. These improvements, nonetheless, shall be designed and constructed to meet or exceed the most recent version of the City of Lansing's Technical Specifications for Public Improvement Projects.

DESIGN CRITERIA FOR
SANITARY SEWERS AND APPURTENANCES

A. DESIGN FACTORS. Sanitary sewers shall 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 shall 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 area using the following minimum criteria:

Sewers up to and including a diameter of 18-inch are to be sized flowing two-thirds full; Interceptors, main sewers, and relief interceptor sewers larger than 18-inch diameter are to be sized flowing three-fourths full. Lateral sewers may be designed to flow at capacity. All sewers are to be designed for anticipated flows from a 50-year interval storm.



C. MAXIMUM SIZE. The diameter of sewers proposed shall not exceed the diameter of the existing or proposed outlet, whichever is applicable, unless directed by the Wastewater Utility Director or City Engineer.

D. MINIMUM SIZE. No public sewer shall be less than eight (8) inches in diameter. Stublines for service connections shall not be less than six (6) inches in diameter.

E. MATERIALS OF CONSTRUCTION. Sanitary sewers shall be constructed of pipe material resistant to or protected from degradation, acid and alkaline solutions, normal sewer temperature variation, abrasion, and industrial wastes or

other materials which may be transmitted by the collection system.

The following types of commercial pipe are approved for gravity sanitary sewer systems constructed in the city of Lansing:

PVC Pipe	ASTM D3034, Type PSM Polyvinyl (Chloride), SDR 26 (SDR 21 will be required for depths in excess of 20 ft.); PVC Material shall conform to ASTM D1784 and shall have a cell classification of 12454-B, 12454-C, or 13364-B. Sizes 18" to 36" shall conform to ASTM F679-80. The minimum pipe stiffness for pipe used for stublines shall be SDR 26.
Reinforced Concrete Pipe	ASTM C76
Ductile Iron Pipe (only with approval of Engineer and with appropriate lining)	ANSI A21.51; ASTM A536, Grade 60-42-10; thickness Class 50, unless otherwise required by the Engineer.

The use of PVC pipe, ASTM D3034, shall be limited to residential or commercial areas as approved by the Wastewater Utility Director or City Engineer and shall not be used for pipelines exceeding 24 inches in diameter, unless approved by the City Engineer. Concrete pipe shall be approved on a per project basis as recommended by the Design engineer and approved by the City Engineer.

F. MINIMUM SLOPE. All sewers shall be designed to give mean velocities when flowing one-half full of not less than 2.0 feet per second.

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.

SEWER SIZE	MINIMUM SLOPE IN PERCENT FULL AND HALF FULL FLOW
8"	0.40
10"	0.28
12"	0.22
15"	0.15
18"	0.12
21"	0.10
24"	0.08
27"	0.065
30"	0.058

Exceptions to these minimum slopes shall be made at the upper end of the lateral sewers serving under 30 dwelling units. Said sewers shall have a minimum slope of 0.80 percent. All sewers larger than 30 inches in diameter shall have the slope approved by the Wastewater Utility Director or City Engineer.

Where lateral sewers serve less than 10 dwelling units, the minimum slope shall not be less than 1.0 Percent.

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 or where velocities greater than 10 feet per second are possible, special provisions shall be made to protect against abrasion damage to

the pipe and manhole. Such protection may be attained utilizing ductile iron pipe, and T-Lock lining of manholes.

I. ALIGNMENT. All sewers shall be laid with straight alignment between manholes, with the bell-end pointed upstream or as per the manufacturer's recommendation.

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 eighteen (18) inches or less in diameter and not greater than six hundred (600) feet for larger sewers.

K. MANHOLES. The construction of all manholes shall conform to the details shown on Standard Details 31-1 through 31-4.

The minimum horizontal clear distance within the barrel of standard manholes should 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. The Engineer may require diameters in excess of four (4) feet when warranted by excessive depth or other circumstances.

Drop manholes should be avoided as much as possible. However, an inside drop pipe shall be provided for a sewer entering a manhole at an elevation of twelve (12) inches or more above the manhole invert. The drop pipe shall have the same nominal diameter as that of the incoming sewer. The minimum diameter of an inside drop type manhole must be increased to five (5) feet.

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 for manholes with greater than 45° turns and 0.1 feet for straight-through trough and up to 45° turns.

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

Minimum Elevation	¼" per foot rise above top back of curb
Maximum Elevation	½" per foot rise above top back of curb

All other sanitary sewer lines (sewer lines across unplatted land, etc.) shall have the tops of manholes set flush with the existing ground elevation. The top of all manholes shall be located a minimum of 1.0 feet above the 100-year flood elevation. Manholes adjacent to flood plain areas must have bolt-down lids.

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 City Engineer or Wastewater Utility Director.

L. SEWER LOCATIONS. Sanitary sewers shall be located within street or alley rights-of-way unless topography dictates otherwise. When located in easements outside of street pavement on private property, access shall be provided to all manholes. A manhole shall be provided at each street or alley crossing. 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. Not less than eight (8) feet of cover shall be provided over top of pipe in street and alley rights-of-way and five (5) feet in all other areas.

The center of sanitary sewer manholes shall be located five (5) feet beyond the right-of-way, and five (5) feet off a property line, within a dedicated easement. Other locations require the Engineer's approval of a written request.

Tees and stub lines shall not be located within ten (10) horizontal feet of any pipe, structure, or other improvements without approval of the Engineer. Stub lines shall extend to the easement boundary, opposite of the right-of-way unless directed by the Engineer.

M. CLEANOUTS AND LAMPHOLES. Cleanouts and lampholes will not be permitted on public lines. Cleanouts must be

installed on private service lines at a maximum spacing of 100 feet, and at alignment changes.

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.

Sanitary sewer lines and water lines shall be constructed a distance of ten (10) horizontal feet apart when they are to be installed parallel to each other. Exceptions to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where sanitary sewer lines are to be installed over or under and across water lines and a two (2) foot clearance cannot be obtained because of limited grades or grades of existing structures, then the sewer pipe shall be encased in concrete for a distance of at least ten (10) feet in each direction from the crossing.

O. AERIAL CROSSINGS. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. All aerial crossings shall be approved by the Wastewater Utility Director or City Engineer.

P. UNSEWERED DWELLINGS. All existing addresses that will be provided access to the sewer that previously did not have sewer service available shall be identified by the Design Engineer. This identification shall include the approximate distance from the dwelling to the sewer.

Q. MAXIMUM SLOPE. All sewers which are designed to flow at 10 feet per second or greater shall be reviewed by the Engineer for approval or alternate design considerations.

R. EXTENSIONS OF THE SEWER. All extensions of the sanitary sewer shall be made so that future extensions may be made by upstream users. When a future sanitary sewer extension will be required to serve adjacent upstream properties, the location for the center of the uppermost manhole, whenever possible, should be at least five (5) feet beyond the plat boundary in a permanent sewer easement.

S. ANALYSIS OF RECEIVING SEWER REQUIRED. Authorization to extend any existing sanitary sewer shall not be granted until an analysis of the receiving sewer system has been completed as outlined in Section T below.

a. Any proposed developments or additions to the existing sanitary sewer pipe network whose additional flows WILL cause or will likely cause a bypass of untreated sewage to the environment or an existing building shall not be approved.

b. Developments or additions to the existing sanitary sewer pipe network whose additional flows WILL NOT cause a bypass of untreated sewage to the environment or an existing building will be considered for approval on a case by case basis. Applicants seeking approval must submit sufficient engineering documents and downstream sewer analysis to the Lansing Wastewater Utility Department staff for their consideration in making a final determination and subsequent recommendation to the Lansing City Council.

T. CITY OF LANSING SANITARY SEWER CAPACITY ANALYSIS PROCEDURE.

As required by the City, the developer shall submit complete sanitary sewer information by creating a spreadsheet with information containing:

1. Building use,
2. Acreage,
3. Square footage,
4. Point of connection to the public system,
5. 24-hour average and peak sanitary sewer flow graphs for the peak day, showing average daily and peak daily flows
6. Seasonal peak if it differs from daily peak
7. Flow line elevations,

8. Pipe diameters,
9. Flow depths and manhole top elevations,
10. Reach distances, reach slopes, and reach capacity using Manning's equation,
11. Also include any other information that would support approval.

The design engineer will then create a hydraulic model with existing flows in the system and add the proposed development to the model to determine adequacy of the receiving sewer downstream to the Wastewater Treatment Facility. As an alternative, for a fee (as listed in the City's current fee and fine schedule), the proposed development may submit the above information to the city to have it evaluated using the City's Sanitary Sewer Hydraulic Model for the trunk sanitary sewer system.

If there is not enough capacity in the existing modeled trunk sanitary sewer system, the developer may be required to upgrade the sanitary sewer system as determined by the City. The required sanitary sewer upgrades will be at the developer's expense. In instances in which KDHE issues the developer an extension permit based and contingent on an approved action plan prior to such time that the trunk capacity is adequate, developer expense for the trunk capacity upgrade may be a prorated portion, as determined by the City.

If the design flow exceeds the pipe capacity, and would cause surcharging to homes, businesses, or the environment, the system would be considered hydraulically overloaded.

If the engineer wishes to propose alternative methods of sanitary sewer evaluation, the engineer must submit a written proposal clearly detailing the method and assumptions to be used in that evaluation. The proposal will be reviewed by the City Engineer and Wastewater Utility Director for appropriateness for the situation. Do not submit alternative analyses until the proposed alternative method has been approved in writing by the Wastewater Utility Director.

DESIGN CRITERIA FOR
STREET IMPROVEMENTS

A. GENERAL. Proposed street improvements within the City and within any city/county joint planning area shall conform to the pattern as established in the current City of Lansing Comprehensive Plan as adopted by the governing body of the City of Lansing. A major goal of transportation planning is to provide a safe and efficient transportation system that facilitates the movement of people and goods within the City.

To this end, street improvements within the City of Lansing and the joint planning area shall be designed to conform with all applicable codes, regulations, and ordinances as established by the City. Plans for said improvements shall be submitted to the Engineer for approvals, and all plans shall include all information as may be required or described hereafter.

B. FUNCTIONAL CLASSIFICATION OF STREETS. In fulfilling the goal of creating a safe and efficient transportation system, the City has defined geometric design standards for streets and highways which would afford both adequate traffic mobility and suitable access to abutting property.

The efficient movement of vehicles within any urban community is dependent on a balance between all types of street facilities; therefore, design standards must be defined by functional classification, i.e. expressways, major arterials, minor arterials, collectors, and local streets:

1. Arterial

   (a) Expressway or Freeway: Since its main purpose is to carry through traffic movement, expressways and freeways are properly classified as arterials. However, owning to their unique geometric and access design, they are more appropriately the function of federal or state control. High operating speeds and controlled or limited access (usually confined to above- or below-grade interchanges) characterize arterial classifications. As a result, geometric design shall conform to those criteria defined by state or federal transportation agencies.
   (b) Major Arterial: A major arterial shall mean a street or highway that provides for rapid and efficient movement of large volumes of through traffic between sections of the City and across the urbanized area. It is not primarily intended to provide land access service. Therefore, the number of curb cuts on a planned major arterial shall be held to a minimum where they can be controlled and adequately protected. In general, the major arterial has full or partial access control, but is not restricted to controlled access facilities. Major arterials can be four to six lanes wide, with or without medians, and commonly can be found on the mile section lines of the City. Signalized intersections along major arterials should be spaced far enough apart to permit efficient two-way progressive movement of traffic between intersections at the desirable off-peak and peak hour operating speeds.
   (c) Minor Arterial: As does the major arterial, a minor arterial provides for the through traffic movement between areas and across the City. However, the minor arterial provides direct access with the abutting property. As a result, the minor arterial accommodates trips of moderate length at a somewhat lower level of service and lower operating speeds than the major arterial. Also, traffic signal progression may be less systematic than on the major arterial. The minor arterial interconnects residential, shopping, employment, and recreational activities at the community level. Although the minor arterial offers access to the abutting land uses, it does not penetrate identifiable neighborhoods. Furthermore, it is subject to required controls of entrance, exits and curb use.

2. Collector Street: The collector street provides traffic circulation within residential areas. Land access is a secondary function of the collector. The collector distributes trips from the arterials to the local street network. Collectors penetrate residential areas. Operating speeds should be 35 mph. Since speeds are slower and turning movements are anticipated, closer intersection/access spacings can be used than on arterials. Deceleration and turning lanes should be provided at intersections. Because land access is a secondary function of collectors, the number of lots fronting onto a collector should be held to a minimum in order to reduce and preferably to eliminate the numbers of driveways, and thus, the number of conflict points.

3. Service Street: The service street provides traffic circulation within commercial and industrial buildings and complexes from the arterial street system. Service streets should not have direct continuity with residential areas. Operating speeds should be 25 to 35 mph. Since speeds are slower and turning movements are anticipated, closer intersection/access spacings can be used than on arterials. Because service streets facilitate truck-related land uses, the special provisions associated with truck accessibility shall be considered within design. Wider turning radii and turning lanes shall be considered. Service streets shall not be utilized for backing or loading maneuvers. All such trucking maneuvers shall be handled on-site of the adjacent land uses.

4. Local Street: The major purpose of the local street is to provide direct traffic access to abutting land. Local streets can and do exist within residential, commercial, and industrial areas.

   Traffic movement on local streets is incidental and involves traveling to or from a collector facility. Therefore, trip length on the local street is short, and as a result, both traffic volumes and operating speeds are usually low. Generally, through traffic is deliberately discouraged.

The development of a street system based on functional classes has numerous benefits, including the following:

1. The arterials can be designed to safely accommodate the high traffic volumes and high speeds.
2. Traffic control is simplified.
3. The pavement of designated streets can be designed to carry the high number of repetitions and heavy wheel loads. Other streets can be designed for a low number of repetitions and light wheel loads. Consequently, total maintenance costs are reduced.
4. Residential areas are not subject to through traffic, which makes them more desirable and safer places to live. Commercial office and retail land uses are concentrated in fewer but larger and better-designed developments. Strip development is reduced.

Implementation of design criteria based on functional class will help ensure that the traffic capacity and level of service is maintained. This, in turn, will help reserve the regional accessibility (market area) of private development and help stabilize land use patterns and property values. Thus, preservation of the levels of service on all functional classes of the City's street system is mutually advantageous to the public and private sectors. Typical cross sections of these classifications are shown on Standard Details 13-1, 13-2, 13-3, and 13-4, 14-1, 14-2, 14-3.

C. STREET DESIGN STANDARDS.

	Major Arterials	Minor Arterials	Collector	Service Roads	Local Streets
Number of Traffic Lanes	4-6	3-4	2-4	2-4	2
Street Width	80' (with median)	52'	36'	36'	28'
Left Turn Lanes	Double at signals	Single (or continuous)	Based on need	n/a	n/a
Minimum R/W Width (ft)	120	100	60	60	60
Design Volume (VPD) Range	22,000-42,000	12,000-22,000	1,500-12,000	1,500-12,000	Less than 1,500
Minimum Design Speed (MPH) *	50	45	35	35	30
Operating Speed (MPH)	45	40	35	35	30
Stopping Sight Distance (ft)	475	400	250	250	200
Minimum Radii Hor. Curves (ft)	1,280	600	500	500	200
Sidewalks Minimum width(**)	5 feet both sides	5 feet both sides	5 feet both sides	Comm.: Both sides 5 feet; Indust: None required	5 feet one side
On Street Parking	Prohibited	Prohibited	Prohibited	Permitted	Permitted
Maximum Grade (Percent ***)	6%	6%	8%	8%	10%
Minimum Grade	1.0%	1.0%	1.0%	1.0%	1.0%
Curb Radii (ft)	50	50	30	30	30
Minimum Spacing of Similar Roadways	1 mile	½ mile	1,000 feet	N/A	300 feet
Intersection (****) R.O.W. Line to near edge of curb cut	250 feet	200 feet	150 feet	150 feet	50 feet min., 75 feet desirable
Minimum Tangent Length	n/a	n/a	n/a	100 feet	50 feet

* May be modified for extenuating circumstances with approval of the Engineer.

** Minimum eight-foot width required where to be used as part of trail system. Minimum six-foot width required where sidewalk abuts the back of curb.

*** The maximum grade may be exceeded only upon written approval of the Engineer. Such approval will be granted only in unusual cases where grades within the acceptable limits cannot be obtained.

**** Curb cuts are not allowed on controlled access routes. For other major arterials, minimum distance to curb cuts shall be 250 feet.

D. RIGHT-OF-WAY GRADING. Within the limits of the right-of-way, the finished grade shall slope from ¼-inch vertical to 1 foot horizontal (1/4" ver. : 1' horiz.) minimum, to one-half-inch vertical to one foot horizontal (1/2" vert. : 1' horiz.) maximum measured above the back of the curb. These gradients may be varied only upon written approval of the Engineer.

E. TANGENT LENGTH. The minimum tangent length between reverse curves shall be 50 feet for local streets. No tangent will be required for radii longer than 500 feet.

DESIGN CRITERIA FOR
STORM DRAINAGE FACILITIES

A. GENERAL. This section sets forth the minimum technical criteria for the analysis and design of drainage systems in the City of Lansing. All development plans submitted for approval to the City of Lansing, and all permits applied for that will increase the amount of impervious surface by 5,000 square feet or more, must be accompanied by an adequate storm drainage system analysis and design in accordance with the criteria as hereinafter described.

B. MINIMUM STANDARDS OF ANALYSIS. Unless otherwise approved by the Engineer, 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 storm water 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 sixty (160) acres or less, the Rational Method of calculating the quantity of runoff shall be utilized. Developments where the area contributing runoff exceed one hundred sixty (160) acres shall be designed using the unit hydrograph method (SCS).
2. Criteria for Drainage System. All calculations relating to runoff analysis shall be based upon the proposed land use and shall take under 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 which 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 of Lansing 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 (C) 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 Engineer for any other method. The most likely flow pattern to be utilized for an undeveloped area shall be based upon existing natural topographical features.

   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.

   Existing runoff flow rates and velocities at locations of discharge from adjacent upstream developments shall be utilized in 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 energy dissipating structures shall be provided as required to result in velocities appropriate for the type of erosion control to be utilized. 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.

   The utilization of on-site 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, and all appropriate permits acquired.

   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 which involves the construction of any structure or the placement of fill material which will hinder or impair surface or subsurface drainage from surrounding areas.

C. MINIMUM STANDARDS OF DESIGN. Storm water runoff shall be conveyed within an enclosed systems or open channels on the basis of criteria established in this section and subject to the final determination and approval of the Engineer. Enclosed drainage systems shall be used to collect and convey drainage on, across and through public

right-of-way. The enclosed system shall extend at least to the limits of the right-of-way and energy dissipating structures shall be provided at the outlet to limit velocities to seven (7) feet per second and/or less as needed to prevent erosion damage.

Where enclosed storm drainage is located along side property lines, it shall remain enclosed to the rear property line or an existing channel. A surface swale shall be designed over this area to contain additional runoff from a 10-year storm. At the point of intersection with an open channel, energy-dissipating structures shall be provided to limit velocity to the capacity of the receiving channel or seven feet per second whichever is less.

Existing open channels, natural or improved with erosion control, may remain along the rear or side of properties when the design provides adequate protection to the adjacent property. Such protection shall be through the provision of a 100-year floodplain setback and a minimum clearance from the top of bank to any building of 30 feet.

The use of open channels is generally acceptable for conveying storm runoff from tributary watersheds if the runoff cannot be contained in a 72-inch diameter pipe.

1. 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 Use/Zoning	Storm Return Frequency
Residential	10 Year
Commercial	25 Year
Industrial	25 Year
Parks, Greenbelts, etc.	10 Year
Open Channels	25 Year
Flood Plains with drainage area up to 160 A.	
Crossing Arterial or Collector Streets	50 Year
Flood Plains with drainage area over 160 A.	
Crossing Arterial or Collector Streets	100 Year

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 30 percent or more of the total tributary area.

2. Runoff Computation. The rational method of calculating storm water quantities, Q = KCIA, shall be used with the following definitions of terms and arbitrary values:

Q is the quantity of runoff in cubic feet per second and is the basis for design of the storm drainage system.

K is a dimensionless coefficient to account for antecedent precipitation.

C is the weighted coefficient of runoff from the tributary area and shall have the following values where applicable:

Surface Use			Average
Land Use/Zoning	"C"	Percent Impervious	Percent Pervious
a. Business			
Downtown Area	0.90	95	5
Neighborhood Areas	0.80	85	15
b. Residential			
Single-Family Areas	0.50	35	65
Multi-Family Areas	0.65	60	40
Churches and Schools	0.75	75	25
c. Industrial			
Light Areas	0.65	60	40
Heavy Areas	0.80	80	20
Parks, Cemeteries	0.36	10	90
Playgrounds	0.35	10	90
Railroad Yard Areas	0.45	25	75
d. Undeveloped Areas			
Permanent Unimproved Areas, Greenbelts, etc.	0.30	0	100
Temporary Unimproved Areas which can be considered as fully developed in the future	0.65		
e. All Surfaces			
Impervious: Asphalt, concrete, Roofs, etc.	0.90	100	0
Turfed	0.30	0	100
Wet detention basins	0.90	100	0

Land areas not zoned, but whose future land use is defined by adopted land use plan, shall be assigned runoff coefficients for the land use indicated by the plan. Undeveloped areas designated as agricultural or those for which no specific future land use is indicated shall be assigned a minimum of 35 percent impervious surface for purposes of the design of storm drainage systems. (C= 0.51, CN=83)

As an alternate to the above coefficients or for areas not specifically listed above (planned building groups, shopping centers, trailer parks, etc.), a composite runoff coefficient based on the percentage of the different types of surfaces involved shall be used.

I is intensity of rainfall in inches per hour and shall be determined for the yearly frequency stipulated previously and as specified from the appropriate intensity duration curves as published in the most recent edition of the American Public Works Association's Standard Specifications and Design Criteria.

Time of concentration (TC) equals the overland 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 consideration. (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:

$$Ti = \frac{1.8\,(1.1 - C)\,D^{1/2}}{S^{1/3}}$$ where:

Ti is Inlet Time in minutes.
C is the Rational Method runoff coefficient as determined by land usage.
D is the overland flow distance parallel to slope in feet.
S is the slope of the tributary area surface perpendicular to contour in percent.

(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.

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:

Average Channel Slope (Percent)	Velocity (fps)
<2	7
2 to 5	10
>5	15

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.

3. Antecedent Precipitation. "K" represents the frequency factor used to account for antecedent precipitation and shall have the following values:

Storm Return Period (Years)	K*
10	1.0
25	1.1
50	1.2
100	1.25

*The product of K x C shall not exceed 1.0.

4. Pipe Sizing. Pipe sizes in integrated underground systems shall be determined in accordance with the Manning Formula $V = \frac{1.486}{n} R^{2/3} S^{1/2}$; and $Q = A \frac{(1.486)}{n} R^{2/3} S^{1/2}$; where

V=Velocity of flow in feet per second.
Q=Discharge in cubic feet per second.
A=Cross-sectional area of flow in square feet.
R=Hydraulic radius (R=A/P) in feet.
S=Slope in feet per foot.
P-Wetted perimeter in feet.
n=Roughness coefficient (see reference below).

Values of "n" to be used in the Manning Formula shall be those shown in the most recently published edition of American Public Works Association's Standard Specifications and Design Criteria. The minimum size storm sewer shall be fifteen (15) inches in diameter.

Storm sewers and inlets shall be of sufficient capacity to adequately carry the anticipated runoff from the

REQUIREMENTS FOR PUBLIC IMPROVEMENT PROJECT PLAN PREPARATION

A. Introduction. The following criteria is being established to provide a uniform system of plan preparation that will aid the Engineer in preparing plans for work within the City of Lansing. It is not intended that the criteria be an iron-clad 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. General. All plans and specifications for public improvement construction, either publicly-financed, or privately financed developments, shall be prepared by a professional Engineer licensed in the state of Kansas and submitted to the office of the Director of Public Works for review. Subsequent to the review, the Design engineer will be notified of the approval of the plans as submitted, or of any necessary changes. (Refer to the section "Public Improvement Project Plan Submittal" for plan review procedures).

Upon completion of the review and approval of the plans by the Engineer, the following number of sets of plans (as approved) must be submitted for signing and distribution:

Sanitary Sewer Projects . . . . . 5 sets and 2 half-size sets
All Other Improvement Projects . . . . . 3 sets and 2 half-size sets
All Projects . . . . . .1 digital copy on CD Rom in Auto Cad format.

One set of approved plans shall be sent by the Design engineer to each of the utility companies providing service in the proposed construction area.

The suggested plan sheet size is 22" x 36" or 24" x 36" with all sheets in a given set of plans being of the same size. Plan and profile shall be drawn on double or single plan and profile sheets to scales of one (1) inch equals 50 feet horizontal by one (1) inch equals 10 feet vertical, unless otherwise approved by the Engineer for special cases.

The plans shall consist of:

1. Title Sheet
2. General Layout Sheets
3. Plan and Profile Sheets
4. Cross-Section Sheets (Street Improvement Plans only unless otherwise required by the City Engineer)
5. Standard and Special Detail Sheets

Each sheet should contain a sheet number, including the individual sheet number and the total number of sheets, the Design engineer's seal, proper project identification, date, and any revision dates.

Where feasible, storm sewer construction details shall be incorporated into street construction drawings.

C. Title Sheet. The following items shall be included on the title sheet:

1. Name of project
2. City project number
3. Index of sheets included in plans
4. A location map adequately showing project location in relation to major streets
5. A summary of plan quantities of principal items, such as but not limited to:
   (a) Pipe sizes, number of manholes, etc. (sanitary sewers)
   (b) Length of curb and gutter, square yardage or tonnage of asphaltic concrete pavement, etc. (streets)
   (c) Pipe sizes, number of inlets, etc. (storm sewers)
6. The project control bench marks shall be identified as to location and elevation; USGS datum, most current
7. Name, address and telephone number of the Design engineer and owner/developer, if applicable

8. List containing name and telephone number of each affected utility company
9. Zoning
10. City Engineer's and Director of Public Works' signature lines
11. Signature and stamp of Professional Engineer registered in the state of Kansas, who designed or directly supervised the design of the project

D. General Layout Sheet. The following items shall be included on the general layout sheet for all improvement projects.

1. A legend of symbols shall be shown which shall apply to all sheets.
2. North arrow and scale. Scale of the general layout map shall be one (1) inch equals 100 feet, unless otherwise approved.
3. Layout shall include names of subdivision, block designation, if any, lot designation, or proposed block and lots, all street names, and an accurate tie to at least one (1) quarter section corner. An unplatted tract shall have an accurate tie to at least two (2) quarter section corners.
4. Boundary line of project area.
5. A list of general notes to the contractor to include at least those notes indicated in the "Procedure For Public Improvement Project Plan Submittal" section of this manual.
6. Existing and final grading contours drawn at intervals not to exceed two (2) feet. The existing contour lines shall be dashed and screened so they are of a lighter line weight as to be easily distinguishable from the final grading contours.
7. Property lines identified as to existing or proposed lot and block number or by name outside platted areas.
8. Elevation and location of nearest benchmark (USGS datum, most current).
9. One-hundred year floodplain line with elevation.
10. Location of all existing (water or sewer) lines properly designated within or adjacent to the project area (list City project name and number).
11. Connection point or points to existing facilities (tied to a known point on existing facility) and the type of connection to be utilized.
12. Location of all proposed (water or sewer) lines and appurtenances with designation and sheet number on which they appear in plan and profile.
13. Pre-blast survey limits.

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

1. North arrows and scale.
2. Existing and proposed streets with names and widths.
3. Property lines properly identified as to existing or proposed lot, block and subdivision.
4. All existing and proposed utilities such as power, gas, oil, water, telephone, sewer, and other items shall be properly located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, material, and type of construction.
5. All existing and known proposed improvements within 75 feet each side of center line shall be shown at their proper locations. This shall include such existing items as paved streets, curbs and gutters, driveways, culverts, fire hydrants, utility poles, trees, shrubs, fences, walls, houses, and other such items, and shall be identified as to type, size, material, etc., as may be applicable. In case of new developments, some irrelevant items may be omitted.
6. All existing easement and right-of-way information recorded with the county.
7. Minor construction notes shall appear on the proper plan and profile sheets.
8. Locations and widths of existing and proposed sidewalks.
9. All pertinent horizontal and vertical data, including elevation and location of nearest USGS benchmark (most current datum), at least two project benchmarks, references to all horizontal control points, all curve data, and property boundary basis.
10. Existing and final grading contours drawn at intervals not to exceed two (2) feet. The existing contour lines shall be dashed and screened so they are of a lighter line weight as to be easily distinguishable from the final grading contours.
11. Property lines identified as to existing or proposed lot and block number.

12. One-hundred year floodplain line with elevation.

In addition, the following items shall be included on the plan and profile sheets for the particular type of improvement stated below.

Streets

1. Horizontal curve data, vertical curve data, stopping sight distances and design speed.
2. Gradient between vertical curves.
3. Center line stations.
4. Stations and grade at curb returns (at ¼ points).
5. Profile shall show existing grade above center line as a dashed line, proposed finish grades or established street grades by solid lines.
6. Location of monument boxes.
7. Curbs, streets, sidewalks and any other paved surfaces shall be shown to scale.
8. The locations and widths of all easements, rights-of-way and streets shall be indicated.
9. Cross-section sheets are required. Cross-section intervals shall be at a maximum of 100 feet, and shorter intervals may be required by the Engineer.

Storm Drainage

1. Detailed alignment of the storm sewer, appurtenances, sizes of line, capacity, and other details relating to the storm drainage system including inlet station and top and invert elevations.
2. Proper ties into existing permanent facilities.
3. Distances between the storm sewer and other existing or future utilities in the right-of-way or drainage easement.
4. Drainage channel, slope and cross sections.
5. Existing and proposed street grades.
6. Proper elevations, slopes and lining for existing outfall ditches.
7. Locations of all bends and appurtenances.
8. Show size, slope and gauge (class) of each line on the profile.
9. Location, cross-section, capacity of, overflow swales. Show velocity in swale and erosion protection where necessary.
10. A site drainage plan (as a separate sheet) including the following information:
    Drainage calculation summary table containing the following information:
    a. Pipe size and slope
    b. Pipe capacity
    c. Velocity
    d. Time of concentration
    e. Runoff coefficient
    f. Antecedent Moisture factor
    g. Incremental tributary acreage
    h. Accumulative acreage
    i. Rainfall intensity
    j. Rainfall runoff
11. A site grading plan (as a separate sheet) including the following information:
    a. Property lines identified as to existing or proposed lot and block number.
    b. Elevation and location of nearest benchmark (USGS datum, most current).
    c. Final grading spot elevations shown for all corners of each lot.
    d. One-hundred year floodplain lines with elevation.

Sanitary Sewer

1. 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 reasonable frequent control points to provide unquestionable locations of the sewer within street right-of-way or on private property.

PRIVATE IMPROVEMENT
DESIGN CRITERIA

A. General. Private improvement construction in the City of Lansing shall in all respects be designed to conform to applicable codes, regulations and ordinances as established by the City of Lansing. Plans for private improvements being made in conjunction with building construction shall be submitted through the Community Development Division of the Department of Public Works. All street, roadway, driveway, and sidewalk construction, public or private, shall conform to the technical specifications and design criteria for public improvements as stipulated herein.

Private improvements that are not being constructed in conjunction with new building construction or an addition to an existing building shall submit plans to the Department of Public Works for review and approval. Improvements for water line, sanitary sewer line, storm sewer line and street construction shall conform to the design criteria of the City of Lansing and/or the applicable sections of the Uniform Building Code, latest edition.

B. Parking Lot Construction. Parking lot construction shall conform to the following design criteria and shall abide by all City of Lansing ordinances.

1. Materials for Construction. The following materials are acceptable for parking lot construction in the City of Lansing:

   (a) Pavement. The pavement cross-section shall consist of full depth asphaltic concrete (minimum of four inches), a combination of asphaltic concrete surface (minimum of 2½ inches) over a crushed rock base (minimum of six inches), or Portland cement concrete pavement (minimum of five inches) with 10 gauge welded wire mesh on six (6) inch centers each way embedded two (2) inches from the bottom surface of the slab.
   (b) Driveway Entrances and Curbing Within Public Right-of-Way. These items shall meet the requirements of Sections 1400, 2000, and 2100 of the Technical Specifications of the City of Lansing. They will be constructed of Class A (AE) concrete.
   (c) Curbing. Parking lot curb shall be of Class A (AE) concrete.

2. Curb and Curb and Gutter. Concrete curbing shall be provided along the perimeter of parking areas and along drives connecting parking areas with public streets. Curbing shall have a six-inch vertical face above the surface of the pavement. Curbs shall be constructed as cast-in-place. In areas of the lot adjacent to proposed future expansion, asphaltic concrete curb may be used if approved by the Engineer. The proposed future expansion shall be shown on the plans.

   All work within public right-of-way shall conform to applicable City of Lansing standards. Driveway approaches shall be constructed with integral curb and gutter conforming to City of Lansing Type “B” curb and gutter. Transition to existing curb shall be made at saw joints in existing curb or at existing expansion joints. Construction and expansion joints, dimension, elevations and surface finish shall match as closely as possible to that of existing adjacent curb and gutter. Expansion joints shall be placed where new curbing abuts existing curbing.

3. Drainage Facilities. All parking areas shall be provided with adequate drainage facilities as approved by the Engineer. Enclosed storm sewers shall be used to collect and convey drainage on, across and through public right-of-way. All effort will be made, within the limits of the existing topography, to prevent storm water runoff from parking lots from exiting through driveway entrances. If the Design engineer can justify the need for storm water to exit through a drive entrance, the maximum flow of water allowed shall be governed by the design criteria for storm drainage facilities for the City of Lansing for gutter flow. If the flow is in excess of the gutter capacity then it must all be picked up by a curb inlet prior to entering public right-of-way.

   Runoff calculations shall be in accordance with the Design Criteria for Storm Drainage Facilities of the City of Lansing. All calculations shall be submitted to the Engineer for review and approval. The Engineer shall determine if storm water detention will be required. Drainage structures located in the public right-of-way used and constructed as a portion of the storm drainage facilities for parking lots shall be in accordance with the Technical Specifications of the City of Lansing.

4. Driveway Entrances. Driveway entrances constructed within the public right-of-way shall be constructed of concrete (see detail in Section 2100). Each commercial or industrial property shall be allowed one driveway approach, but may at the Engineer's discretion, have more as long as the total maximum summation of the widths of all driveway approaches upon the property does not exceed 20 percent of the length of the real property that fronts the abutting City street. Should more than one driveway approach be approved, there shall not be less than 150 feet between the center lines of each driveway approach. In addition to the above, the following dimensions shall govern construction of driveway approaches:

   (a) Width of Driveway Approach

      1. Commercial Driveway Approach – The width of commercial driveway approaches shall not exceed 35 feet or be less than 25 feet measured parallel to the center line of the street at the property lines for two-way driveway approaches, provided, however, that commercial property may be allowed to have a driveway approach not exceeding 52 feet, if said driveway approach does not exceed 20 percent of the length of the real property abutting the adjacent City street and a four foot raised median is placed within such driveway approach to divide the entrance and exit lane(s). The minimum width of a one-way driveway shall be 16 feet.
      2. Industrial Driveway Approach. The width of industrial driveway approaches shall not exceed 65 feet or be less than 25 feet measured parallel to the center line of the street at the property lines for two-way approaches, provided that the minimum width for a one-way driveway shall be 16 feet. The minimum radius for an industrial driveway shall be 25 feet.

   (b) Corner of Adjacent Property Line Offset

      Commercial or Industrial Driveway Approaches. When commercial or industrial driveway approaches are located at or near a street intersection, in no case shall the distance from the property corner at the intersection be less than 150 feet to the near line of the nearest driveway approach, as extended to the street curb or pavement edge.

      No commercial or industrial driveway approach shall be constructed having a tangent length between the curb return and the property line extended, of less than 12½ feet.

   (c) Driveway Offset. Either center lines of opposing driveways shall align, or shall be offset no less than 75 feet. This condition shall not apply where a permanent median exists without break for these driveways.

   (d) Turning Radii.

      1. Commercial Driveways. Commercial driveway approaches shall have minimum radii of 15 feet.
      2. Industrial Driveways. Industrial driveway approaches shall have minimum radii of 25 feet. When a private improvement is determined to serve trucks with longer wheelbases, the Engineer may require a greater minimum radii for driveway approaches.
      3. Common Driveways. Driveways that are shared by adjacent property owners require that a common driveway (ingress/egress) easement be filed and on record at the County Register of Deeds office.

5. Construction on Public Right-of-Way Under State Jurisdiction or Control.

   All construction within right-of-way under the control or jurisdiction of the state of Kansas shall be reviewed and approved by the appropriate state agency prior to submittal of the plans to the City of Lansing. Plans submitted to the City of Lansing for review shall reflect all changes or corrections as required by that state agency and also outlined on the approved state permit.

2. The channel center line of waterways within 50 feet either side of center line of sewer shall be shown.
3. 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.
4. Results of all rock borings shall be shown at the proper locations.
5. 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.
6. A uniform system of line and manhole designation shall be used subject to the approval of the Engineer. Sewer lines shall have an alpha designation. The manhole designation shall be alpha numeric, with the first manhole connected to the existing system being assigned as the line's alpha designation and the numeric assignment as one (1), unless otherwise approved by the City Engineer.
7. Station, slope, length and minimum serviceable floor elevation (MSFE) of each stubline.
8. Profile shall show existing grade above center line 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 50 feet either side of center line. Each line shall be properly identified. The proposed sewer shall be shown as double solid lines properly showing the height of the pipe.
9. All utility crossings shall be shown on the profile view with approximate elevations given.

Water Lines

1. Alignment of the proposed water line dimensioned from curb lines or right-of-way lines.
2. Designation by station of all fire hydrants and line valves.
3. Results of all rock borings shall be shown at the proper locations.
4. All utility crossings shall be shown on the profile view with approximate elevations given.

F. Cross-Section Sheets. The following items shall be included on the cross-section sheets.

1. Street cross-section at each station, showing existing grade by dashed lines and proposed grade by a solid line. Cross-sections to show existing grade lines a minimum of 10 feet beyond right-of-way lines. Show cut and/or fill quantities at each cross-section.
2. Center line elevation of top of pavement.
3. Cross-sections shall be shown at all intersecting streets and driveways.
4. Channel cross-sections shall be shown for all drainage channel improvements.
5. Additional cross-sections shall be shown as required to clearly describe the extent of the grading operations.

G. Standard and Special Detail Sheets. Detail sheets shall be included to show all details of appurtenances, materials, and construction whether or not covered by the Lansing, Kansas, standards. Details shall conform to the City of Lansing standards and are to be drawn clearly and neatly with proper identifications, dimensions, materials, and other information necessary to ensure the desired construction.

H. Construction Record Drawings. Construction record drawings shall be submitted to the Engineer upon completion of the project and prior to final acceptance of the project by the City of Lansing. The Design engineer shall provide the Engineer with one (1) set of prints for all public 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"; shall include the date of revision and certifications by the Engineer; and shall be sealed as such by the licensed professional Engineer who prepared, or under whose direct supervision were prepared, the record drawings. The Design engineer shall provide the Engineer with one (1) digital copy of the Construction Record Drawings on CD Rom in Auto Cad format at the time the paper copy is delivered.

PRIVATE IMPROVEMENT
PLAN PREPARATION

A. Introduction. The following criteria is being established to provide a uniform system of plan preparation for work within the City of Lansing related to private improvements.

B. General. All plans for private improvements shall be prepared by a professional Engineer licensed in the state of Kansas and submitted to the Director of Public Works for review. Subsequent to the review, the Design engineer will be notified of the approval of the plans as submitted, or of any necessary changes.

Private improvement plans that involve sanitary sewer lines, storm sewer lines, or street construction, shall be prepared in accordance with the plan preparation requirements detailed in the Public Improvement Plan Preparation section of the Design Criteria (Section 5).

Private improvements involving parking lot construction shall meet the requirements outlined in Section 6 of the Design Criteria.

C. Parking Lot Plans. The following items shall be contained on the plans submitted for review for the construction of a new parking lot or an addition to an existing parking lot.

1. A location map, with north arrow, adequately showing project location in relation to major streets.
2. General site layout to include: building location (if applicable), street names, lot and block designation, and an accurate tie to at least one quarter section corner. Unplatted tracts shall have an accurate tie to at least two quarter section corners.

All existing property lines, lot lines, street right-of-way lines and temporary and permanent easement lines shall be shown at their proper location. Street right-of-way lines and existing driveways shall be shown on both sides of the street that falls on the perimeter of the lot.

All existing and proposed utilities such as electric, gas, oil, water, telephone, sanitary sewer, storm sewer, and other applicable items located in conformance with the best information available in the records of the owner of such facilities, or field location, and identified as to size, material and type of construction.

3. Include existing and proposed site contours for the site. Supplement the proposed contours with spot elevations at critical locations.
4. Show limits of paving and perimeter curbing. Indicate the location of parking stalls, including handicapped parking, and show all dimensions, radii and other significant geometric details.
5. The plans shall include a legend for the site layout detail and a sheet of standard details. The standard details shall include a profile view of the proposed curb(s), a section through the proposed pavement detailing pavement composition, a driveway entrance detail (must use the appropriate City Detail if the entrance is from a public street), proposed drainage structures, and any other appropriate details as may be required for clarity or by request of the Engineer.
6. Storm drainage facilities shall be shown in both plan and profile view. These views shall show inlet and pipe locations, size, material, gage, slope of pipe, and all invert and top of structure elevations. Include on the plan sheets a drainage calculation summary table containing information on: pipe size and slope, pipe capacity, velocities, time of concentration, runoff coefficient, incremental and accumulated tributary acreage, rainfall intensity, and the total rainfall runoff.
7. General construction notes as required.

STREET LIGHTING CONSTRUCTION
DESIGN CRITERIA

A. GENERAL. Proposed street lighting construction in the City of Lansing shall in all respects conform to the technical criteria for analysis and design of street lighting as set forth in this section. Plans shall be submitted to the office of the Engineer for approval and shall include all information as may be required or described hereinafter.

B. DESIGN PROCESS. The illumination design process involves the selection of the proper lighting equipment and the establishment of the geometry of the system in order to provide the most effective lighting system to satisfy the needs. The major steps of the design process are outlined as follows:

1. Existing conditions. Determination of roadway facility and land use area classifications.
2. Selection of Illumination Level. The recommended average intensity of horizontal illumination may be determined based upon the classifications of roadway facility and area type.
3. System Characterization. Detailed calculations using selected light source types and sizes and luminaire mounting height and spacing locations are employed in order to determine the average intensity of horizontal illumination.

Based upon the selected equipment and geometrics, an isocandle diagram or computer program equivalent is employed to determine the minimum illumination level.

The uniformity of illumination is checked by comparing the ratio of average maintained illumination to minimum maintained illumination, commonly referred to as the uniformity ratio, with the recommended criteria in order to determine optimal effectiveness of lighting system.

C. DESIGN CONDITIONS. Maximum spacing, consistent with good illumination design, should be emphasized. Luminaire supports are hazardous roadside objects and the total number should be minimized and/or strategically located behind sidewalks for safety considerations. Supports shall be set back as far as practical. In general, the pole setback distance from the face of the curb shall be six or more feet. In locations where the proper setback distance cannot be achieved, the use of breakaway pole bases is required.

Determination of light source size and type and luminaire mounting height and spacing shall be based upon the required illuminance levels when the luminaries are at their lowest output. This condition occurs just prior to lamp replacement and luminaire washing. Therefore, formulas calculating average illuminance shall include light loss factors relating lamp lumen depreciation and luminaire dirt depreciation.

D. AREA CLASSIFICATION. The classification of urbanized areas shall be generally defined as follows:

1. Commercial. That portion of a municipality in a business development where ordinarily there are large numbers of pedestrians during business hours. This definition applies to densely developed business areas outside, as well as within, the central part of a municipality. The area contains land use which attracts a relatively heavy volume of nighttime vehicular and/or pedestrian traffic on a frequent basis.
2. Intermediate. That portion of a municipality often characterized by a moderately heavy nighttime pedestrian activity such as in blocks having libraries, community recreation centers, large apartment buildings or neighborhood retail stores.
3. Residential. A residential development, or a mixture of residential and commercial establishments, characterized by a few pedestrians at night. This definition includes areas with single family homes, town houses, and/or small apartment buildings.

E. ROADWAY CLASSIFICATION. The classification of roadways shall be generally defined as follows:

1. Freeway. A divided major roadway with full control of access and with no crossings at grade. This definition applies to toll as well as non-toll roads.

2. Expressway. A divided major roadway for through traffic with partial control of access and generally with interchanges at major crossroads. Expressways for non-commercial traffic within parks and park-like areas are generally known as parkways.
3. Arterial. The part of the roadway system that serves as the principal network for through traffic flow. The routes connect areas of principal traffic generation and important rural highways entering the City.
4. Collector. The distributor and collector roadways serving traffic between major and local roadways. These are roadways used mainly for traffic movements within residential, commercial and industrial areas.
5. Local. Roadways used primarily for direct access to residential, commercial, industrial, or other abutting property. They do not include roadways carrying through traffic. Long local roadways will generally be divided into short sections by collector roadway systems.
6. Alleys. Narrow public ways within a block, generally used for vehicular access to the rear of abutting properties.

F. RECOMMENDED ROADWAY AVERAGE MAINTAINED HORIZONTAL ILLUMINATION (IN FOOTCANDLES).

AREA CLASSIFICATION

Vehicular Roadway Classification

	Commercial	Intermediate	Residential
Freeway	0.6	0.6	0.6
Expressway	1.4	1.2	1.0
Major (Arterial)	2.0	1.4	1.0
Collector	1.2	0.9	0.6
Local	0.9	0.6	0.4
Alley	0.6	0.4	0.4

These are the recommended minimum values for average maintained horizontal illumination for the given type of roadway facility and land use area.

G. LUMINAIRE TYPE AND PLACEMENT. The following table and figure should be employed as a general guide for selection of lateral light distribution types, luminaire placement and mounting heights:

GUIDE FOR LUMINAIRE LATERAL LIGHT TYPE AND PLACEMENT

Side of the Roadway Mounting			Center of the Roadway Mounting		
One Side or Staggered	Staggered or Opposite	Grade Intersection	Single Roadway	Twin Roadways (Median Mounting)	Grade Intersections
Width up To 1.5 MH	Width beyond 1.5 MH	Width up to 1.5 MH	Width up to 2.0 MH	Width up to 1.5 MH (Each Pavement)	Width up to 2.0 MH
Types II-III-IV	Types III & IV	Type II 4-way	Type I	Types II & III	Types I 4-way & V

GUIDE TO THE SELECTION OF LUMINAIRE MOUNTING HEIGHTS

Lamp Lumens	Mounting Height
≤20,000	≤35 ft.
20,000-45,000	35-45 ft.
45,000-90,000	45-60 ft.

H. CALCULATING AVERAGE LUMINANCE. The basic formula for determination of average horizontal luminance is as follows:

$$\text{Average Luminance} = \frac{(\text{Lamp Lumens}) \times (\text{Coefficient of Utilization} \times (\text{Light Loss Factor})}{(\text{Spacing Between Luminaires}) \times (\text{Width of Roadway})}$$

The spacing between the luminaries is the longitudinal distance if spaced in staggered or one-sided arrangement. This distance is one-half the longitudinal distance if luminaries are arranged in opposite spacing.

The light loss factor represents the luminaire conditions at their lowest output level. The total factor is based upon the contribution of individual light loss factors such as lamp lumen depreciation, luminaire dirt depreciation, ambient temperature, in-service voltage, ballast, lumen component depreciation, physical surroundings and burnouts. The light loss factor can be determined by tables from the equipment manufacturer for the given luminaire type.

The coefficient of utilization is equal to the total of street side and house side coefficients of utilization as determined from the equipment manufacturer coefficient of utilization curves for the given luminaire type, placement and mounting height.

I. DETERMINATION OF MINIMUM LUMINANCE. Minimum illumination is determined from the isofootcandle diagram or computer program equivalent from the equipment manufacturer for the given luminaire type, placement and mounting height.

J. UNIFORMITY RATIO. The basic formula for determination of the uniformity ratio is as follows:

$$\text{Uniformity Ratio} = \frac{\text{Average Maintained Illumination}}{\text{Minimum Maintained Illumination}}$$

The uniformity ratio shall not exceed 4:1 and preferably should not exceed 3:1 except on residential streets, where 6:1 may be acceptable.

K. CUTOFF. The control of candlepower distribution shall be based upon engineering judgment and the area classification. The following table should be employed as a general guide for the selection of the cutoff type:

AREA CLASSIFICATION	CUTOFF TYPE
Commercial	Full Cutoff or Semi Cutoff
Intermediate	Full Cutoff or Semi Cutoff
Residential	Full Cutoff

L. ELECTRICAL SYSTEM. The electrical system shall comply with the standards as listed in the American National Standard Practice for Roadway Lighting (ANSI/IES RP-8), the National Electrical Code (ANSI/NFPA 70) and the National Electrical Safety Code (ANSI C2).

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. All storm drainage systems shall be designed so as to maintain a minimum velocity of flow at the outlet of three (3) feet per second and a maximum velocity of seven (7) feet per second when flowing full.

5. Pipe Slope. Pipe slopes may not be greater than fifteen (15) percent and water velocities in pipe may not be greater than fifteen (15) feet per second without a variance from the Engineer. If a variance is allowed, then pipe runs whose slope is fifteen (15) percent or greater and/or whose water velocity is twenty-five (25) fps or greater, will be required to have concrete collars on every sixth joint unless the conditions necessitate a greater or lesser spacing.

6. Depth. All storm drainage lines shall have a minimum cover of eighteen (18) inches. Cover may be decreased to avoid conflicts or on short laterals, depending upon the type of pipe and manufacturers' recommendation, and as approved by the Engineer. Special bedding and backfill and rigid pipe may be required where cover is decreased below eighteen (18) inches.

7. Curb Inlets, 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. The Izzard Formula shall be used to assure that the gutter flow will not encroach on the following center widths of streets:

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

Izzard Formula: $Q=0.56\ (Z/n)\ S^{1/2}\ D^{8/3}$; where

Q=The gutter flow in cubic feet per second.
Z=The reciprocal of the average cross-slope, including gutter section in feet per foot.
S=The longitudinal street grade in feet per foot.
D=The depth of flow at curb face in feet.
N=Manning's "n". See reference below.

Values of "n" to be used in the Manning Formula shall be those shown in the most recently published edition of American Public Works Association's Standard Specifications and Design Criteria.

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 in writing by the Engineer.

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

(a) Channel invert elevation;
(b) Plus depth (diameter) of outlet channel (pipe);
(c) Plus "h" calculated in accordance with energy losses and coefficients as listed in the most recent version of the American Public Works Association's Standard Specifications and Design Criteria; except for structures where 50 percent or more of the discharge enters the system from the surface of the structure "h" minor losses shall be calculated by:

$h=k\ (V^2/2g)$ where:

h=Head loss in feet.
V=Velocity of flow in feet per second at point of interest.

2g=64.4 feet per second per second.
K=Coefficient as shown in the American Public Works, "Standard Specifications and Design Criteria", Section 5600, Table B. Head Loss Coefficient "k".

The hydraulic gradient elevation shall be calculated at the entrance to the outlet line of each structure. The crown(s) of pipe(s) entering a structure shall be at the same elevation, and at or above the crown of the line exiting from the structure when practicable.

8. Open Channels. Unless in a designated flood plain or a critical area as determined by the Engineer, open channels shall be designed for the 100-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.

Channel capacities shall be computed using the Manning Formula for uniform flow.

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.

Pipe culverts, box culverts, and other structures entering channels shall not project into the normal waterway area. Channel design shall include lining or treatment of the invert and sides as required to minimize erosion. Minimum treatment shall include seeding. Channel inverts and sides shall be lined in accordance with the following table:

Mean Flow Velocity	Type of Lining
Less than 3 F.P.S.	Seeded
3 to 5 F.P.S.	Sod, staked
5 to 10 F.P.S.	Stone riprap (15" Min. Thickness)
10 to 15 F.P.S.	Grouted stone riprap, gabion revetment or concrete paving
Over 15 F.P.S.	Concrete paving or sound in-situ natural rock

Lining materials having equivalent erosion control properties to those shown in the foregoing table may be used in lieu thereof with the written approval of the Engineer.

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 by the Engineer. Friction factors used in design shall consider the type of lining as listed in the roughness coefficient tables for Manning's Formulas as published in the most recent version of the American Public Works Association's Standard Specifications and Design Criteria. Alignment changes shall be achieved by curves having a minimum radius of:

$$R = \frac{V_2 W}{8D}$$

R = Minimum radius on centerline in feet.
V = Average velocity of flow in feet/sec.
W = Width of channel at water surface in feet.
D = Depth of flow in feet.

All improved channels shall be lined to a minimum height of the 25 year hydraulic grade line plus a minimum of 1.0 feet freeboard above the 100-year storm.

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.
D = Depth of flow in feet.

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

(a) 30 (y) feet downstream from the point of tangency (p.t.).
(b) 10 (y) feet upstream from the point of curvature (p.c.).

9. Natural Channels. The use of existing natural drainage ways as an integral part of a storm drainage system is recommended and encouraged where feasible. The appearance and functioning of significant natural open channels shall be preserved as determined by the Director of Public Works. For such consideration, the channel should be wide and shallow, and be characterized as slow flowing having a mean flow velocity of no greater than five (5) feet per second. Relocation of significant natural channels will not be approved unless such relocation has been substantiated by a thorough and complete analysis of the resultant consequences, and appropriate permits are obtained. The area preserved for the natural open channel shall be sized adequately to convey the theoretical peak discharge during one-hundred (100) year return period storm plus ten (10) feet on either side of the channel, without damaging surrounding properties, and shall be encompassed by a permanent drainage easement of not less than 30 feet and the width shall be increased if necessary to permit access by truck along the entire length of the channel.

10. Culverts. Culverts under major arterials (thoroughfares) shall have sufficient capacity to pass the runoff from the appropriate design storm considering 20% of the inlet opening plugged.

The following design criteria shall be utilized for all culvert design:

(a) The culvert including inlet and outlet structures shall properly pass the design storm and debris at all stages of flow. Whenever practical, box (or pipe) culverts shall have a minimum inside height of 7 feet to facilitate the removal of silt and debris.
(b) Inlet. Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall be provided 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 feet per foot.
(e) Headwater. Generally, the headwater to diameter ratio (HW/D) should not exceed those recommended as follows:

Storm Frequency	HW/D
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. The value of the roughness coefficient (n) used shall not be less than those specified in the most recent edition of the American Public Works Association's Standard Specifications and Design Criteria.

(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 Lansing and shall be as approved by the Engineer. Design aides 4-9 and 4-10 are provided for determining the gauge requirements for corrugated metal pipe. Manufacturer should be contacted to review gauge versus design fill.

D. EASEMENTS. Drainage easements shall be a minimum of fifteen (15) feet for enclosed structures and twenty (20) feet for open (paved or grass-lined) channels where they cross private property or as designated by the Engineer.

E. STORMWATER DETENTION. The Design engineer shall provide sufficient calculations and analysis to determine whether a proposed plan will cause or increase downstream local flooding conditions. This determination shall be made on the basis of an engineering analysis of storm water runoff prior to and after the proposed development. If the Design engineer determines that the proposed development will cause or increase downstream local flooding conditions during the design storms, provisions for controlled detention or City approved alternate method of control of storm water runoff and its regulated discharge to the downstream system to preclude such flooding conditions, shall be included in the design of storm drainage improvements.. .All determinations and calculations are subject to review and approval of the Engineer.

Temporary detention of storm water runoff shall be required for all industrial, commercial, and residential developments that would otherwise increase the peak rate of runoff for the design storms. Storm water detention basins shall be designed and constructed for the attenuation of the peak rate of runoff to an amount not greater than that occurring prior to development, as calculated for the 10, 25, and 100 year return storms.

1. Storage Volume Requirements. Storage volume shall be adequate to contain the differential volume of runoff which would result from the design storm occurring on a fully developed site over the maximum allowable release rate. The minimum rainfall event to be utilized in determining the detention storage volume shall be based upon the planned land usage and intensity within the tributary area. The intensity to be used for a residential development shall be a ten-year rainfall event while a commercial and industrial development shall use a twenty-five year rainfall event.

2. Maximum Allowable Release Rate. In general, the maximum release rate shall be defined as the rate of runoff occurring prior to the proposed development taking place and shall be determined mathematically as the runoff resulting from the design storm return-frequency rainfall calculated using an appropriate hydrologic method acceptable to the Engineer. Deviations from the use of this rainfall frequency in design calculations shall be only where approved in writing by the Engineer.

3. Freeboard. The minimum elevation of the top of the detention storage basin embankment shall be at least one foot above the water surface with the emergency spillway flowing at design, or a minimum of two feet above the crest of the emergency spillway.

4. Sediment Storage. A sediment storage volume of at least 5 percent of the total required temporary storage volume for runoff detention shall be provided.

5. Outlet Control Works. Outlet control works shall not include any mechanical components or devices (valves, gates, pipes, etc.) and shall function without requiring attendance or control during operation. Size and hydraulic characteristics shall be such that all water in detention storage is released to the downstream storm sewer system within twenty-four hours after the end of the design rainfall.

6. Emergency Overflow. A method of emergency overflow shall be designed and provided to permit the safe passage of runoff generated from a one hundred-year storm.

7. Structure Integrity. The basin shall be designed with the capability of passing a one hundred-year storm event from a fully developed watershed basin through the outlet works without causing failure of the embankment.

8. Erosion Control. Principal spillways and outlet works, as well as conveyance system entrances to detention basins, shall be equipped with energy dissipating devices as necessary to limit the peak discharge velocity. See Section 8. Open Channels, of the "Design Criteria for Storm Drainage Facilities".

9. Design Data Submittals. In addition to completed plans, the Design engineer shall submit the following for all projects that include temporary detention facilities using the following methods, unless otherwise directed by the Engineer.

Computational Methods:

a. Time of Concentration and Travel Time: Use methods as outlined in Technical Release No. 55, "Urban Hydrology for Small Watersheds," Chapter 3.

b. Temporary Storage Volume: A preliminary value of the storage requirement may be obtained through methods outlined in Technical Release No. 55, Chapter 6 or other acceptable methods. The storage shall be checked during routing of design hydrographs through the basin and adjusted appropriately.

c. Hydrograph Routing: The method of routing a hydrograph through a detention/retention basin must be indicated within the report.

Required Submittals:

a. A brief narrative describing the project, design approach and a listing of all software packages used in the analysis.

b. A scaled drawing with the boundary of the watershed draining into the storm water detention facility clearly delineated with sub-area acreage indicated. The drawing scale shall be submitted at the smallest as practical to show the entire watershed boundary.

c. Tables showing all input values used in calculations such as, but not limited to, the tributary area, SCS curve numbers or runoff coefficients, rainfall intensities, and time of concentration calculations.

d. A cross-section of each emergency spillway complete with all pertinent dimensions. Cross-sections should include scale drawings of all weirs, seepage barriers, erosion protection, and all other integral features of the dam or emergency spillway construction.

e. Elevation-area-volume curves for the storage facility including notation of the storage volumes allocated to runoff, sediment and permanent residual water storage for other uses (wet basins only).

f. Inflow hydrographs for the 10-year and 100-year recurrence interval design storms.

g. Stage (feet) – Discharge (cfs) rating curves for each spillway and for combined spillway discharges.

h. Routing curves for the 10-year or 25-year, and 100-year recurrence interval design storms with time plotted as the abscissa and the following plotted as ordinates:

    1) Cumulative inflow volume.
    2) Cumulative discharge.
    3) Stage Elevation.
    4) Cumulative storage.

10. Optional Detention Methods. Some possible types of detention facilities can be (but are not limited to) the following:

(a) Wet-bottom basins. The minimum normal pool elevation prior to the introduction of excess storm water shall be four feet. If fish are to be used to keep the basin clean, at least one quarter of the area of the permanent pool must have a minimum depth of ten feet. For emptying purposes, cleaning of shoreline maintenance, facilities shall be provided or plans prepared for the use of auxiliary equipment to permit emptying and draining.
(b) Dry-bottom basins. Where possible these shall be designed to serve secondary purposes for recreation, open space or other types of use which will not be adversely affected by occasional or intermittent flooding. To facilitate interior drainage, concrete paved swales or piping systems shall be required from the inflow to the outlet structures.
(c) Paved parking lots. Parking lots may be designed to provide temporary storage of storm water on all or a portion of their surfaces to a maximum depth of seven (7) inches. Outlets will be designed so as to empty the stored waters in such a time to create the least amount of inconvenience to the public. Minimum slopes of 1 percent and maximum slopes of 4 percent are to be utilized.
(d) Underground. May be used under paved parking on limited space sites where the hydraulic gradient permits gravity release.

The minimum freeboard from the maximum water ponding elevation to lowest opening elevation of adjacent buildings to structures shall be one foot.

F. DEVELOPMENT ACTIVITIES UNDER STATE JURISDICTION. The following activities are subject to State of Kansas jurisdiction, require state permits, and are subject to environmental coordination review as required K.S.A. 82a-325 through 327 and subsequent updates:

(a) Dams and dam modifications; K.S.A. 82a-301 through 305a.
(b) Levees; K.S.A. 24-126.
(c) Floodplain fills; K.S.A. 24-126.
(d) Stream obstructions and Channel changes; K.S.A. 82a-301 through 305a.

NPDES Notice of Intent is required for most projects.

A USACE 404 permit may be required for projects affecting the regulatory floodplain.

Permit applications and fees are the responsibility of the developer, or in the case of City projects, the City, and submittals and supporting documentation should be prepared by the Design engineer.

To obtain state permits, plans and applications must first be submitted to the City of Lansing for review for general conformance to City standards. They will then be forwarded to the Kansas State Board of Agriculture, Division of Water Resources for state review and approval. The City of Lansing cannot approve plans for construction that are under state jurisdiction until a state permit is obtained.

F. OFF-CENTER STREET INTERSECTIONS. Off-center street intersections shall be separated by a minimum centerline to centerline dimension of 200 feet. The minimum separation of a particular set of intersections may be increased for reasons of public safety by the Engineer.

G. CONNECTIONS TO EXISTING PAVEMENTS. Where new street construction is to connect to an existing street, a minimum of five feet of the existing pavement is to be removed to subgrade. This subgrade is to be prepared with that of the new improvement and repaved with the new construction. Existing pavement is to be removed at a saw cut for entire width of street from curb face to curb face. If full-depth pavement removal is required, the subgrade shall be re-compacted to 95 percent of standard density.

H. MINIMUM ANGLE OF INTERSECTION. It is desirable for all intersections to meet at approximately a 90° angle. Skewed intersections require written permission of the Engineer and in no case should the angle be less than 75°.

I. SIDEWALKS. Sidewalk construction shall typically follow the requirements in Standard Detail 21-4.

J. STORM DRAINAGE. All storm drainage work constructed in connection with street improvements shall be designed in accordance with the City of Lansing Design Criteria for Storm Sewers and Appurtenances. All storm sewers under curbs or pavement shall be RCP.

K. 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 permitted. Such cul-de-sacs shall be constructed with a minimum radius of 39 feet to the back of the curb. Maximum length of cul-de-sac streets from the nearest intersection shall be 500 feet.

L. TEMPORARY TURN-AROUNDS. At locations where streets are to be temporarily terminated which will be extended at a later date, and said street extends beyond the intersection of an adjacent street more than five lots, a temporary cul-de-sac shall be constructed with a minimum radius of 35 feet. The temporary cul-de-sac shall be constructed of asphaltic concrete with a minimum depth of six inches. Curb and gutter will not be required. The cul-de-sac shall be constructed within the limits of a permanent construction easement or right-of-way. Maximum length of street to temporary turn-around from nearest intersection shall be 500 feet.

M. MONUMENT BOXES. Monument Boxes conforming to Standard Detail 21-10 shall be installed at all quarter section corners as an element of the street construction.

N. SIGHT DISTANCES.

1. Stopping Sight Distance – Sight distance is the length of roadway ahead visible to the driver. The minimum sight distance available on a roadway should be sufficiently long to enable a vehicle driving at or near the design speed to stop before reading a stationary object in its path.

   Stopping sight distance represents the sum of the brake reaction distance and the braking distance. These distances are measured from the height of the driver's eye to the height of the object (3.5 feet and 2.0 feet above the road surface, respectively). Design controls for stopping sign distances vary slightly for crest vertical curves and sag vertical curves and are dependent on the algebraic difference in the grades as well as the design speed. Stopping sight distances to be used in design of roadways shall be in accordance with the most recently published guidelines of the American Association of State Highway Transportation Organizations (AASHTO).

2. Intersection Sight Distance – Sight distances at intersections vary from stopping sight distance. The intersection sight distance should be sufficient to permit a vehicle on the minor leg of the intersection to cross the traveled way without requiring the approaching through traffic to slow down. To allow this, an area free of visual obstruction is required at every corner of an intersection. This area is known as the sight triangle. An obstruction to vision shall be defined as an obstacle (i.e., a parking vehicle, a wall or commercial sign, bush or hedge, guardrail or fence, etc.) which forms a restriction to an assumed line of sight measured from the driver's eye height to a target some distance along the cross street. Every effort shall be made to select intersection locations so that the maximum sight distance is possible. As an element of this, location of intersections shall always consider the grade changes along the adjacent street in terms of possible sight obstructions. Design criteria for intersections are stratified into minimum and desirable values. The minimum values represent the lowest

dimensions that shall be accepted by the City of Lansing. The desirable values shall be used to every extent possible within the intersection right-of-way available. In unique circumstances, the Engineer may grant variances.

3. Minimum – All corner lots within the City limits of Lansing (except those in the Central Business District) shall have a sight triangle from a point 15 feet back along the intersecting street from the edge of the curb line of the abutting street, to a point 140 feet along the curb line of the abutting street. Such an area shall be and remain free of visual obstruction higher than two feet above the roadway surface. Within the Central Business District, the sight distance triangle shall conform as closely as possible to the above specification for sight distance, as approved by the Engineer. (Refer to DA 3-3)

4. Desirable – To every extent possible, sight distance from the minor legs of intersections shall conform to the stopping sight distances indicated in Design Criteria C. (Street Design Standards Table). The standard assumed height of the driver's eye for a passenger vehicle is 3.5 feet above the roadway surface. This relates to the line of sight required to detect a target approach vehicle on the cross street (2.5 feet above the roadway surface). These desirable values are dependent on the design speed of the intersecting street and on the design vehicle which will approach the intersection.

O. PRIVATE STREETS. All streets and roadways within any development which are classified as "Private Streets" shall conform to the standards and specifications for public streets, as stipulated in the Technical Specifications and Design Criteria for Public Improvement Projects for the City of Lansing.

P. BICYCLE-PEDESTRIAN TRAIL SYSTEM. The Design engineer shall contact the Parks and Recreation Department and the Planning and Development Division of the Public Works Department to determine whether any portion of the proposed construction will involve the City of Lansing's Bicycle-Pedestrian Trail System. Sidewalks constructed as part of this system shall be eight feet in width. If they are to be located within street right-of-way, they shall be constructed with woven wire mesh or fiber reinforced concrete a minimum of four (4) inches in depth with all of the joints saw cut instead of tooled. If they are to be located on City property but not within the street right-of-way, they may be constructed, at the Engineer's discretion, of asphalt four (4) inches in depth with a four (4) inch crushed rock (AB-3) base underneath.

Q. GEOTECHNICAL REPORT. Prior to final plan approval, the Engineer will require three approved copies of a geotechnical report, scaled by a Kansas licensed professional engineer. The report must identify all soils to be used for roadway embankment, roadway subgrade, structure backfill, and trench backfill. Two sets of clearly labeled jar samples representative of the soils shall be furnished for visual and tactile identification. The report shall identify soils encountered on the site that are unsuitable for the uses noted above.

The report shall evaluate the following for each soil as a minimum: Sieve Analysis, USCS Classification, Atterburg Limits, Maximum Dry Density (ASTM D 698), Optimum Moisture Content, Moisture Density Curve (Standard Proctor).

For roadway subgrade, soils must have a liquid limit not exceeding 40, and a placticity index not exceeding 25. If the soils to be used do not meet these requirements, the report must specify how they will be modified to comply.

The report shall indicate the methods to be used for placement and compaction of the subgrade, and when soil treatment/amendment is specified, detailed methods of incorporation, placement, compaction, and curing.

In addition, the report must include the inspection procedures to be followed during placement and compaction of subgrade. The procedures must include all the following as a minimum:

1. Inspection by the contractor of the subgrade for vertical and horizontal alignment prior to placement of flyash.

2. Maximum time from flyash incorporation to compaction per KDOT standard specifications (maximum of two hours).

3. Standard Proctor curves for flyash/soil mixtures must be received by the City's on-site inspector 48 hours prior to flyashing field activities.

4. Finishing and curing per KDOT standard specifications section 310 – Flyash Modification.

The geotechnical report must also outline the testing and quality control procedures to be used during the placement and compaction of the subgrade. The testing listed in Section 7007 will be required as a minimum.

In addition, the following testing will be required:

1. Moisture content of soil prior to flyash incorporation.

2. Moisture content of flyash/soil mixture immediately prior to compaction.

The on-site testing lab personnel shall be equipped with soil classification and standard proctor curves for both soil and flyash/soil mixture.

R. PERMANENT GROUND COVER. Areas disturbed in front of homes or businesses in all residential and business zoning categories shall be sodded.

S. FIXED OBJECTS IN RIGHT-OF-WAY. For all collector and arterial streets, no fixed object over 6" above grade shall be allowed within 10 ft. of the edge of pavement, with the exception of traffic signs and mailboxes on posts approved by the Department of Public Works, traffic signal poles, and street light poles providing they are mounted on approved frangible breakaway bases.

It is intended that fire hydrants be located no further than 15' from the edge of pavement. When it is not feasible, as determined by the Director of Public Works, to locate fire hydrants at least 10' from the edge of pavement on arterial and collector streets, exceptions may be made on a case by case basis by the Director.

T. RETAINING WALLS AND LANDSCAPE WALLS. All concrete retaining walls shall be designed by a Kansas Registered Professional Engineer, except integral sidewalk retaining walls of 30" or less height as shown on SD21-5.

Modular block walls up to 48" high are considered landscape walls and when founded on a concrete footing at least one course below finish face ground grade, and are installed according to the modular block manufacturer's recommendations, do not require design and inspection by a Kansas Registered Professional Engineer.

All other modular block walls are considered retaining walls, must be designed by a Kansas Registered Professional Engineer, and a Kansas Registered Professional Engineer must certify upon completion that they were constructed in accordance with that design.

The City Engineer will not be responsible for the design or certification of modular block walls.

U. TRAFFIC IMPACT STUDY REQUIREMENTS. Traffic impact analyses required by the City of Lansing for public and/or private projects and developments shall, as a minimum, meet the following requirements:

1. Project description

   (a) Location
   (b) Size
   (c) Proposed land use (consistent or change from Comprehensive Plan)
   (d) Study Area (To be approved by the Director of Public Works BEFORE the study is performed.)

2. Existing Conditions

   (a) 24-hour traffic counts, not more than one year old. If there has been recent development, then the counts must be current.
   (b) Peak hour turning movement counts for subject and adjacent intersections – must be current. If this is a larger development, then typically recommended to go beyond one intersection, but is determined depending upon the site location. (See "Study Area" above.)

(c) Roadway geometry (dimensions, lanes, curb/gutter or ditch, turn lanes, access/driveway/intersection locations) for study area
(d) Intersection control (stop, yield, signals) within study area
(e) Traffic distribution (%north, %east, %south, %west)
(f) Any other major traffic contributors that should be noted
(g) Any major traffic intersections (arterial intersections, freeway ramps, etc.)
(h) Graphic illustrating peak hour turning movements and segment 24-hour traffic volumes
(i) Existing traffic operations (level of service conditions within study area)
(j) Comprehensive Plan (land use and transportation component) plans (widen road, future bike path, etc.)

3. Proposed Development

(a) Land Use
(b) Development size (include map)
(c) ITE Trip Generation code(s)
(d) ITE Trip Generation (typically done in a table format with development type, size, daily traffic for generator[s] and peak hour traffic for generator[s])
(e) Trip Distribution (where is the traffic coming from/going to from this proposed development)
(f) Identify other new/proposed developments and include that traffic (as a separate graphic)
(g) Peak Hour and Daily traffic volumes with the proposed development (graphic – this identifies segment and turning movement volumes)
(h) Peak Hour and Daily traffic volumes for proposed development and any other related new/proposed approved developments that are not constructed, but have provided a traffic study
(i) Access locations

4. Future Conditions

(a) Peak Hour and Daily traffic volumes (existing plus proposed developments combined)
(b) Peak Hour level of service for study area
(c) Identification of impacts
(d) Consistency with Comprehensive Plan
(e) Recommendations

5. Appendix

(a) Map that clearly indicates the limits of Study Area with proposed geometric improvements and traffic control devices consistent with the recommendations
(b) Turning Movement Counts
(c) 24-hour Counts
(d) Existing Conditions Level of Service evaluation output
(e) Future Conditions Level of Service evaluation output

installed on private service lines at a maximum spacing of 100 feet, and at alignment changes.

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.

Sanitary sewer lines and water lines shall be constructed a distance of ten (10) horizontal feet apart when they are to be installed parallel to each other. Exceptions to this requirement shall be granted only upon written approval by the Kansas Department of Health and Environment.

Where sanitary sewer lines are to be installed over or under and across water lines and a two (2) foot clearance cannot be obtained because of limited grades or grades of existing structures, then the sewer pipe shall be encased in concrete for a distance of at least ten (10) feet in each direction from the crossing.

O. AERIAL CROSSINGS. Adequate support shall be provided at all joints in pipes utilized for aerial crossings. All aerial crossings shall be approved by the Wastewater Utility Director or City Engineer.

P. UNSEWERED DWELLINGS. All existing addresses that will be provided access to the sewer that previously did not have sewer service available shall be identified by the Design Engineer. This identification shall include the approximate distance from the dwelling to the sewer.

Q. MAXIMUM SLOPE. All sewers which are designed to flow at 10 feet per second or greater shall be reviewed by the Engineer for approval or alternate design considerations.

R. EXTENSIONS OF THE SEWER. All extensions of the sanitary sewer shall be made so that future extensions may be made by upstream users. When a future sanitary sewer extension will be required to serve adjacent upstream properties, the location for the center of the uppermost manhole, whenever possible, should be at least five (5) feet beyond the plat boundary in a permanent sewer easement.

S. ANALYSIS OF RECEIVING SEWER REQUIRED. Authorization to extend any existing sanitary sewer shall not be granted until an analysis of the receiving sewer system has been completed as outlined in Section T below.

a. Any proposed developments or additions to the existing sanitary sewer pipe network whose additional flows WILL cause or will likely cause a bypass of untreated sewage to the environment or an existing building shall not be approved.

b. Developments or additions to the existing sanitary sewer pipe network whose additional flows WILL NOT cause a bypass of untreated sewage to the environment or an existing building will be considered for approval on a case by case basis. Applicants seeking approval must submit sufficient engineering documents and downstream sewer analysis to the Lansing Wastewater Utility Department staff for their consideration in making a final determination and subsequent recommendation to the Lansing City Council.

T. CITY OF LANSING SANITARY SEWER CAPACITY ANALYSIS PROCEDURE.

As required by the City, the developer shall submit complete sanitary sewer information by creating a spreadsheet with information containing:

1. Building use,
2. Acreage,
3. Square footage,
4. Point of connection to the public system,
5. 24-hour average and peak sanitary sewer flow graphs for the peak day, showing average daily and peak daily flows
6. Seasonal peak if it differs from daily peak
7. Flow line elevations,

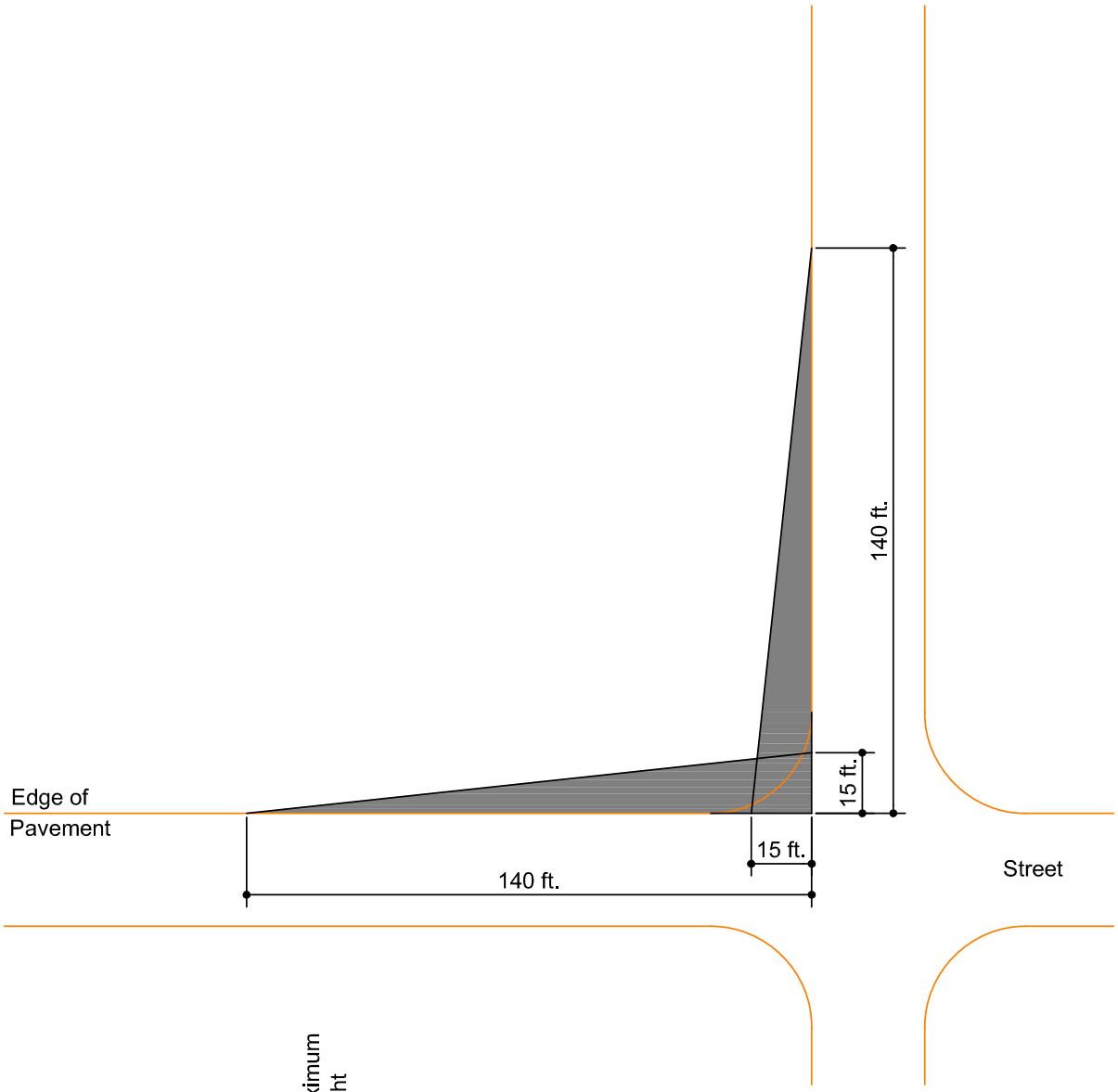
8. Pipe diameters,
9. Flow depths and manhole top elevations,
10. Reach distances, reach slopes, and reach capacity using Manning's equation,
11. Also include any other information that would support approval.

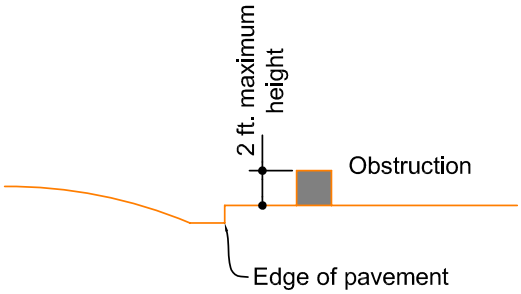
The design engineer will then create a hydraulic model with existing flows in the system and add the proposed development to the model to determine adequacy of the receiving sewer downstream to the Wastewater Treatment Facility. As an alternative, for a fee (as listed in the City's current fee and fine schedule), the proposed development may submit the above information to the city to have it evaluated using the City's Sanitary Sewer Hydraulic Model for the trunk sanitary sewer system.

If there is not enough capacity in the existing modeled trunk sanitary sewer system, the developer may be required to upgrade the sanitary sewer system as determined by the City. The required sanitary sewer upgrades will be at the developer's expense. In instances in which KDHE issues the developer an extension permit based and contingent on an approved action plan prior to such time that the trunk capacity is adequate, developer expense for the trunk capacity upgrade may be a prorated portion, as determined by the City.

If the design flow exceeds the pipe capacity, and would cause surcharging to homes, businesses, or the environment, the system would be considered hydraulically overloaded.

If the engineer wishes to propose alternative methods of sanitary sewer evaluation, the engineer must submit a written proposal clearly detailing the method and assumptions to be used in that evaluation. The proposal will be reviewed by the City Engineer and Wastewater Utility Director for appropriateness for the situation. Do not submit alternative analyses until the proposed alternative method has been approved in writing by the Wastewater Utility Director.





SCALE: NOT TO SCALE

CITY OF LANSING DEPARTMENT OF PUBLIC WORKS	SIGHT DISTANCE TRIANGLE	APPROVED BY: _____ DATE: FEB. 2004	REVISED _____ _____ _____	STANDARD DETAIL DA3-3

ROB

CIRCULAR CULVERT PIPE

DIAMETER (inches)	GAUGE		ANNULAR CORRUGATIONS (inches)
	Not under road	Under road*	
8	16 ga.	16 ga.	1–1/2 x ¼
10	16 ga.	16 ga.	1–1/2 x ¼
12	16 ga.	16 ga.	2–2/3 x ½
15	16 ga.	16 ga.	2–2/3 x ½
18	16 ga.	16 ga.	2–2/3 x ½
21	16 ga.	16 ga.	2–2/3 x ½
24	16 ga.	16 ga.	2–2/3 x ½
30	16 ga.	14 ga.	2–2/3 x ½
36	16 ga.	14 ga.	2–2/3 x ½
42	16 ga.	14 ga.	3 x 1
48	16 ga.	14 ga.	3 x 1
54	16 ga.	14 ga.	3 x 1
60	16 ga.	14 ga.	3 x 1
66	16 ga.	14 ga.	3 x 1
72	16 ga.	14 ga.	3 x 1
78	14 ga.	14 ga.	3 x 1
84	14 ga.	12 ga.	3 x 1
90	14 ga.	12 ga.	3 x 1
96	14 ga.	12 ga.	3 x 1
102	12 ga.	12 ga.	3 x 1
108	12 ga.	12 ga.	3 x 1
114	12 ga.	12 ga.	3 x 1
120	12 ga.	12 ga.	3 x 1

* Reinforced concrete pipe or reinforced box culvert required under street in new construction.

CITY OF LANSING DEPARTMENT OF PUBLIC WORKS	MINIMUM GAGE REQUIREMENTS (CIRCULAR C.M.P. CULVERT PIPE)	APPROVED BY: DATE: NOV. 2003	REVISED 10-18-05	STANDARD DETAIL DA4-9 ROB

ARCH CULVERT PIPE

EQUIVALENT ROUND DIAMETER (inches)	SPAN (inches)	RISE (inches)	GAUGE		ANNULAR CORRUGATIONS (inches)
			Not under road (inches)	Under road* (inches)	
15	17	13	16ga.	16ga.	2–2/3 x ½
18	21	15	16ga.	16ga.	2–2/3 x ½
21	24	18	16ga.	16ga.	2–2/3 x ½
24	28	20	16ga.	16ga.	2–2/3 x ½
30	35	24	14ga.	14ga.	2–2/3 x ½
36	42	29	14ga.	14ga.	2–2/3 x ½
42	46	36	14ga.	14ga.	3 x 1
48	53	41	14ga.	14ga.	3 x 1
54	60	46	14ga.	14ga.	3 x 1
60	66	51	14ga.	14ga.	3 x 1
66	73	55	14ga.	12ga.	3 x 1
72	81	59	14ga.	12ga.	3 x 1
78	87	63	14ga.	12ga.	3 x 1
84	95	67	14ga.	12ga.	3 x 1
90	103	71	14ga.	12ga.	3 x 1
96	112	75	12ga.	12ga.	3 x 1
102	117	79	12ga.	12ga.	3 x 1
108	128	83	12ga.	10ga.	3 x 1
114	137	87	12ga.	10ga.	3 x 1
120	142	91	12ga.	10ga.	3 x 1

Span and rise dimensions are industry standards. However, span and rise dimensions can be varied within AASHTO tolerances to allow additional cover at critical fill height installations.

It should be noted that when using arch culvert pipe, the designer should take into account the reduction in hydraulic capacity when compared to that of circular pipe.

* Reinforced concrete pipe or reinforced box culvert required under street in new construction.

CITY OF LANSING
DEPARTMENT OF PUBLIC WORKS

MINIMUM GAGE REQUIREMENTS (ARCH C.M.P. CULVERT PIPE)

APPROVED BY: _____

DATE: NOV. 2003

REVISED 10-18-05

STANDARD DETAIL

DA4-10

ROB