The City of Kokomo Stormwater Management Technical Standards Manual

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CHAPTER 100 POLICY AND PROCEDURES

SECTION 101: INTRODUCTION

101.01 Purpose

This manual provides technical standards for proper stormwater management and stormwater quality practices for engineers, builders, contractors, land planners, and property owners implementing land alteration or improvement within the boundaries of the City of Kokomo Municipal Separate Storm Sewer System (MS4) area. This Stormwater Quality Management Technical Standards Manual is intended to establish the policies relating to stormwater management, stormwater quality practices, and flood control, submittal requirements and procedures for issuance of a stormwater permit, and procedures for inspection, testing and final acceptance of stormwater facilities.

The contents of the Manual were compiled by the Department of Engineering, Traffic, and Inspection Services for the City of Kokomo MS4. The regulations have been established to accomplish the following objectives:

- Provide for consistent, high quality project design and evaluation by consolidating current departmental standards and ñpoliciesò within a single document.
- Establish minimum requirements and standards for stormwater management plan submittals and project reviews.
- Facilitate more consistent review of stormwater permit applications and land alteration plans by the stormwater permit staff.
- Establish a standard for the proper and consistent installation of stormwater facilities, with a high level of workmanship, according to the approved stormwater management plan.
- Minimize the impacts of new development and redevelopment projects on existing stormwater management facilities.

This Manual was developed with the assumption that the user will possess a basic understanding of civil engineering design, construction, stormwater quality practices, or land alteration, depending upon the userôs particular area of expertise. Readers of the Manual which are not qualified by education and experience in the field of construction, engineering, stormwater quality practices, or land alteration should consult with a more qualified person or persons possessing professional expertise in one or more of these fields prior to application of the requirements set forth herein.

101.02 Provisions

This Manual, together with all future revisions, shall be referred to as **"The Stormwater Management Technical Standards Manual"**. The City of Kokomo MS4 has been granted authority to ñprotect the safety, health, and general welfare of the citizens of the City of Kokomo by requiring compliance with standards and practices, which result in proper stormwater drainage and sediment control in the accomplishment of land alterations or other improvements.

101.03 Applicability & Exemptions

This Manual applies to all land disturbing or construction activity as stated and defined in the City of Kokomo MS4 Stormwater Ordinances (**Appendix- 1**). Any land disturbing or construction activity, within the jurisdiction of this Manual, must be accomplished in conformity with the stormwater requirements set forth herein.

This Manual should be used in conjunction with the City of Kokomo MS4 Construction Site, Post Construction, and Illicit Discharge Ordinances. Additional requirements related to land alteration may be found in the existing codes and ordinances of the City of Kokomo. Exceptions to the provisions of this Manual are provided in the above referenced ordinances.

101.04 Stormwater Manual Organization

This Manual is organized to present the technical and engineering procedures and criteria needed to comply with the City of Kokomo stormwater regulations. Copies of the MS4ôs pertinent stormwater management ordinances are presented in the Appendices of this Chapter. In addition, the general design policy and procedures are presented.

Each chapter of this Manual contains an initial section that presents all of the policies and procedures that must be satisfied for approval. These policies and procedures shall be considered as design criteria that are unique for approval within the jurisdiction of this Manual.

101.05 Updating

The process of updating this Manual shall be through the City of Kokomo MS4. This Manual shall be periodically updated and revised, as necessary, to reflect current engineering practices and information applicable to the MS4 jurisdictional area. Users of this Manual are encouraged to obtain any and all updates and supplements to this Manual

each time a land alteration project is considered. The ultimate responsibility for checking for and obtaining updated material shall be the responsibility of the user.

The most current standards shall be required for approval of a land alteration. The incorporation of outdated standards shall be cause for the MS4 Operator, or designee, to reject the proposed project.

SECTION 102: APPPLICATION REQUIREMENTS AND PROCEDURES

102.01 Introduction

The project site owner shall submit a stormwater management application to the City of Kokomo MS4, or said designee for any land disturbing or construction activity as per the ordinance. The application will include a Draft Notice of Intent letter (NOI) that would also act as permit application form, construction plan sheets, stormwater drainage technical report, a stormwater pollution prevention plan, and any other necessary support information. Specific information to be included in the application can be found in Section 102.03 below. One (1) copy of each required application material must be submitted to the City of Kokomo MS4, or said designee. Additionally, a digital copy of the construction plans is required in a format accepted by the MS4.

After receipt of the application, the City of Kokomo MS4, or said designee, shall review the application and construction plans within 28 days. Once all comments have been received and a review completed by the MS4, or said designee, the applicant will be notified as to whether their application was complete or insufficient.

Should the application be found insufficient, the applicant will be asked for additional information. Any re-submittals provided will be reviewed in detail by the MS4 and/or designee within 28 days of the receipt of re-submittal.

The project site owner must notify the City of Kokomo MS4 and IDEM in the form of an updated IDEM NOI form, along with a proof of publication notice, 48 hours before beginning any ground disturbing activity. Once construction starts, the project owner shall monitor construction activities and inspect all stormwater pollution prevention measures in compliance with the City of Kokomoõs applicable ordinances- and the terms and conditions of the application approval.

Upon completion of construction activities, as-built plans must be submitted to the MS4, or said designee. A Notice of Termination (NOT) shall be sent to the MS4, or said designee, once the construction site has been stabilized and all temporary erosion and sediment control measures have been removed. The City of Kokomo MS4, or designated

representative, shall inspect the construction site to verify the requirements for a NOT have been met in accordance with the Rule 5 (327 IAC 15-5). Once the applicant receives a ñverifiedò copy of the NOT, they must forward a copy to IDEM.

Applications approved under this scenario will expire 5 years from the date of issuance. If construction is not completed within 5 years, the NOI must be resubmitted at least 90 days prior to expiration. No Rule 5 (327 IAC 15-5) permit is required from IDEM for projects within the City of Kokomo MS4 area boundary, since the MS4 is the permitting authority. A flow chart of the major steps in the stormwater plan review/permit process is provided as **Figure 100-1**.

The different elements of an application submittal shall include a Draft Notice of Intent (NOI), construction plans, a stormwater drainage technical report, a stormwater pollution prevention plan for active construction sites, a post-construction stormwater pollution prevention plan, and any other necessary supporting information. In addition, an updated NOI along with proof of publication of a public notice will need to be submitted directly to IDEM, with a copy provided to the City of Kokomo MS4 after the permit is approved. All plans, reports, calculations, and narratives shall be signed and sealed by a professional engineer or a licensed land surveyor, registered in the State of Indiana.

Specific projects or activities may be exempt from all or part of the informational requirements listed below. Exemptions are detailed in the applicable ordinances and ñApplicability and Exemptionsò Sections of Chapters 200 through 500. If a project or activity is exempt from any or all requirements of the ordinances or this Manual, an application should be filed listing the exemption criteria met, in lieu of the information requirements listed below. The level of detailed information requested below is not required from individual lots, disturbing less than 1 acre of land, developed within a larger permitted project site. Review and acceptance of such lots is covered under Section 102.07 of this Chapter.

The NOI is a standard form developed by the Indiana Department of Environmental Management which requires general project information. As part of the MS4 Stormwater Management application package, the NOI form should be completed in full based on data and information available at the time of application.

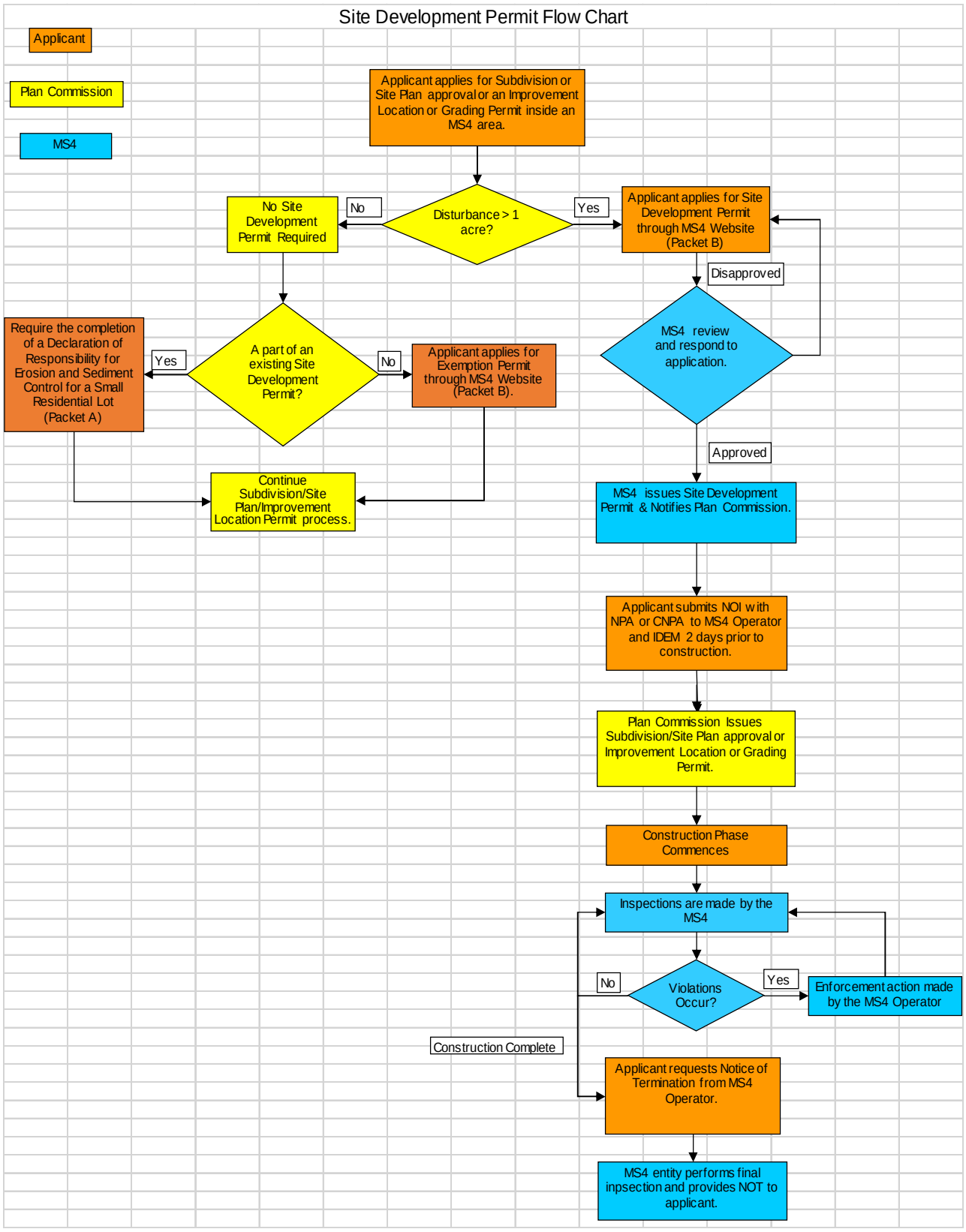


Figure 100-1: Flow Chart of the Stormwater Plan Review/Permit Process.

An updated version of this form, accompanied by proof of publication in a newspaper of general circulation in the affected area that notified the public that a construction activity is to commence, will need to be resubmitted later after the stormwater application is approved is granted and at least 48 hours prior to commencement of construction. The publication must include the following language:

Draft Notice of Intent

ñ(Company name, address) is submitting an NOI letter to notify the City of Kokomo MS4 and the Indiana Department of Environmental Management of our intent to comply with the requirements of City of Kokomo Stormwater Management Ordinance, as well as the requirements of 327 IAC 15-5 and 327 IAC 15-13, to discharge stormwater from construction activities for the following project: (name of the construction project, address of the location of the construction project, and Parcel Identification Number). Run-off from the project site will discharge to (stream(s) receiving the discharge(s)).ò

102.02 Construction Plans

Construction plan sheets (larger than 11ò by 17ò, but not to exceed 24ò by 36ò in size) with a scale of 1 inch = 20 feet, 30 feet, 40 feet, 50 feet or 60 feet, and an accompanying narrative report shall describe and depict the existing and proposed conditions. Note that in order to gain an understanding of and to evaluate the relationship between the proposed improvements for a specific project section/phase and the proposed improvements for an overall multi-section (phased) project, the detailed information requested herein for the first section/phase being permitted must be accompanied by an overall project plan that includes the location, dimensions, and supporting analyses of all detention/retention facilities, primary conveyance facilities, and outlet conditions. Construction plans need to include the following detailed items:

1) Title sheet which includes location map, vicinity map, operating authority, design company name, developer name, and index of plan sheets.

2) A copy of a legal boundary survey for the site, performed in accordance with Rule 12 of Title 865 of the Indiana Administrative Code or any applicable and subsequently adopted rule or regulation for the subdivision limits, including all drainage easements and wetlands.

3) A reduced plat or project site map showing the parcel identification numbers, lot numbers, lot boundaries, easements, and road layout and

names. The reduced map must be legible and submitted on a sheet or sheets no larger than eleven (11) inches by seventeen (17) inches for all phases or sections of the project site.

4) An existing project site layout that must include the following information:

a. A topographic map of the land to be developed and such adjoining land whose topography may affect the layout or drainage of the development. The contour intervals shall be one (1) foot when slopes are less than or equal to two percent (<2%) and shall be two (2) feet when slopes exceed two percent (>2%). All elevations shall be given in North American Vertical Datum of 1988 (NAVD). The horizontal datum of topographic map shall be based on Indiana State Plane Coordinates, NAD83. The map will contain a notation indicating these datum information. The names of adjoining properties must be labeled on the map.

1. If the project site is less than or equal to two (2) acres in total land area, the topographic map shall include all topography of land surrounding the site to a distance of at least one hundred (100) feet.

2. If the project site is greater than two (2) acres in total land area, the topographic map shall include all topography of land surrounding the site to a distance of at least two hundred (200) feet.

b. Location, name, and normal water level of all wetlands, lakes, ponds, and water courses on or adjacent to the project site.

c. Location of all existing structures on the project site.

d. One hundred (100) year floodplains, floodway fringes, and floodways. Please note if none exists.

e. Identification and delineation of vegetative cover such as grass, weeds, brush, and trees on the project site.

f. Location of storm, sanitary, combined sewer, and septic tank systems and outfalls.

g. Land use of all adjacent properties.

h. Identification and delineation of sensitive areas.

i. The location of regulated drains, farm drains, inlets and outfalls. Prior to construction plan design beginning, all existing regulated drains on the site are to be located, exposed, and invert shots taken to ensure the system is installed deep enough to provide drainage to the upstream watershed. This is also applicable if the site outlets into a regulated drain and no record drawings on the drain exists.

j. Location of all existing cornerstones within the proposed development and a plan to protect and preserve them.

k. Location of all known wells.

l . Location of known potential contaminant facilities.

5) A grading and drainage plan, including the following information:

a. All information from the existing site layout items listed above.

b. Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas.

c. One hundred (100) year floodplains, floodway fringes, and floodways. Please note if none exists.

d. Delineation of all proposed land disturbing activities, including off-site activities that will provide services to the project site.

e. Information regarding any off-site borrow, stockpile, or disposal areas that are associated with a project site, and under the control of the project site owner.

f. . Proposed topographic information at one-foot contour interval.

g. Location, size, and dimensions of all existing streams to be maintained, and new drainage systems such as culverts, bridges, storm sewers, conveyance channels, and 100-year overflow paths or ponding areas shown as hatched areas, along with all associated easements.

h. Pipes and associated structures data, including sizes, lengths, and material.

i. Location, size, and dimensions of features such as permanent retention or detention facilities, including natural or constructed wetlands, used for the purpose of stormwater management. Include existing retention or detention facilities that will be maintained, enlarged, or otherwise altered and new ponds or basins to be built.

j. Emergency flood routing path(s) and their invert elevations from detention facilities to the receiving system.

k. One or more typical cross sections of all existing and proposed channels or other open drainage facilities carried to a point above the 100-year high water and showing the elevation of the existing land and the proposed changes, together with the high water elevations expected from the 100-year storm under the controlled conditions called for by the City of Kokomoôs applicable stormwater management ordinance, and the relationship of structures, streets, and other facilities.

l. A drainage summary, which summarizes the basic conditions of the drainage design, including site acreage, off-site/upstream acreage, allowable release rates, pre and post developed 10-year and 100-year development flows leaving the site, volume of detention required, volume of detention provided, and any release rate restrictions.

m. Arrows designating the direction of stormwater runoff.

n. Spot elevations appropriate to define elevations.

6) Utility plan sheet(s) showing the location of all existing and proposed utility lines for the project, including all available information related to the utilities, such as pipe size and material, and invert elevations.

7) Storm sewer plan/profile sheet(s) at a scale of 5 vertical and 50 horizontal showing the elevation, size, length, location of all proposed storm sewers. Existing and proposed ground grades, storm sewer structures elevations, and all existing and proposed utility crossings also must be included. The actual correct datum (not an assumed one) must be used for the profile sheets and all pipe inverts, top of casting elevations, casting types, structure numbers, and pipe slopes clearly labeled.

8) A plat on the same sheet size used for recording, including the

following information:

a. Legal description.

b. Cross reference to Rule 12.

c. Regulated drain statement and table.

9) Proposed subdivision landscape plans.

10) A copy of the subdivision covenants.

11) Any other information required by the MS4 in order to thoroughly evaluate the submitted material.

102.04 Stormwater Drainage Technical Report

A written stormwater drainage technical report must contain a discussion of the steps taken in the design of the stormwater drainage system. Note that in order to gain an understanding of and to evaluate the relationship between the proposed improvements for a specific project section/phase and the proposed improvements for an overall multi-section (phased) project, the detailed information requested herein for the first section/phase being permitted must be accompanied by an overall project plan that includes the location, dimensions, and supporting analyses of all detention/retention facilities, primary conveyance facilities, and outlet conditions. The technical report needs to include the following detailed items:

1) A summary report, including the following information:
   a. Description of the nature and purpose of the project.
   b. The significant drainage problems associated with the project.
   c. The analysis procedure used to evaluate these problems and to propose solutions.
   d. Any assumptions or special conditions associated with the use of these procedures, especially the hydrologic or hydraulic methods.
   e. The proposed design of the drainage control system.
   f. The results of the analysis of the proposed drainage control system showing that it solves the projectôs drainage problems and that it meets the requirements of the ordinance and these standards. Current detention standards require control of 10-year and 100-year storms. **For a given site the 100-year post-development peak rate of runoff must be restricted to the 10-year pre-development peak runoff rate.** This must include a table summarizing, for each eventual site outlet, the pre-developed acreage tributary to

each eventual site outlet, the unit discharge allowable release rate used, the resulting allowable release rate in cfs for the pre and post-developed flow rates for 10-year and 100-year events. The worksheet provided as **Figure 100-2** should be filled and submitted as part of the report. Any hydrologic or hydraulic calculations or modeling results must be adequately cited and described in the summary description. If hydrologic or hydraulic models are used, the input and output files for all necessary runs must be included in the appendices. A map showing any drainage area subdivisions used in the analysis must accompany the report.

g. Soil properties, characteristics, limitations, and hazards associated with the project site and the measures that will be integrated into the project to overcome or minimize adverse soil conditions.
h. A narrative and photographic record of the condition of the downstream receiving system.
i. Identification of any other State or Federal water quality permits that are required for construction activities associated with the ownerôs project site.
j. Proof of Errors and Omissions Insurance for the registered professional engineer or licensed surveyor showing a minimum amount of $1,000,000 in coverage.

2) A Hydrologic/Hydraulic Analysis, consistent with the methodology and calculation included in Chapters 200 and 300 of this Manual,

3) and including the following information:

a. A hydraulic report detailing existing and proposed drainage patterns on the subject site. The report should include a description of present land use and proposed land use. Any off-site drainage entering the site or any downstream restrictions should be addressed as well. This report should be comprehensive and detail all of the steps the engineer took during the design process.

b. All hydrologic and hydraulic computations should be included in the submittal. These calculations should include, but are not limited to the following: runoff curve numbers and runoff coefficients, runoff calculations, stage-discharge relationships, times-of-concentration and storage volumes.

c. Copies of all computer runs. These computer runs should include both the input and the outputs. Electronic copies of the computer runs with input files must also be included.

d. A set of exhibits should be included showing the drainage

sub-areas and a schematic detailing of how the computer models were set up.

e. A conclusion which summarizes the hydraulic design and details how this design satisfies the City of Kokomo applicable stormwater management ordinance(s).

SITE OUTLET	ITEM	PRE-DEVELOPMENT					POST-DEVELOPMENT				
		D.A. (ac.)	Depress. Storage (yes/no)?	2-Yr.	10- Yr.	100- Yr.	D.A. (ac.)	Depress. Storage (yes/no)?	2-Yr.	10- Yr.	100- Yr.
1	Default Unit Discharge Allowable Release Rate (cfs/acre)										
	Basin Specific Unit Discharge Allowable Release Rate, if any (cfs/acre)										
	Unit Discharge Allowable Release Rate Based on D/S Restrictions, if any (cfs/acre)										
	Adopted Unit Discharge Allowable Release Rate (cfs/acre)										
	Allowable Release Rate (cfs)										
	Modeling Results (cfs)										

Figure 100-2: Allowable Release rate Determination and Modeling Results.

102.05 Stormwater Pollution Prevention Plan For Construction Sites

A stormwater pollution prevention plan associated with construction activities must be designed to, at least, meet the requirements of the City of Kokomoôs applicable stormwater management ordinance(s) and must include the following:

1). Location, dimensions, detailed specifications, and construction details of all temporary and permanent stormwater quality measures.

2). Soil map of the predominant soil types, as determined by the United States Department of Agriculture (USDA), Natural Resources Conservation Service (NRCS) Soil Survey, or as determined by a soil scientist. Hydrologic classification for soils should be shown when

hydrologic methods requiring soils information are used. A soil legend must be included with the soils map.

3). Fourteen (14) Digit Watershed Hydrologic Unit Code.

4). An estimate of the peak discharge, based on the ten (10) year storm 24-hour event, of the project site for post-construction conditions.

5). Locations where stormwater may be directly discharged into groundwater, such as abandoned wells or sinkholes. Please note if none exists.

6). Locations of specific points where stormwater discharge will leave the project site.

7). Name of all receiving waters. If the discharge is to a separate MS4, identify the name of the municipal owner and the ultimate receiving water.

8). Temporary stabilization plans and sequence of implementation.

9). Permanent stabilization plans and sequence of implementation.

10). Temporary and permanent stabilization plans shall include the following:

a. Specifications and application rates for soil amendments and seed mixtures.

b. The type and application rate for anchored mulch.

11). General construction sequence of how the project site will be built, including phases of construction.

12). Construction sequence describing the relationship between implementation of stormwater quality measures and stages of construction activities.

13). Location of all soil stockpiles and borrow areas.

14). A typical erosion and sediment control plan for individual lot development.

15). Self-monitoring program including plan and procedures.

16). A description of potential pollutant sources associated with the construction activities, which may reasonably be expected to add a significant amount of pollutants to stormwater discharges.

17). Material handling and storage associated with construction activity shall meet the spill prevention and spill response requirements in 327 IAC 2-6.1.

18). Name, address, telephone number, and list of qualifications of the trained individual in charge of the mandatory stormwater pollution prevention self-monitoring program for the project site.

102.06 Post-Construction Stormwater Pollution Prevention Plan

The post-construction stormwater pollution prevention plan must include the following information:

1) A description of potential pollutant sources from the proposed land use, which may reasonably be expected to add a significant amount of pollutants to stormwater discharges.

2) Location, dimensions, detailed specifications, and construction details of all post-construction stormwater quality measures.

3) Stormwater quality measures that will remove or minimize pollutants from construction stormwater run-off.

4) A description of Best Management Practices (BMPôs) that will be installed to control pollutants in stormwater discharges that will occur after construction activities have been completed. Such practices include infiltration of runoff, flow reduction by use of open vegetated swales and natural depressions, buffer strip and riparian zone preservation, filter strip creation, minimization of land disturbance and surface imperviousness, maximization of open space, and stormwater retention and detention ponds. Selection of a BMP, or series of BMPôs, shall be designed on a minimum performance criteria of 80% removal of the Total Suspended Solids (TSS).

5) Stormwater quality measures that will be implemented to prevent or minimize adverse impacts to stream and riparian habitat.

6) A sequence describing when each post-construction stormwater quality measure will be installed.

7) An operation and maintenance manual for all post-construction stormwater quality measures to facilitate their proper long term function and operation and maintenance manual shall be made available to future parties who will assume responsibility for the operation and maintenance of the post-construction stormwater quality measures. The manual shall include the following:

a. Contact information for the BMP owner (i.e. name, address, business and/or cell phone number, pager number, e-mail address, etc.).

b. A statement that the BMP owner is responsible for all costs associated with maintaining the BMP.

c. A right-of-entry statement allowing MS4, or designee, to inspect the BMP.

d. Specific actions to be taken regarding routine maintenance, remedial maintenance of structural components, and sediment removal.

e. Sediment removal procedures should be explained in both narrative and graphical forms.

f. A tabular schedule should be provided listing all maintenance activities and dates for performing these required maintenance activities.

g. Site drawings showing the location of the BMP and access easement, cross sections of BMP features (i.e. pond, forebay(s), structural components, etc.), and the point of discharge for stormwater treated by the BMP.

102.07 Review of Individual Lots Within a Permitted Project

For individual lots disturbing less than 1 acre, developed within a larger permitted project, all stormwater management measures necessary to comply with the City of Kokomoôs applicable stormwater management ordinance(s) must be implemented in accordance with permitted plan for the larger project.

An individual lot disturbing one (1) acre or more, within a larger permitted project, must submit an individual stormwater plan for review as laid out in Section 102.05.

The individual lot owner is responsible for installation and maintenance of all erosion and sediment control measures until the site is stabilized.

102.08 Changes to Plans

Any changes or deviations in the detailed plans and specifications after approval of the applicable stormwater management permit shall be filed

with, and accepted by, the City of Kokomo Engineer prior to the land development involving the change. Copies of the changes, if accepted, shall be attached to the original plans and specifications.

102.09 Fee Structure

A. Fee Amount

Currently the Howard County Soil and Water Conservation District (SWCD), has an agreement with the City of Kokomo, to review stormwater pollution prevention plans, and conduct on-site inspections for the City of Kokomo MS4. As a condition of the agreement, the Howard County Soil and Water Conservation District (SWCD) charges for the review of stormwater pollution prevention plans, and applicable pre-paid inspection fees. The applicant shall agree to pay an applicable fee as set by the MS4 and SWCD, with respect to the review of all, any accompanying information and data, as well as any applicable pre-paid inspection fees. A copy of the said fee schedule is listed in **Figure 100-3**.

B. Time of Payment

Payment will be made by the applicant at the time of plan submittal. Should problems, or violations, occur on the site which require more frequent inspection- the applicant will be assessed charges for the additional inspections.

C. Rights of Non Acceptance

The City of Kokomo MS4, or designee, shall have the right to not accept drainage improvements or to not accept the advancement of any project for which the applicable fees have not been paid.

D. Waiver of Payment

Fees may be waived for certain projects at the discretion of the City of Kokomo MS4 Operator.

MS4 FEE SCHEDULE

CITY OF KOKOMO STORMWATER PERMIT FEES	TOTAL FEES
RESIDENTIAL	
Single Family Dwelling	$325
Multi-Family Dwelling	$550 per Building
Demolition	$150
Additions	$150
Declaration of Responsibility for Individual Lots	$50
SUBDIVISION	
2-4 Lots	$450
5 Lots or more	$300+$50/Lot
Planned Unit Development	$300+$50/Lot
COMMERCIAL / INDUSTRIAL	
Principal	$950+$50/Acre
UTILITY	
Per Acre Disturbed	$150
POND	
Per Acre Disturbed	$150
NOTES	
*RETURNED CHECK FEE	$30
*Please make check or money orders payable to the City of Kokomo.	
*If a check is returned due to insufficient funds, the plan will NOT be reviewed.	
*Any land disturbing activity requiring its own NOI (Notice of Intent) will be subject to the above fees.	
*Fees are Non-Refundable.	
*Fees Cover Costs of Plan Reviews & Inspections for Life of the Permit & MS4 Software Sytem Maintenance.	

Figure 100-3.

102.10 Environmentally Sensitive Areas

It is the intent of the City of Kokomo to direct the communityôs physical growth away from sensitive areas and towards areas that can support it without compromising water quality. In the event that a project site is determined to impact or discharge to a environmentally sensitive area, or is located in an impacted drainage area, the MS4 Operator may require more stringent stormwater quantity and quality measures than detailed in the applicable ordinances.

A. Determination of Environmentally Sensitive Areas

Sensitive areas include highly erodible soils, wetlands, threatened or endangered species habitat, outstanding waters, impaired waters, recreational waters, and surface drinking water sources. A listing of highly erodible soils, outstanding water, impaired water, recreation water, and surface drinking water sources can be found in the City of Kokomo Storm Water Quality Management Plan (SWQMP) - Part B and its updates. Any discharge from a stormwater practice that is a Class V injection well shall meet the Indiana groundwater quality standards. If wetlands are suspected on a site, wetland delineation shall be completed in accordance with the methodology established by the U.S. Army Corps of Engineers (COE) and the wetland addressed in accordance to the requirements of the law. If the presence of threatened or endangered species habitat is suspected on a site, the site must be evaluated and inspected by a professional experienced in such and the results reported to the MS4 Operator. Special terms and conditions for development determined to impact or discharge to any sensitive area shall be included in the stormwater management permit.

B. Determination of Impacted Drainage Areas

The following areas shall be designated as Impacted Drainage Areas, unless good reason for not including them is presented to the MS4 Operator:

i. A floodway or floodplain as designated by the most updated the City of Kokomo Code dealing with floodplain regulation.
ii. Land within 75 feet of the centerline of any drain tile or, within 75 feet of each bank of any regulated open drain within the Howard County Regulated Drainage System.

The MS4 Operator is authorized, but not required, to classify certain additional geographical areas as Impacted Drainage Areas. In determining Impacted Drainage Areas, the MS4 Operator shall consider such factors as

land use, topography, soil type, capacity of existing drains, and distance from adequate drainage facility. Land that does not have an adequate outlet, taking into consideration the capacity and depth of the outlet, may also be designated as an Impacted Drainage Area by the MS4 Operator. Special terms and conditions for development within any Impacted Drainage Area shall be included in the stormwater management application.

C. Special Requirements in Protective Areas

a. Impervious surfaces shall be kept out of the protective area to the maximum extent practicable.

b. Where land disturbing construction activity occurs within a protective area, and where no impervious surface is present, adequate sod or selfï sustaining vegetative cover of 70% or greater shall be established and maintained. The adequate sod or selfï sustaining vegetative cover shall be sufficient to provide for bank stability, maintenance of fish habitat and filtering of pollutants from upslope overland flow areas under sheet flow conditions. Nonï vegetative materials, such as rock riprap, may be employed on the bank as necessary to prevent erosion, such as on steep slopes or where high velocity flows occur.

c. Best management practices such as filter strips, swales, or wet detention basins that are designed to control pollutants from nonï point sources may be located in the protective area.

d. Stormwater discharges to critical areas with sensitive resources (i.e. navigable waters, receiving waters with approved TMDL limits, recharge areas, water supply reservoirs) may be subject to additional performance criteria, or may need to utilize or restrict certain stormwater management practices.

102.11 Requirements for Fueling and Maintenance Areas

Any new or existing fueling and vehicle maintenance areas (this includes commercial, federal, institutional, municipal, retail, or state facilities) that replace and/or repair existing tank systems must have BMPs designed, installed and maintained to reduce copper, lead, hydrocarbons, petroleum, and zinc within runoff.

102.12 Application Approval Terms and Conditions

In approving the stormwater management application, the MS4 may impose such terms and conditions as are reasonably necessary to meet the purposes of this Manual. The project site owner shall insure compliance with such terms and conditions. Non-compliance with the terms and

conditions will be subject to enforcement as described in the applicable ordinances.

The project site owner shall inform all general contractors, construction management firms, grading or excavating contractors, utility contractors, and the contractors that have primary oversight on individual building lots of the terms and conditions of the stormwater management permit and the schedule for proposed implementation.

SECTION 103: CONSTRUCTION INSPECTION AND APPROVAL

103.01 Introduction

After the approval of the stormwater management application, the MS4 Operator (or designee) has the authority to conduct inspections of the work being done to ensure full compliance with the provisions of the applicable ordinances and this Manual, and the terms and conditions of the approved application. The installed storm sewer shall not be accepted by the MS4 until all requirements for inspection and testing described in this Manual are completed. Inspection of the stormwater drainage system and associated land grading and erosion control measures shall be completed by the MS4 Operator (or designee) as set forth herein to ensure conformance with the approved site construction plan and supporting documents. Any portion of the stormwater facility not passing the tests prescribed herein shall be repaired or replaced to the extent required by the MS4, and retested.

103.02 General Requirements

The Contractor and/or Owner shall provide written notice to the City of Kokomo MS4 of planned commencement of construction forty-eight (48) hours prior to such commencement. Copies of the final, approved construction plans, stormwater drainage technical report, stormwater pollution prevention plan for construction sites, and post-construction stormwater pollution prevention plan shall also accompany the above-noted written notification. The number of required copies varies from case to case and should be determined by contacting the MS4.

A pre-construction meeting is required to be held with the participation of the MS4 Operator (or designee) and other entities involved prior to any grading activity to ensure that appropriate erosion control measures have been implemented on the site and the location of any existing tiles has been properly marked.

A stop-work-order shall be issued by the City of Kokomo for all projects that are proceeding without such notification. The City of Kokomo MS4

has the authority to conduct inspections of the work being done to ensure full compliance with the provisions of the applicable ordinances and this Manual, and the terms and conditions of the approved application.

103.03 Testing

Once constructed, all storm sewer pipes and manholes shall be soil tight. The Contractor shall repair to the satisfaction of the MS4 Operator (or designee) all visible points of possible bedding and/or backfill infiltration into the system. The method of repair shall be per the approval of the MS4. When necessary, the Contractor shall remove and reconstruct as much of the work as is necessary to obtain a system that passes the minimum tests prescribed herein.

A. Mandrel Test for HDPE Pipes and Sub-Surface Drains

No sooner than thirty (30) days after installation, all gravity flow storm sewers constructed of HDPE pipe 18-inch in diameter or smaller and all Sub-Surface Drains (SSD) shall be mandrel tested (NOTE: All storm sewer installed beneath any paved area shall require RCP). A representative of the MS4 shall be present on-site during all mandrel tests. The MS4 Operator shall be given written and/or verbal notification of the proposed testing times and locations at least 48 hours prior to the intended time for beginning of the tests. Arrangements for the cost and supply of all equipment necessary to perform mandrel tests shall be the responsibility of the Contractor and Owner.

Mandrel tests shall be conducted under the supervision of the MS4 Operator or the designated observer.

A five percent (5%) ñGO/NO-GOò Mandrel Deflection Test shall be performed on all HDPE gravity storm sewer pipe.

These pipes shall be mandrel led with a rigid device sized to pass five percent (5%) or less deflection (OR deformation) of the base inside diameter of the pipe. The mandrel test shall be conducted no earlier than thirty (30) days after reaching final trench backfill grade.

The mandrel (GO/NO-GO) device shall be cylindrical in shape and constructed with nine (9) or ten (10) evenly spaced arms or prongs. Variations of mandrel diameter dimensions due to pipe wall thickness tolerances or ovality (from heat, shipping, poor production, etc.) shall not be deducted from the diameter dimension of the mandrel but shall be counted as par of the five percent (5%) deflection allowance. Each pipe material/type required to be Mandrel tested shall be tested with a mandrel approved by the MS4 and meeting the requirements of this chapter. The mandrel diameter dimension shall carry a minimum tolerance of 0.01 inches.

The mandrel shall be hand pulled through all sewer lines and any section of sewer not passing the mandrel shall be uncovered, replaced or repaired, and retested.

The contact length (L) shall be measured between points of contact on the mandrel arm.

The Contractor shall provide proving rings to check the mandrel. Drawings of mandrels with complete dimensions shall be furnished by the Contractor to the MS4 Operator upon request for each diameter and specification of pipe.

HDPE pipes that are eighteen inch (18ò) in diameter or larger shall be inspected through visual recordings (via closed circuit television) as well as a walk through (visual survey) inspection with the contractor, developer, and a representative from the MS4.

B. Manhole and Box Inlet Inspection

Each manhole and/or box inlet structure within all storm sewer line segments shall be visually inspected by a representative of the MS4 Operator to ensure seams are sealed, pipes have concrete collars, and structure is watertight. A secondary inspection by a representative of the MS4 Operator shall be required to check for excessive leakage, backfill infiltration, or improper workmanship and materials. Manholes or box inlet structures which fail to meet minimum construction standards shall be repaired or, if necessary, replaced, and re-inspected.

103.04 As-built or Record Drawings

As part of the final acceptance process, record drawings of the stormwater facilities must be submitted to the MS4 Operator, as set forth herein, for the following types of developments:

ÅAll platted subdivisions

ÅIndustrial and commercial sites five acres and larger

After completion of construction of the project and before final project acceptance of the stormwater management plan (the issuance of a ñverifiedò NOT), a professionally prepared and certified record drawings (óas-builtô set of plans) by a Professional Engineer or licensed Land Surveyor registered in the State of Indiana shall be submitted to the MS4 Operator for review. Additionally, a digital copy of the record drawings (óas-builtô plans) as well as finalized digital versions of all analyses, models, manuals, and reports that are consistent with the as-built conditions is required in a format accepted by the City of Kokomo MS4

Operator. These plans shall include all pertinent data relevant to the completed storm drainage system and stormwater management facilities, and shall be in accordance with City of Kokomo standards.

103.05 Enforcement of Standards

Failure to comply with those minimum guidelines set forth by this manual may result in Enforcement Action per the applicable City of Kokomo ordinances.

SECTION 104: POST-CONSTRUCTION MAINTENANCE REQUIREMENTS

104.01 Maintenance Agreement

Stormwater quantity and quality management facilities shall be maintained in good condition, in accordance with the Operation and Maintenance procedures and schedules listed in the latest editions of the *Indiana Handbook for Erosion Control In Developing Areas*, requirements contained in this Manual, and the terms and conditions of the approved stormwater application. These facilities shall not be subsequently altered, revised, or replaced except in accordance with the approved stormwater application, or in accordance with approved amendments or revisions in the application.

The property owner, developer, or contractor shall be required to file a maintenance agreement with the City of Kokomo. Specifically, the said agreement is intended to guarantee that the following be properly maintained after the construction under the provisions of the City of Kokomoôs applicable stormwater management ordinance(s) and these Technical Standards:

- ÅPost-Construction Erosion and Sediment controls
- ÅSurface Drains
- ÅDetention facilities
- ÅPost-Construction BMPs

The maintenance agreement shall further be conditioned upon owner, developer, or contractor satisfactorily completing, following the completion of construction, such corrective actions as the MS4 Operator may determine are reasonably necessary to remedy any damages to upstream or downstream channels or storm sewers resulting from the as-built development of the project.

104.02 Post-Construction Inspection

The City of Kokomo MS4 shall have the authority to perform long-term, post-construction inspection of all public or privately owned stormwater quantity and quality facilities. The inspection procedures will follow the City of Kokomo ordinances, the Operation and Maintenance procedures included in this Manual for each specific BMP. The inspection will cover physical conditions, available water quantity and quality storage capacity and the operational condition of key facility elements. Noted deficiencies and recommended corrective action will be included in an inspection report. If deficiencies are found during the inspection, the owner of the facility will be notified by the City of Kokomo MS4 Operator, or designee, and will be required to take all necessary measures to correct such deficiencies.

104.03 Transfer of Maintenance Agreement

Following construction completion and final inspection by the MS4 Operator, or said designee, the maintenance of stormwater quantity or quality facilities will be transferred to, and become the long-term responsibility of, the homeowners association and/or designated responsible property owners.

To verify that all enclosed drains are functioning properly, visual recordings (via closed circuit television) of such tile drains shall be required prior to the transfer of the maintenance agreement to the homeowners association, or other responsible parties. These visual recordings will be scheduled at least 90 days prior to the transfer of the maintenance agreement. Reports summarizing the results of the visual recordings shall be reviewed and accepted by the MS4 Operator, or designee, before the maintenance agreement would be recommended to be transferred.

SECTION 105: OTHER REQUIREMENTS

105.01 Floodplain Management

The intent of Floodplain management is to protect against loss of property, protect human life, and maintain natural beneficial functions of floodplains in helping mitigate flooding and providing habitat and water quality benefits. Floodplain management shall be in accordance with the City of Kokomoôs adopted floodplain regulations.

In addition to these regulations, if the project site is within a Howard County Regulated Drain Watershed, the applicant will also need to abide by the Howard County Surveyorôs Office applicable floodplain management requirements, whether the site is located in an incorporated area or not.

105.02 Grading and Building Pad Elevations

Maximum yard slopes are 3:1 where soil has been disturbed during construction processes. Finished floor elevation or the lowest building entry elevation must be no less than 6 inches above finished grade around the building. Also, the buildingôs lowest entry elevation that is adjacent to and facing a road shall be a minimum of 15 inches above the road elevation.

All buildings shall have a minimum flood protection grade shown on the secondary plat. Minimum Flood Protection Grade of all structures fronting a pond or open ditch shall be no less than 2 feet above any adjacent 100-year local or regional flood elevations, whichever is greater, for all windows, doors, pipe entrances, window wells, and any other structure member where floodwaters can enter a building.

For all structures located in the Special Flood Hazards Area (SFHA) as shown on the FEMA maps, the lowest floor elevations of all residential, commercial, or industrial buildings shall be such that Lowest Floor elevation, including basement, shall be at the flood protection grade and therefore have 2 feet of freeboard above the 100-year flood elevation.

The Lowest Adjacent Grade for residential, commercial, or industrial buildings outside a FEMA or IDNR designated floodplain shall have two feet of freeboard above the flooding sourceôs 100-year flood elevation under proposed conditions. Lowest Adjacent Grade is the elevation of the lowest grade adjacent to a structure, where the soil meets the foundation around the outside of the structure (including structural members such as basement walkout, patios, decks, porches, support posts or piers, and rim of the window well.

For areas outside a FEMA or IDNR designated floodplain, the Lowest Adjacent Grade (including walkout basement floor elevation) for all residential, commercial, or industrial buildings adjacent to ponds shall be set a minimum of 2 feet above the 100-year pond elevation or 2 feet above the emergency overflow weir elevation, whichever is higher. In addition to the Lowest Adjacent Grade requirements, any basement floor must be at least a foot above the permanent water level (normal pool elevation).

Special considerations, based on detailed geotechnical analysis, should be made prior to considering placement of any basement below the 100-year flood elevation of an adjacent flooding source or pond.

CHAPTER 200 HYDROLOGY

SECTION 201: INTRODUCTION

201.01 Purpose

This chapter outlines the common hydrologic policies, practices, and procedures necessary for determining the quantity of stormwater runoff for a given watershed and its impact on upstream and downstream stormwater facilities.

SECTION 202: RUNOFF CALCULATIONS

202.01 Selecting a Runoff Calculation Method

This section provides guidance for standard hydrologic methods used to determine runoff quantities. Runoff quantities shall be computed for the watershed under development and the contributing watershed flowing into or through the watershed. Runoff quantities shall be computed for existing and proposed site conditions.

202.02 Rational Method

The Rational Method (Q = CiA) may be used for estimation of peak runoff when the total watershed area tributary to the design point is 200 acres or less, provided analysis of downstream detention facilities is not required. Other more sophisticated methods may be used during design upon approval from Stormwater Engineering.

202.03 Soil Conservation Service (SCS) Technical Release 20 (TR-20) and U.S. Army Corps of Engineers Hydraulic Engineering Circular No. 1 (HEC-1)

SCS TR-20 and HEC-1 are the preferred hydrograph and routing methods for the computation of peak runoff rates when:

- The total watershed area tributary to the design point is greater than 200 acres;
- Upstream and downstream stormwater facilities require analysis; or
- Specifically requested by the Stormwater Engineering Department.

202.04 Other Methods

Other methods for the determination of peak runoff rates for a given watershed may be used upon approval from the City Engineer.

SECTION 203: APPLICATION OF A RUNOFF CALCULATION METHOD

203.01 Rational Formula

(Q = CiA)

1). C ï Runoff Coefficient

The runoff coefficient, ñCò factor, represents the ratio of the peak runoff rate to the average rainfall rate over a given watershed or subarea during the time of concentration. Runoff coefficients often account for factors affecting hydrologic condition such as ground cover, soil type, antecedent moisture condition, infiltration, evaporation, and evapotranspiration.

Where distinctive and varying land features are identifiable, a composite weighted runoff coefficient shall be used for the watershed. Single ñCò factors should be applied only in cases where land use is mostly homogeneous. Large areas of imperviousness should be separated into subareas. Runoff coefficients commonly used in the Rational Formula are summarized in **Figure 200-1**.

2). Rainfall Intensity

The variable ñiò is the rainfall intensity in inches per hour, applied to the watershed area for a given design storm return period. When using the Rational Formula, the intensity shall be determined using the Intensity ï Duration ï Frequency Table in **Figure 200-2** or the Intensity ï Duration ï Frequency Curves provided in **Figure 200-3**. A Depth-Duration Frequency Table is provided in **Figure 200-4**.

The storm duration used for determining the rainfall intensity for a particular design storm return period shall be the watershedôs time of concentration. The time of concentration for individual watersheds may be determined using the Time of Concentration Worksheet provided in **Figure 200-5** and **200-6** which was developed using SCS TR-55 for determining times of concentration. The minimum time of concentration for all watersheds shall be 5 minutes.

3). Area

The variable ñAò is the watershed area, in acres, for which the peak runoff rate is to be determined.

Figure 200-1: AVERAGE RUNOFF COEFFICIENTS FOR USE IN RATIONAL FORMULA

Hydrologic Soil Group****			A			B			C			D		Percent-Impervious Surface*
Land Slope		0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	0-2%	2-6%	6%+	
	RF**													
Land Use	(yrs)													
Commercial	5&10	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	.85	
	50	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	70-95
	100	.98	.98	.98	.98	.98	.98	.98	.98	.98	.98	.98	.98	
Industrial	5&10	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	.80	
	50	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	.90	65-90
	100	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	.95	
High	5&10	.55	.57	.58	.56	.58	.60	.58	.60	.62	.60	.62	.65	
Density	50	.62	.64	.66	.63	.66	.68	.66	.68	.70	.68	.70	.73	40-60
Residential	100	.65	.67	.69	.66	.69	.71	.69	.71	.74	.71	.74	.77	
(<12,000 sf)														
Medium	5&10	.31	.35	.38	.33	.37	.40	.38	.40	.45	.40	.45	.50	
Density	50	.35	.40	.43	.37	.42	.45	.43	.45	.51	.45	.51	.57	15-30***
Residential	100	.37	.42	.45	.39	.44	.47	.45	.47	.54	.47	.54	.60	
(12000 to														
½ acre)														
Low	5&10	.20	.25	.28	.23	.27	.30	.28	.30	.38	.30	.34	.43	
Density	50	.23	.28	.32	.26	.31	.34	.32	.34	.43	.34	.38	.49	5-15
Residential	100	.24	.29	.34	.27	.33	.36	.34	.36	.45	.36	.40	.51	
(>1/2 acre)														
Agricult.	5&10	.14	.18	.20	.16	.20	.25	.20	.22	.30	.22	.28	.38	
and Other	50	.16	.20	.23	.18	.23	.28	.23	.25	.34	.25	.32	.43	less than 5
Open Land	100	.17	.21	.24	.19	.24	.29	.24	.26	.36	.26	.34	.45	

* Average range of percent-impervious surface expected for designated land-use condition.
** Design storm return frequency in years.
*** Where percent-impervious surface ranges between 30 and 40 percent (e.g. 35%) interpolate runoff coefficient between values given.
**** Hydrologic soil group for a particular type of soil may be obtained from the ñHoward County Soil Surveyò by the U.S.D.A.ôs NRCS. NOTE: Calculated ñCò factors based upon actual conditions may be used.

Hours	Minutes	Return Frequency ï Rainfall Intensity (in/hr)					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
.08	5 *	4.82	5.76	6.53	7.61	8.50	9.45
.17	10	3.90	4.66	5.28	6.16	6.88	7.65
.25	15	3.28	3.92	4.44	5.18	5.79	6.44
.33	20	2.83	3.39	3.84	4.48	5.00	5.56
.50	30	2.22	2.66	3.01	3.51	3.92	4.36
.75	45	1.68	2.01	2.27	2.65	2.96	3.29
1	60	1.35	1.61	1.82	2.13	2.37	2.64
2	120	0.80	0.97	1.11	1.32	1.49	1.68
3	180	0.59	0.72	0.83	0.98	1.11	1.25
6	360	0.35	0.43	0.49	0.58	0.65	0.74
12	720	0.20	0.24	0.28	0.33	0.38	0.42
24	1440	0.11	0.14	0.16	0.19	0.21	0.24

Figure 200-2: INTENSITY-DURATION-FREQUENCY TABLE

* Minimum Time of Concentration.

** Interpolation is acceptable to obtain values not provided in the above table.

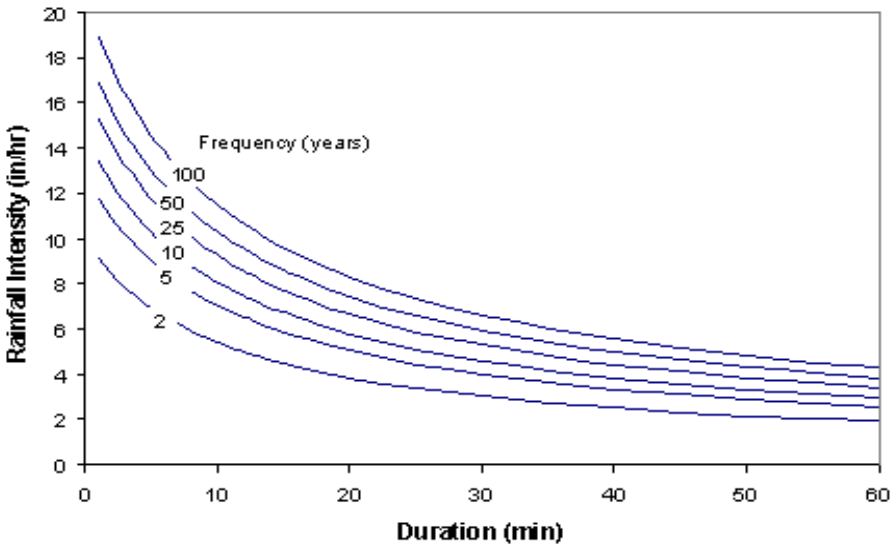


Figure 200-3: A typical rainfall intensity-duration-frequency curve.

Hours	Minutes	Return Frequency ï Total Rainfall Depth (in)					
		2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
.08	5 *	0.35	0.46	0-52	0.59	0.65	0.71
.17	10	0.56	0.75	0.85	0.98	1.03	1.16
.25	15	0.73	0.95	1.09	1.27	1.39	1.52
.33	20	0.83	1.10	1.27	1.49	1.60	1.79
.50	30	0.93	1.27	1.49	1.75	1.93	2.14
.75	45	1.05	1.41	1.65	1.95	2.16	2.42
1	60	1.12	1.52	1.78	2.10	2.34	2.61
2	120	1.36	1.82	2.16	2.54	2.84	3.10
3	180	1.50	2.03	2.40	2.82	3.15	3.45
6	360	1.80	2.40	2.88	3.36	3.72	4.08
12	720	1.92	2.76	3.24	3.84	4.32	4.68
24	1440	2.16	3.12	3.60	4.32	4.80	5.28

Figure 200-4: DEPTH-DURATION -FREQUENCY TABLE.

Figure 200-5: TIME OF CONCENTRATION WORKSHEET

Time of Concentration Worksheet, Derived from TR-55

Project: _____ By: _____ Date: _____
Location: _____ Checked: _____ Date: _____
Circle one: Present Developed _____
Circle one: T_c T_t through subarea _____
NOTES: Space for as many as two segments per flow type can be used for each worksheet. Include a map, schematic, or description of flow segments.

Overland (sheet) flow (Applicable as part of T_c computation only) Segment ID				
1. Surface description: paved or unpaved é é é é é é é é é é é é ..				
2. Manningôs roughness coeff., n (See Figure 200.6)é é é é é é é é é .				
3. Flow length, L (total L≤300 ft for unpaved, L≤100 ft for paved)é é é ft				
4. Two-yr 24-hr rainfall, P_2 é é é é é é é é é é é é é é é é é é .in	2.16	2.16		
5. Land slope, sé .ft/ft				
6. $T_t = \frac{0.007\,(nL)^{0.8}}{P_2^{0.5} s^{0.4}}$ Compute T_té é é é é é é é é é ..hr		+		=

Shallow concentrated flow Segment ID				
7. Surface description: paved or unpavedé é é é é é é é é é é é ..				
8. Flow length, Lé .ft				
9. Watercourse slope, sé .ft/ft				
10. Average velocity, $V_{unpaved}=16.1345(s)^{0.5}$, or $V_{paved}=20.3282(s)^{0.5}$ .ft/s				
11. $T_t = \frac{A.\ L}{3600\ V}$ Compute T_té é é é é é é é é . hr		+		=
Channel flow Segment ID				
12. Cross sectional flow area, aé é é é é é é é é é é é é é é é é ft^2				
13. Wetted perimeter, p_wé é é é é é é é é é é é é é é é é é é ft				
14. Hydraulic radius, $r = \frac{a}{p_w}$ Compute ré é é é é é é é é ..ft				
15. Channel slope, sé .ft/ft				
16. Manningôs roughness coeff., né é é é é é é é é é é é é é é é ..				
17. $V = \frac{1.49\, r^{2/3} s^{1/2}}{n}$ Compute Vé é é é é é é é é .ft/s				
18. Flow length, Lé ...ft				
19. $T_t = \frac{L}{3600\ V}$ Compute T_té é é é é é é é é hr		+		=
20. Watershed or subarea T_c or T_t (add T_t in steps 6, 11, and 19)é é é .. hr				

Figure 200-6: Values of Manning's Roughness Coefficient, *n*

	Manning's n Range
I. Closed Conduits	
A. Concrete Pipe	0.013
B. Corrugated-metal pipe or pipe arch	
1. 2 2/3 by ½ -in. Corrugation (riveted pipe):	
a. Plain of fully coated	0.024
b. Paved invert (range values are for 25 and 50 percent of circumference paved):	
(1) Flow full depth	0.021-0.018
(2) Flow .8 depth	0.021-0.016
(3) Flow .6 depth	0.019-0.013
2. 2/2/3 by ½-in. helical corrugation	0.022
3. 2 2/3 by ½-in. annular corrugation	
a. 15 in. to 36 in.	0.025
b. 42 in. to 96 in.	0.024
4. 3 by 1 in. corrugation	0.027
5. 5 by 1 in. corrugation	0.025
C. Structural plate pipe or pipe arch	
1. 6 by 2 in. corrugation	0.033
2. 9 by 2 ½ in. corrugation	0.035
D. Ductile Iron Pipe	0.012
E. Smooth high Density polyethylene (HDPE)	0.012
G. Smooth-lined interior Polyvinyl Chloride (PVC)	0.012
II. Open Channels, lined (straight alignment):	
A. Concrete with surfaces as indicated:	
1. Formed, no finishes	0.013-0.017
2. Trowel finish	0.012-0.014
3. Float finish	0.013-0.015
4. Float finish	0.015-0.017
5. Gunite, good section	0.016-0.019
6. Gunite, wavy section	0.019-0.022
B. Concrete, bottom float finished, sides as indicated:	
1. Dressed stone in mortar	0.015-0.017
2. Random stone in mortar	0.017-0.020
3. Cement rubble masonry	0.020-0.025
4. Cement rubble masonry, plastered	0.016-0.020
5. Dry rubble (rip rap)	0.020-0.030
C. Gravel Bottom, sides as indicated:	
1. Formed concrete	0.017-0.020
2. Random stone in mortar	0.020-0.023
3. Dry rubble (rip rap)	0.014-0.017
III. Open Channels, (straight alignment, natural lining):	
A. Earth, uniform section:	
1. Clean, recently completed	0.016-0.018
2. Clean, after weathering	0.018-0.020
3. With short grass, few weeds	0.022-0.027
4. In gravelly soil, uniform section, clean	0.022-0.025
B. Earth, fairly uniform section:	
1. No vegetation	0.022-0.026
2. Grass, some weeds	0.025-0.030
3. Dense weeds or aquatic plants in deep channels	0.030-0.036
4. Sides clean, gravel bottom	0.025-0.030
5. Sides clean, cobble bottom	0.030-0.040
C. Channels not maintained, weeds and brush uncut:	
1. Dense weeds, high as flow depth	0.06-0.13
2. Clean bottom, brush on sides	0.05-0.06
3. Clean bottom, brush on sides, highest stage of flow	0.07-0.11
4. Dense brush, high stage	0.10-0.14

	Manning's n Range
IV. Street and Expressway Gutters:	
A. Concrete gutter, troweled finish	0.013
B. Asphalt pavement:	
1. Smooth texture	0.013
2. Rough texture	0.016
C. Concrete gutter with asphalt pavement:	
1. Smooth	0.013
2. Rough	0.015
D. Concrete pavement:	
1. Float finish	0.014
2. Broom finish	0.016
E. For gutters with small slope, where sediment may accumulate, increase above values by	0.002
V. Natural Stream Channels:	
A. Minor streams (surface width at flood stage less than 100 ft.):	
1.Fairly regular section:	
a. Some grass and weeds, little or no brush	0.030-0.035
b. Dense growth of weeds, depth of flow materially greater than weed height	0.035-0.06
c. Some weeds, light brush on banks	0.035-0.06
d. Some weeds, heavy brush on banks	0.05-0.07
e. Some weeds, dense willows on banks	0.06-0.08
f. For trees within channel, with branches submerged high stage, increase all above values	0.01-0.02
2. Irregular sections, with pools, slight channel meander: Increase values given in 1 a-e about	0.01-0.02
VI. Sheet Flow (for use in time of concentration calculations only):	
A. Paved Surfaces	
1. Smooth Surfaces (concrete, asphalt, gravel, or bare soil)	0.011
B. Unpaved Surfaces	
1. Fallow (no residue)	0.05
2. Cultivated Soils	
a. Cover $\leq$ 20%	0.06
b. Cover $\geq$ 20%	0.17
3. Grass	
a. Short grass, prairie	0.15
b. Dense grass	0.24
c. Bermuda grass	0.41
d. Range	0.13
4. Woods	
a. Light underbrush	0.04
b. Dense underbrush	0.80

203.02: Runoff Hydrograph and Routing Methods

1). Rainfall Intensity, Duration and Distribution

The rainfall intensity, duration and distribution used in TR-20, HEC-1, and other runoff hydrograph methods shall be determined according to the requirements defined in Section 205, Rainfall. The duration of storm events applied in hydrograph and routing methods and computer models should be analyzed in separate model runs using a range of storm durations to indicate the storm duration that maximizes the peak runoff rate and maximizes the required storage volume.

2). NRCS Curve Number, CN

The Curve Number (CN) Method was developed by the Natural Resources Conservation Service (NRCS) to determine the quantity of runoff resulting from a given amount of precipitation over a given area. The CN Method uses the hydrologic soil grouping, cover type data, rainfall depth, and the antecedent moisture to estimate runoff volumes. **Figure 200-7** and **200-8** present runoff Curve Numbers commonly used for urban and undeveloped areas.

The hydrologic soil grouping of Howard County soils, as well as other soil and water features, is presented in the USDA Soil Conservation Service ñSoil Survey for Howard County, Indianaò and should be referenced for hydrologic data and soils information. Additional information relating to the determination of Curve Numbers may be obtained from the HERPICC Manual and SCS TR-55, References #1 and #2, respectively.

SECTION 204: OFFSITE HYDROLOGIC ANALYSIS

204.01 Introduction

The design of stormwater facilities shall consider and accommodate the drainage of runoff from watersheds tributary to the drainage area(s) being analyzed. Investigation of facilities outside the boundaries of the project area is a required part of the design process, except in cases where oversized detention is provided for runoff traveling through the project area from tributary watersheds.

Figure 200-7: Runoff Curve Numbers for Urban Areas

Cover Description		Curve Numbers for Hydrologic Soil Group			
Cover Type and Hydrologic Condition	Average Percent Impervious Area	A	B	C	D
Fully Developed Urban Areas (vegetation established)					
Open space (lawns, parks, golf courses, cemeteries, etc):					
Poor Condition (grass cover < 50%)		68	79	86	89
Fair Condition (grass cover 50% to 75%)		49	69	79	84
Good Condition (grass cover >75%)		39	61	74	80
Impervious areas:					
Paved parking lots, roofs, driveways, etc. (excluding right-of ï way)		98	98	98	98
Streets and roads:					
Paved; curbs and storm sewers (excluding right-of-way)		98	98	98	98
Paved; open ditches (including right-of way)		83	89	92	93
Gravel (including right-of-way)		76	85	89	91
Dirt (including right-of-way)		72	82	87	89
Western desert urban areas:					
Natural desert landscaping (previous areas only)		63	77	85	88
Artificial desert landscaping (impervious weed barrier, desert shrub with 1 to 2 inch sand or gravel mulch and basin borders		96	96	96	96
Urban districts:					
Commercial and business	85	89	929	94	95
Industrial	72	81	88	91	93
Residential district by average lot size:					
1/8 acre or less (town houses)	65	77	85	90	92
1/4 acre	38	61	75	83	87
1/3 acre	30	57	72	81	86
1/2 acre	25	54	70	80	85
1 acre	20	51	68	79	84
2 acre	12	46	65	77	82
Developing urban areas					
Newly graded areas (previous areas only, no vegetation)		77	86	91	94

Figure 200-8: Runoff Curve Numbers for Undeveloped Areas

Cover Description		Curve Numbers for Hydrologic Soil Group			
Cover Type	Hydrologic Condition	A	B	C	D
Pasture, grassland, or range ï continuous forage for grazing	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow ï continuous grass, protected from grazing and generally mowed for hay	--	30	58	71	78
Brush ï brush-weed-grass mixture with brush the major element	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30	48	65	73
Woods ï grass combination (orchard or tree farm)	Poor	48	67	77	83
	Fair	43	65	76	82
	Good	32	58	72	79
Woods	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30	55	70	77
Farmsteads ï buildings, lanes, driveways, and surrounding lots	--	59	74	82	86

204.02 Analysis of Impacts of Improvements on Upstream, Downstream, and Peripheral Facilities

1). When Upstream, Downstream, and Peripheral Analysis is Not Required.

Analysis of impacts will not be required when:

A. Available downstream facilities will not be needed to transport runoff from the project area after the completion of improvements.

B. Alterations to existing residential and commercial properties does not increase the amount of impervious area by more than 0.5 acres and no alteration or increase in the capacity to transport additional stormwater runoff is required.

C. Site improvements where the stormwater facilities have been designed such that:

a). The combination of flows from off-site and on-site drainage areas results in no increase in the peak discharge from the pre-developed site during the 10-year through 100-year storm event.

b). The volume of runoff for the project site is not increased for the 10-year to 100-year storm events.

c). The increase in the water level stage in the receiving water water source is less than 0.10 feet immediately downstream of the outlet for the project area during peak flow for the design storm event and analysis is conclusive that no detrimental upstream impacts are caused by the backwater from the proposed improvements.

2). Downstream Analysis Requirements

Downstream analysis of the impacts of drainage improvements shall be completed to a point in the receiving water course where an increase in the stage of the receiving stream during the design storm event is less than or equal to 0.10 feet. Additional information may be required by the City of Kokomo Engineer on a case-by-case basis.

204.03 Analysis of Runoff Impacts Along Watershed and Project Boundaries

Areas along watershed, project, or property boundaries for the proposed improvement area shall be evaluated to ensure that areas adjacent to and outside the limits for improvements are not adversely affected by the proposed improvements.

Section 205 Rainfall

205.01 Introduction

The following sections define the rainfall requirements to be used during design for projects located outside a regulated floodway. Culverts and bridges over floodways must obtain a flow, Q, from Coordinated Discharge Tables approved by IDNR.

205.02 Intensity

Figures 200-2 and **200-3** (see Section 203) shall be used to determine storm intensities for the design of stormwater facilities in the City of Kokomo. **Figure 200-2** contains rainfall intensities in tabular form for various storm durations and return frequencies for the same data. Figure **200-3** represents a typical rainfall intensity-duration-frequency curve generated using Three Rivers Coordinating Council rainfall data.

Figure 200-4 (see Section 203) presents total rainfall depths in tabular form for various storm durations and return frequencies. The data should be used in runoff calculation methods and analyses that require the use of total rainfall depths over a given storm duration.

205.03 Duration

Storm durations used in conjunction with the Rational Formula shall be equal to the time of concentration for the watershed being analyzed.

Storm durations used in runoff hydrograph analyses and routing methods for the design of stormwater facilities shall use a storm duration that maximizes the peak discharge for the pre-improved site conditions and a storm duration that maximizes the required detention volume shall be used.

205.04 Distribution

Storm distribution for hydrograph computation shall be determined by applying the appropriate Huff Distribution for the following conditions:

Storm Duration	Distribution
6 hours and less	Huff 1st Quartile
6 hours < Duration ≤ 12 hours	Huff 2nd Quartile
12 hours < Duration ≤ 24 hours	Huff 3rd Quartile
> 24 hours Duration	Huff 4th Quartile

CHAPTER 300 STORM DRAINAGE

SECTION 301: INTRODUCTION

The following Design Criteria are summarized herein to establish practical uniform design of storm drainage for the City of Kokomo. These criteria cover design factors and provide guidelines for evaluation of plans and specifications by the City departments having jurisdiction over the review of plans and specifications. However, more detailed analyses may be required depending on the specific site characteristics.

Adherence to standard details shall be required in addition to other requirements in this chapter. In case of discrepancy, the most restrictive requirement shall apply.

301.01 Abbreviations & Definitions:

Antecedent Moisture Condition: The index of runoff potential before a storm event. The index, developed by the Natural Resource Conservation Service (NRCS), is an attempt to account for the variation of the NRCS runoff curve number (CN) from storm to storm.

BMP: Best Management Practice

Catch Basin: A chamber usually built at the curb line of a street for the admission of surface water to a storm drain or subdrain, having at its base a sediment sump designed to retain grit and detritus below the point of overflow.

Channel: A portion of a natural or artificial watercourse which periodically or continuously contains moving water, or which forms a connecting link between two bodies of water. It has a defined bed and banks which serve to confine the water.

COE: United States Army Corps of Engineers

Culvert: A closed conduit used for the conveyance of surface drainage water

under a roadway, railroad, canal or other impediment.

Curve Number: The NRCS index that represents the combined hydrologic effect of soil, land use, land cover, hydrologic condition and antecedent runoff condition.

Depression Storage: Non-riverine depressions in the earth where stormwater collects. The volumes are often referred to in units of acre-feet.

Design Storm**:** A selected storm event, described in terms of the probability of occurring once within a given number of years, for which drainage or flood control improvements are designed and built.

Drainage Area: The area draining into a stream at a given point. It may be of different sizes for surface runoff, subsurface flow and base flow, but generally the surface runoff area is considered as the drainage area.

Duration: The time period of a rainfall event.

Hydrograph: For a given point on a stream, drainage basin, or a lake, a graph showing either the discharge, stage(depth), velocity, or volume of water with respect to time.

IDEM: Indiana Department of Environmental Management.

IDNR: Indiana Department of Natural Resources.

INDOT: Indiana Department of Transportation.

Infiltration: Passage or movement of water into the soil.

Inlet: An opening into a storm drain system for the entrance of surface storm water runoff, more completely described as a storm drain inlet.

Lowest Adjacent Grade: The elevation of the lowest grade adjacent to a structure, where the soil meets the foundation around the outside of the structure (including structural members such as basement walkout, patios, decks, porches, support posts or piers, and rim of the window well.

Major Drainage System: Drainage system carrying runoff from an area of one or more square miles.

Minor Drainage System: Drainage system carrying runoff from an area of less than one square mile.

NRCS: USDA-Natural Resources Conservation Service (formerly Soil Conservation Service).

Peak Discharge: The maximum instantaneous flow from a given storm condition at a specific location.

Rainfall Intensity: The rate at which rain is falling at any given instant, usually expressed in inches per hour.

Regulated Drain: A drain subject to the provisions of the Indiana Drainage Code, I.C.-36-9-27

Runoff: That portion of precipitation that flows from a drainage area on the land surface, in open channels, or in stormwater conveyance systems.

Storm Frequency: The time interval between major storms of predetermined intensity and volumes of runoff (e.g. a 5-yr., 10-yr., or 20-yr. storm).

Storm Sewer: A closed conduit for conveying collected storm water, while excluding sewage and industrial wastes. Also called a storm drain.

Stormwater Drainage System: All means, natural or man-made, used for conducting storm water to, through or from a drainage area to any of the following: conduits and
appurtenant features, canals, channels, ditches, storage facilities, swales, streams, culverts, streets and pumping stations.

Stormwater Facility: All ditches, channels, conduits, levees, ponds, natural and manmade impoundments, wetlands, tiles, swales, sewers and other natural or artificial means of draining surface and subsurface water from land.

Swale: An elongated depression in the land surface that is at least seasonally wet, is usually heavily vegetated, and is normally without flowing water. Swales conduct stormwater into primary drainage channels and may provide some groundwater recharge.

Tailwater: The water surface elevation at the downstream side of a hydraulic structure (i.e. culvert, bridge, weir, dam, etc.).

Time of Concentration: The travel time of a particle of water from the most hydraulically remote point in the contributing area to the point under study. This can be considered the sum of an overland flow time and times of travel in street gutters, storm sewers, drainage channels, and all other drainage ways.

USDA: United States Department of Agriculture.

Watershed: The region drained by or contributing water to a specific point that could be along a stream, lake or other stormwater facilities. Watersheds are often broken down into subareas for the purpose of hydrologic modeling.

301.02 Symbols

To provide consistency within this chapter the following symbols will be used. These symbols were selected because of their wide use in hydrologic and hydraulic publications. In some cases the same symbol is used in existing publications for more than one definition. Where this

occurs in this chapter, the symbol will be defined where it occurs in the text or equations.

Symbols	Definition	Units
A	Drainage area	acres
C	Runoff Coefficient	--
CN	NRCS-runoff curve number	--
D	Duration	hours
I	Rainfall intensity	in/hr
N	Manning roughness coefficient	--
Q	Rate of runoff	cfs
q_p	Peak rate of discharge	cfs
tc or Tc	Time of concentration	minutes
V	Velocity	ft/s

SECTION 302: SITE DRAINAGE

302.01 Site Grading Plan

Site grading plans shall be prepared with 1 foot existing and proposed contours showing all lots having proper drainage. Site grading plans for developments shall also have proposed building pad elevations to ensure proper drainage of the development. Individual site plans within a development must conform to the subdivision drainage site plan.

302.02 Cuts & Fills

No land shall be graded, cut, or filled so as to create a slope exceeding a vertical rise of 1 foot for each 2 ½ feet of horizontal distance between abutting lots, unless a retaining wall of sufficient height and thickness is provided to retain the graded bank. Major cuts, excavation, grading, and filling, where the same material changes and site and its relationship with surrounding areas, shall not be permitted as such excavation, grading, and filling will result in a slope exceeding a vertical rise of 1 foot for each 2 ½ feet of horizontal distance between abutting lots or between adjoining tracts of land, except where adequate provision is made to prevent slides and erosion by cribbing and retain walls.

302.03 Compaction of Fill

All fill shall be compacted to a density of 90% or greater. Inspection of fill shall be conducted by the City Engineering Department.

302.04 Retaining Walls

Retaining walls may be required whenever topographic conditions warrant or where necessary to retain fill or cut slopes within the right-of-way. Such improvements shall require the approval of the City Engineering Department.

302.05 Filling of Existing Areas

No existing area shall be filled or graded to adversely affect adjoining properties, as determined by the City Engineering Department.

302.06 Runoff Considerations

The runoff from drainage areas upstream of the proposed development or improvement must be provided with an unobstructed outlet and an emergency overflow. The outlet should provide the capacity needed to carry the runoff from a 5-year storm in its existing land use condition.

The flow path from the development outfall(s) to a regulated drain or natural watercourse (as determined by the jurisdictional entity) shall be provided on an exhibit that includes topographic information. Any existing field tile encountered during the construction shall also be incorporated into the proposed stormwater drainage system or tied to an acceptable outlet.

Where the runoff outfall from the stormwater drainage system of any development flows through real estate owned by others prior to reaching a regulated drain or watercourse, no acceptance shall be granted for such drainage system until all owners of real estate and/or tenants crossed by the outfall consent in writing to the use of their real estate through a recorded easement or are notified of such proposal and their rights to appeal any approval of the design. Proof of this notification must be submitted to the City Engineer.

302.07 Acceptable Outlets

1. General Recommendations

    a. All outlets, either open drain or storm sewer, shall extend to the regulated drain or natural watercourse.

    b. All storm sewers shall extend to either a receiving storm

sewer system or an open regulated drain or natural surface watercourse as approved by the City Engineer.

c. Storm sewers shall not outlet into rear yard swales.

d. Outlets shall not directly discharge onto the ground surface as surface flow without adequate outlet protection.

e. Underwater discharges shall not be allowed. All discharges into a watercourse, pond, or lake shall have the invert at or above the normal pool elevation or normal flow elevation for the receiving stream.

2. Adequate Outlets

a. If an adequate outlet is not located on site, then off-site drainage improvements- or further reduction in allowable release rates may be required. Those improvements may include, but are not limited to, extending storm sewers, clearing, dredging and/or removal of obstructions to open drains or natural water courses, and the removal or replacement of undersized culvert pipes as required by the MS4 Operator.

3. Regulated Drain Considerations

a. If the project siteôs outlet directly discharges to a Howard County Regulated Drain, the applicant will also need to abide by the Howard County Surveyorôs Office applicable requirements, whether the site is located in an incorporated area or not.

SECTION 303: OPEN CHANNEL DESIGN

303.01 Introduction

Open channel flow may be evaluated utilizing Manningôs equation, however, restrictions within open channels, such as at open culverts or storm drains, may be required to be evaluated by more sophisticated design methods such as those listed in Section 303.04. Section 303.03 may be used to determine the value of ñnò, Manningôs Roughness Coefficient, to be used in the calculations. These calculations of open ditch capacity should be provided to the reviewing agency along with the construction drawings.

303.02 Mannings Equation

The waterway area for channels shall be determined using Manning's Equation, where:

$$A = Q/V$$

A = Waterway area of channel in square feet

Q = Discharge in cubic feet per second (cfs)

V = Steady-State channel velocity, as defined by Manningôs Equation (See Section 304.02)

303.03 Mannings Roughness Coefficient For Channel Materials

Channel Material	ñnò value
Vitrified clay	0.014
Cast iron pipe	0.015
Smooth earth	0.018
Firm gravel	0.023
Corrugated metal pipe	0.022
Natural channels in good condition	0.025
Natural channels with stones and weeds	0.035
Very poor natural channels	0.060

303.04 Backwater Method for Drainage System Analysis

The determination of 100-year water surface elevation along channels and swales shall be based on accepted methodology and computer programs designed for this purpose. Computer programs HEC-RAS, HEC-2, and ICPR are preferred programs for conducting such backwater analysis. The use of other computer models must be accepted in advance by the City of Kokomo.

303.05 Appurtenant Structures

The design of channels will include provisions for operation and

maintenance and the proper functioning of all channels, laterals, and structures associated with the project. Recessed inlets and structures needed for entry of surface and subsurface flow into channels without significant erosion or degradation shall be included in the design of channel improvements. The design will also provide for necessary, water level control devices, and any other appurtenance structure affecting the functioning of the channels.

The effects of channel improvements on existing culverts, bridges, buried cables, pipelines, and inlet structures for surface and subsurface drainage on the channel being improved shall be evaluated to determine the need for modification or replacement. Culverts and bridges which are modified or added as part of channel improvement projects shall meet reasonable standards for the type of structure, and have a minimum capacity equal to the design discharge.

303.06 Grading and Depth of Open Channels

1. The required channel cross-section and grade are determined by the design capacity, the material in which the channel is to be constructed, and the requirements for maintenance. A minimum depth may be required to provide adequate outlets for subsurface drains, tributary ditches, or streams. The channel grade shall be such that the velocity in the channel is high enough to prevent siltation but low enough to prevent erosion. Velocities less than 2 feet per second are not acceptable, as siltation will take place and ultimately reduce the channel cross-section area. The maximum permissible velocities for vegetated-lined channels are shown in **Figure 300-1**. In addition to existing runoff, the channel design should incorporate increased runoff due to the proposed development.

2. Where depth of design flow is slightly below critical depth, channels all have freeboard adequate to cope with the effect of hydraulic jumps.

3. Along the streets and roads, the bottom of the ditch should be low enough to install adequately-sized driveway culverts without creating "speed bumps". The driveway culvert inverts shall be designed to adequately consider upstream and downstream culvert elevations.

4. Flow of a channel into a closed system is prohibited, unless runoff rate and head loss computations demonstrate the closed conduit to be capable of carrying the 100-year channel flow for developed conditions, either entirely or in combination with a defined overflow channel, with no reduction of velocity.

Figure 300-1: Maximum Permissible Velocities

Maximum Permissible Velocities in Vegetal-Lined Channels (1)			
Cover	*Channel Slope Range (Percent)* **(3)**	*Permissible Velocity* **(2)**	
		Erosion Resistant Soils (ft. per sec.) **(4)**	*Easily Eroded Soils (ft. per sec.)* **(4)**
Bermuda Grass	0-5 5-10 Over 10	8 7 6	6 5 4
Bahia Buffalo Grass Kentucky Bluegrass Smooth Brome Blue Grama	0-5 5-10 Over 10	7 6 5	5 4 3
Grass Mixture Reed Canary Grass	**(3)** 0-5 5-10	5 4	4 3
Lespedeza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	**(4)** 0-5 5-10	3.4	2.5
Common Lespedeza **(5)** Sudangrass **(5)**	**(6)** 0-5	3.5	2.5

(1) From Natural Resources Conservation Service, SCS-TP-61, "Handbook of Channel Design for Soil and Water Conservation".

(2) Use velocities exceeding 5 feet per second only where good channel ground covers and proper maintenance can be obtained.

(3) Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

(4) Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.

(5) Annuals - use on mild slopes or as temporary protection until permanent covers are established.

(6) Use on slopes steeper than 5 percent is not recommended.

5. When the design discharge produces a depth of greater than three (3) feet in the cannel, appropriate safety precautions shall be added to the design criteria based on reasonably anticipated safety needs.

6. Swale side slopes shall be no steeper than 3 horizontal to 1 vertical (3:1). Flatter slopes may be required to prevent erosion and for ease of maintenance the swale design shall be according to applicable standards.

7. Minimum swale slopes are 1.0%, unless designed to act as a stormwater quality BMP. All flow shall be confined to the specific easements associated with each rear and side lot swale that are part of the minor drainage system. Unless designed to act as a stormwater quality BMP, vegetated swales shall have tile underdrains to dry the swales. Tile lines may be outletted through a drop structure at the ends of the swale or through a standard tile outlet. Further guidance regarding this subject may be found in the latest edition of the Indiana Drainage Handbook.

8. Residential rear and side lot swales shall not exceed 300 feet in length to any inlet and shall not convey flow from more than 3 lots.

303.07 Channel Stability

Channel stability shall be determined for an aged condition and the velocity shall be based on the design flow or the bankfull flow, whichever is greater, using an "n" value for various channel linings as shown in Section 303.03. Characteristics of a stable channel are:

a) It neither promotes sedimentation nor degrades the channel bottom and sides.

b) The channel banks do not erode to the extent that the channel cross-section is changed appreciably.

c) Excessive sediment bars do not develop.

d) Excessive erosion does not occur around culverts, bridges, outfalls or elsewhere.

e) Gullies do not form or enlarge due to the entry of uncontrolled flow to the channel.

Channel stability shall be checked for conditions representing the period immediately after construction. For this stability analysis, the velocity shall be calculated for the expected flow from a 10-year frequency storm on the watershed, or the bankfull flow, whichever is smaller, and the "n" value for the newly constructed channels in fine-grained soils and sands

may be determined in accordance with the "National Engineering Handbook 5, Supplement B, Soil Conservation Service" (currently NRCS) and shall not exceed 0.025. This reference may be obtained by contacting the National Technical Information Service in Springfield. The allowable velocity in the newly constructed channel may be increased by a maximum of 20 percent to reflect the effects of vegetation to be established under the following conditions:

a) The soil and site in which the channel is to be constructed are suitable for rapid establishment and support of erosion controlling vegetation.

b) Species of erosion controlling vegetation adapted to the area, and proven methods of establishment are shown.

c) The channel design includes detailed plans for establishment of vegetation on the channel side slopes.

303.08 Channel Protection

Channel protection material shall be placed at pipe outlets and other areas of high velocity flow to prevent erosion. The type, location, and depth of the protective material shall be reviewed and approved by the City Engineer.

Materials acceptable for use as channel lining are:

1. Grass (hand sown or hydroseed)
2. Revetment Riprap
3. Concrete
4. Hand Laid Riprap
5. Precast Cement Concrete Riprap
6. Gabions (or reno mattresses)
7. Coconut fiber and/or erosion control blanket with grass establishment.

Use of bio-engineered (green solution) methods for lining materials is recommended and may be explored, as applicable. Other lining materials must be accepted in writing by the City Engineer. Materials shall comply with the latest edition of the INDOT, "Standard Specifications".

303.09 Drainage System Overflow Design

Ponding and overflow path throughout the development resulting from a 100-year storm event or from a flood route of an internal detention pond or off-site development or watershed, calculated based on all contributing

drainage areas, on-site and off-site, in their proposed or reasonably anticipated land use and with the storm pipe system assumed completely plugged, shall be determined, clearly shown as hatched area on the plans, and a minimum width of 20 feet along the centerline of the overflow path contained in permanent drainage easements. A statement shall be added to the secondary plat that would refer the viewer to the construction plans to see the entire extent of overflow path as hatched areas. No fences or landscaping or any other above grade improvements can be constructed within the easement areas that may impede the free flow of stormwater. These areas shall be designated as flood routes and contained in common areas that are to be maintained in accordance with restrictive covenants, codes or policies. The Lowest Adjacent Grade for all residential, commercial, or industrial buildings shall be set a minimum of 2 feet above the highest noted overflow path/ponding elevation across the property frontage.

All buildings shall have a minimum flood protection grade shown on the secondary plat. Minimum Flood Protection Grade of all structures fronting a pond or open ditch shall be no less than 2 feet above any adjacent 100-year local or regional flood elevations, whichever is greater, for all windows, doors, pipe entrances, window wells, and any other structure member where floodwaters can enter a building.

The overflow path/ponding may be modeled as successive series of natural ponds and open channel segments. Consideration shall be given to the highest ground elevations along the overflow path. Ponds should be modeled similar to that discussed for modeling depressional areas in Section 307.02. Channels should be modeled according to modeling techniques discussed earlier in this Chapter. The calculations for determining the 100-year overflow path/ponding elevations may be based on hand calculation methods utilizing normal depth calculations and storage routing techniques or performed by computer models. Examples of computer models that either individually or in combination with other models can handle the required computations include TR-20, HEC-HMS, and HEC-1, combined with HEC-RAS. Other models may be acceptable and should be accepted by City Engineer prior to their utilization.

Values in **Figure 300-2** may be utilized as an alternative to the above-noted detailed calculations for determining the required pad elevations of buildings near an overflow path.

If **Figure 300-2** is used, the City Engineer reserves the right to require independent calculations to verify that the proposed building pads provide approximately 2 feet of freeboard above the anticipated overflow path/ponding elevations.

In the case of existing upstream detention, an allowance

equivalent to the reduction in flow rate provided may be made for upstream detention only when:

(1) such detention and release rate have previously been accepted by the City Engineer with the approval authority at the time of the acceptance, and;

(2) evidence of its construction and maintenance can be shown.

Building Pad Elevations With Respect to Overflow Path Invert Elevations		
Drainage Area (acres)	**Building Pad Above Overflow Path Invert (ft.)**	**Building Pad Above Overflow Path Invert, if Overflow Path is in the Street (ft.)**
Up to 5	3.5	2.5
6-10	4.0	2.5
11-15	4.25	2.75
16-20	4.5	2.75
21-30	5.0	3.0
30-50	5.25	3.0

Figure 300-2: Overflow Path & Building Pad Elevations.

SECTION 304: STORM SEWERS

304.01 Introduction

These design criteria are intended to conform to the standard drawings for storm sewers. Storm sewer design should follow these criteria and Indiana Department of Transportation (INDOT) Location and Design, Volume Two, Drainage Design.

All storm sewer calculations must be submitted to the City before any approvals will be given. Uniform slopes shall be maintained between inlets, manholes and inlets to manholes. Final grade shall be set with full

consideration of the capacity required, sedimentation problems, and other design parameters.

An adequate storm drainage system shall be constructed for all new developments. Natural drainage areas should be closely followed. Outlets for the storm water runoff for development upstream of the proposed development must be provided.

304.02 Storm Drain Pipe Design

Storm runoff from urban areas may constitute a large volume of flow. The rational method is the preferred method for estimating storm runoff for areas less than or equal to 20 acres. Once the runoff is determined, the Manning Formula is the preferred method to calculate the capacity of the storm sewer pipes. Storm sewer shall be designed based on the full flow capacity of all pipes being able to carry at least the runoff from a 5-year storm event.

Also, the Hydraulic Grade Line (HGL) should be checked to ensure that a 25-year storm event will not cause ponding water at catch basins and manholes.

The Rational Formula used to compute the runoff that reaches a storm sewer inlet consists of the following:

Q = CiA

Q = Peak rate of runoff in cubic feet per second (cfs)
C = A coefficient expressing the ratio of runoff to the average rainfall
rate during the time of concentration
i = Intensity of rainfall, in inches per hour
A = Drainage area, in acres

Other methods for determination of peak runoff rates may be used upon approval from or by request of the City of Kokomo Engineer.

Allowable "n" values and maximum permissible velocities for storm sewer materials are listed in Section 304.08. **Figures 300-3** (Runoff Coefficient- C), **300-4** (Computation for Storm Sewer Design), and **300-5** (Computation for Storm Sewer Design Worksheet) provide assistance for storm sewer design. See **Figures 200-4** (Intensity-Duration-Frequency Table), **200-5** (Time of Concentration Worksheet), **Figure 200-6 (**Values of Manningôs Roughness Coefficient, *n)* for additional help with storm sewer design calculations.

Predominant Land Use	
Business:	
Downtown Area	.80
Neighborhood Area	.70
Residential:	
Single-Family Areas	.40
Multi-Family Areas	.60
Industrial:	
Light Areas	.70
Heavy Areas	.80
Parks, Cemeteries	.30
Playgrounds	.35
Railroad Yard Areas	.35
Row Crops or Open Land	.25
Surface Characteristics	
Street:	
Asphalt	.90
Concrete	.90
Drives and Walks	.90
Roofs	.85
Lawns	
Flat ï 2% or less	.25
Average ï 2% to 7%	.35
Steep ï 7% or greater	.40

Lists values of ñCò for several land uses and surface characteristics. If more than one land use is present in particular drainage area, a composite ñCò value should be computed to represent the site.

Figure 300-3: Runoff Coefficent- C

This sheet can be used to determine values of ñIò for several storm frequencies.

The Manning Formula, used to compute flow in open conduits, consists of the following:

$$Q = \frac{1.486}{n} R^{2/3} S^{1/2} A$$

Q = Flow in cubic feet per second (cfs)
n = Coefficient of conduit roughness (n = 0.013)
R = Hydraulic radius, ratio of flow area to wetted perimeter in feet
S = Channel or pipe slope, in feet per feet
A = Area of Cross-section of flow in square feet

The design of storm sewers in the City of Kokomo shall be outlined as follows.

A. Prepare a contour map of the drainage area including the surrounding area, drainage limits, and direction of surface flow.

B. Divide the area into the subareas tributary to the proposed sewer inlets. These inlets should be located at reversals of road grade from negative to positive and at street intersections. A maximum distance of 400 feet between catch basins will be allowed along long street grades.

C. Determine the acreage and imperviousness of each area.

D. Calculate the required capacity of each inlet using the appropriate time of concentration, the tributary area and the rational method.

E. Beginning at the highest elevation, compute the flow to be carried by each line. The time of concentration for each line other than the first in a series is the sum of the time of concentration to the inlet next upstream and the flow time in the connecting pipe. Where more than two lines meet, the time of concentration to be used for the succeeding line is the longest time in the lines meeting. Each line will thus require calculation of time of concentration, tributary area (all upstream areas), and flow.

F. Select tentative pipe sizes and grades using the Manning Formula. Each line must be selected in order since the time of concentration for subsequent lines will be dependent upon the time of flow in all upstream lines.

G. Minimum cover requirements specified by ASTM specifications must be met.

H. **Figure 300-5**, Computation for Storm Sewer Design Sheet, may be used for storm sewer calculation.

Figure 300-4: Computation for Storm Sewer Design.

Figure 300-5: Computation for Storm Sewer Design Worksheet.

COMPUTATION FOR STORM SEWER DESIGN

MANNING FORMULA: n _____ Project: _____ Date _____ Sheet No. _____

Manhole No.	Begin/ End Sta.	Δ ñAò	ñCò	Δ ñCAò	Sum ñCAò	Δ ñTò	Sum ñTò	ñIò ___ YR	ñIò ___ YR	ñQò Disch ___ YR	ñQò Disch ___ YR	ñLò FT.	Slope Ft./Ft.	Pipe Dia. In.	ñVò FPS	CAP CFS	Flow Line Elev. Inlet/ Outlet

304.03 Backwater Method for Pipe System Analysis

Various computer modeling programs such as HYDRA, ILLUDRAIN, and STORMCAD are available for analysis of storm drains. Computer models to be utilized, other than those listed, must be accepted by the City Engineer. The use of submerged storm sewer outfalls is prohibited.

304.04 Storm Sewer Pipe Size

The minimum diameter of storm sewer pipe shall be 12 inches. The diameter shall be increased as necessary according to the design analysis.

Minimum cover over storm sewer pipe shall be 3 feet unless otherwise approved by the City Engineering Department. Cover is measured from the top of pipe to the finished grade directly above the pipe.

A minimum of 2.0 feet of vertical separation between storm sewers and sanitary sewers shall also be required. When this is not possible, the sanitary sewer must be encased in concrete within 5 feet, each side, of the crossing centerline. A minimum 10ô horizontal clearance and 18ò vertical clearance shall be maintained between storm sewers and any other utilities lines, unless specifically authorized by the City Engineer.

304.05 Storm Sewer Material Requirements

All pipe used in storm sewer construction shall be Class III concrete (RCP). If the storm sewer pipe is to be placed in an area subject to extreme loading, or for cover depths in excess of 10 feet or less than 2 feet a higher class concrete may be required. Other storm sewer pipe materials may be utilized if approved by the City Engineering Department.

Other pipe and fittings not specified herein or in Sections 907-908 of the latest edition of the INDOT ñStandard Specificationsò may be used only when specifically authorized by the City Engineer.

Pipe joints shall be flexible and watertight and shall conform to the requirements of Section 906, of the latest edition of the INDOT "Standard Specifications".

304.06 Bedding and Backfill Standards for Storm Sewers

Bedding and backfill materials around storm sewer pipes, sub-drains, and the associated structures are limited. The specific requirements for the use of these materials are dependent on pipe location in relation to pavement structures and on pipe material. Bedding details for storm

sewer pipe are shown in **Figures 300-6**, **300-7**, **300-8**, and **300-9**.

Class III RCP pipe placed under a paved thoroughfare surface subject to loading shall have a minimum four inches (4ò) of #11 stone bedding installed under the pipe, and continue to a point ½ the outside diameter of the pipe. Number 53 or #73 stone backfill, compacted in maximum of twelve inch (12ò) lifts shall be installed to within nine and a half inches (9 1/2ò) of the bottom of pavement. An eight inch (8ò) layer of concrete shall be poured over the top of the compacted backfill, and brought up to the bottom of pavement. The final inch and a half (1 1/2ò) shall be asphalt (see **Figure 300-6**).

Class III RCP pipe placed under a paved residential street surface subject to loading shall have a minimum four inches (4ò) of #11 stone bedding installed under the pipe, and continue to a point ½ the outside diameter of the pipe. Number 53 or #73 stone backfill, compacted in maximum of twelve inch (12ò) lifts shall be installed to within seven and a half inches (7 1/2ò) of the bottom of pavement. A six inch (6ò) layer of concrete shall be poured over the top of the compacted backfill, and brought up to the bottom of pavement. The final inch and a half (1 1/2ò) shall be asphalt (see **Figure 300-7**).

Class III RCP pipe placed under a stone drive surface subject to loading shall have a minimum four inches (4ò) of #11 stone bedding installed under the pipe, and continue to 12ò above the top of pipe, being compacted in six inch (6ò) lifts. Number 53 or #73 stone backfill, compacted in maximum of twelve inch (12ò) lifts shall be installed to within six inches (6ò) of the surface. A six inch (6ò) layer of #8 stone, compacted in four inch lifts (3ò) shall then be placed and brought up to the surface (see **Figure 300-8**).

Class III RCP pipe placed under natural ground 5ô outside of pavement placed into natural ground shall have a minimum four inches (4ò) of #11 stone bedding installed under the pipe, and continue to a point ½ the outside diameter of the pipe. Clean earth backfill, compacted in maximum of twelve (12ò) lifts shall then be installed to the surface. The area above the pipe is to be seeded (see **Figure 300-9**).

The specifications for the construction of storm sewers and sub-drains, including backfill requirements, shall not be less stringent than those set forth in the latest edition of the ñINDOT Standard Specifications".

304.07 Minimum Slope

The minimum recommended slope for storm sewers shall be 0.10 foot per 100 feet, unless a greater slope is required to obtain the minimum mean

velocity. Culverts may be installed on flatter grades as approved by the City Engineering Department.

304.08 Velocities

The absolute minimum mean velocity for all storm sewers shall be 2.0 feet per second when flowing full based on Manningôs Formula using an ñnò value of 0.013. Use of other ñnò values will be considered if deemed justifiable on the basis of extensive field data. The desirable minimum velocity is 3.0 feet per second based on the same criteria.

The maximum velocity of all storm sewers shall be 10 feet per second. If the velocity is greater than 10 feet per second, provisions should be made to protect against displacement and erosion of the pipe. Allowable "n" values and maximum permissible velocities for storm sewer materials are listed below in **Figure 300-10**.

304.09 Other Requirements

Dips/sags on newly installed storm systems will not be allowed. Infiltration from cracks, missing pieces, and joints shall not be allowed. The use of Stormwater lift stations are not allowed within the City of Kokomo.

304.10 Connections

Any connections to the storm sewer system shall be shown in the drainage calculations. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability of the system to accommodate any permitted connections, for example, sump pumps and footing drains.

1. **Sump pumps** installed to receive and discharge groundwater or other stormwater shall be connected to the storm sewer. Sump pumps installed to receive and discharge basement floor drain or garage floor drain flow, or backed up sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of stormwater or the discharge of sanitary sewage, each being connected to the respective receiving system only.

2. **Footing drains and perimeter drains** shall be connected to Manholes or Curb inlets, where possible, or to designated storm sewers or discharged into designated storm drainage channels/swales and not to the sanitary sewer.

3. All **roof downspouts**, roof drains, or roof drainage piping may be discharged onto the ground, and/or directly connected into the storm drainage system. No downspouts or roof drains shall be connected to the sanitary sewers.

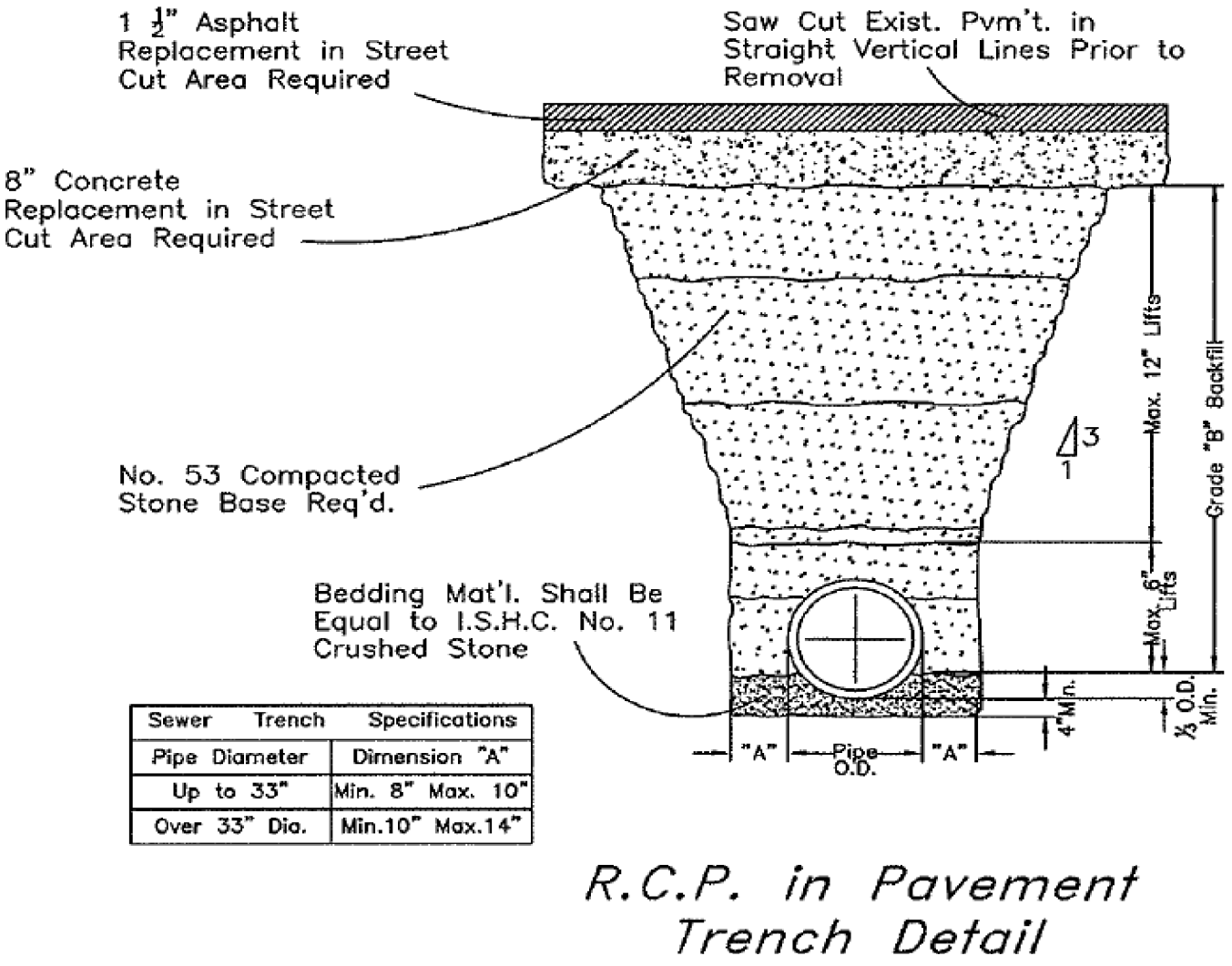
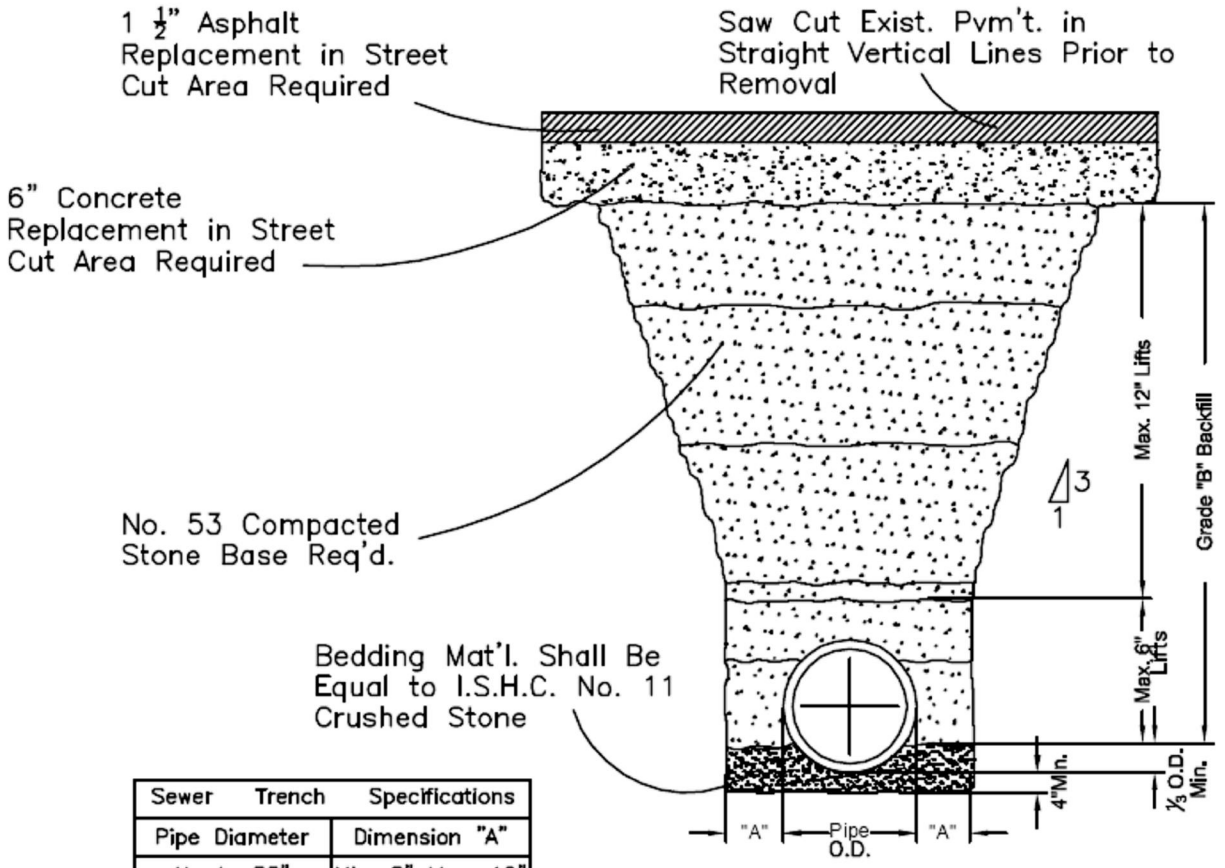
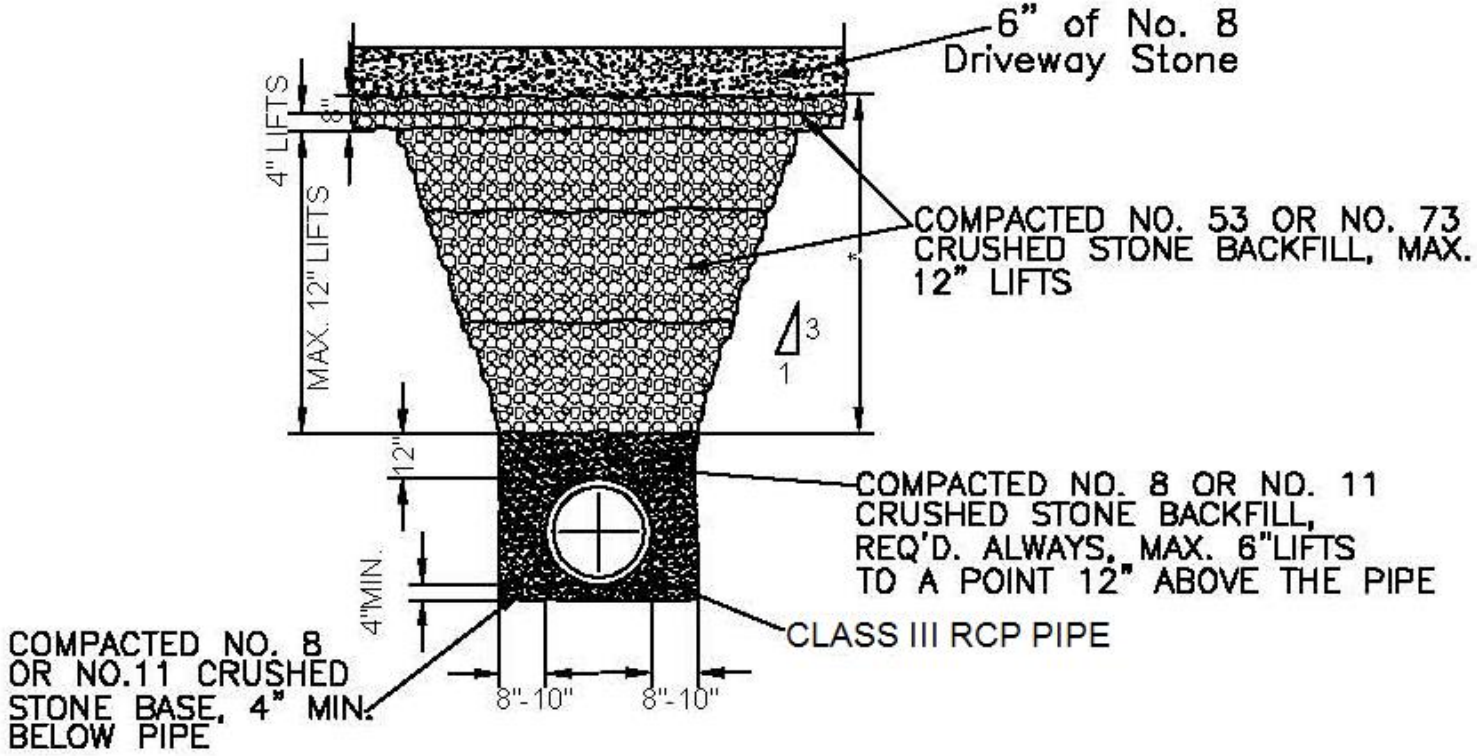


Figure 300-6: RCP Class III Pipe under Thoroughfare Pavement.



Sewer Trench Specifications	
Pipe Diameter	Dimension "A"
Up to 33"	Min. 8" Max. 10"
Over 33" Dia.	Min.10" Max.14"

Figure 300-7: RCP Class III Pipe under Residential Streets.



Trench in Stone Drive Detail

Figure 300-8: RCP Class III Pipe under Stone Drives.

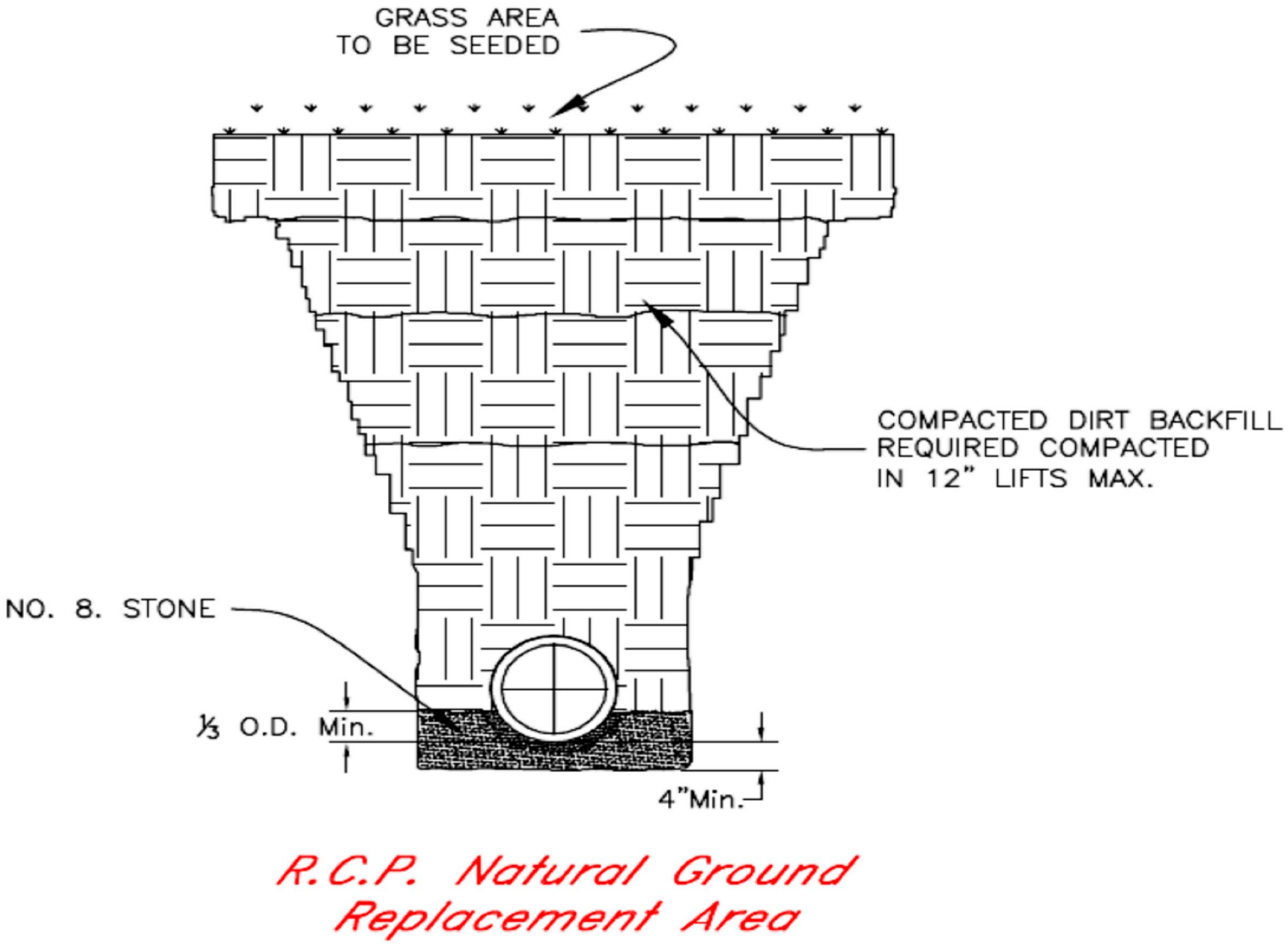


Figure 300-9: RCP Class III Pipe under Natural Ground.

304.10 Connections

Any connections to the storm sewer system shall be shown in the drainage calculations. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability of the system to accommodate any permitted connections, for example, sump pumps and footing drains.

1. **Sump pumps** installed to receive and discharge groundwater or other stormwater shall be connected to the storm sewer. Sump pumps installed to receive and discharge basement floor drain or garage floor drain flow, or backed up sanitary sewage shall be connected to the sanitary sewers. A sump pump shall be used for one function only, either the discharge of stormwater or the discharge of sanitary sewage, each being connected to the respective receiving system only.

2. **Footing drains and perimeter drains** shall be connected to Manholes or Curb inlets, where possible, or to designated storm sewers or discharged into designated storm drainage channels/swales and not to the sanitary sewer.

3. All **roof downspouts**, roof drains, or roof drainage piping may be discharged onto the ground, and/or directly connected into the storm drainage system. No downspouts or roof drains shall be connected to the sanitary sewers.

4. **Garage and Basement floor drains and water softener discharge** shall be connected to the sanitary sewer, and may not be connected to any storm sewers.

5. **Swimming Pool drains** shall not be connected to the storm sewers unless the water is de-chlorinated. The City of Kokomo Pretreatment Coordinator shall be contacted for inspection prior to the release of de-chlorinated water into any storm sewer system.

Figure 300-10: Typical Values of Manning's "n"

Material	*Manning's "n"*	*Maximum Velocities (feet/second)*
˜ **Closed Conduits**		
Concrete	0.013	10
Vitrified Clay	0.013	10
HDPE	0.012	10
PVC	0.011	10
˜ **Circular CMP, Annular Corrugations, 2 2/3 x ½ inch**		
Unpaved	0.024	7
25% Paved	0.021	7
50% Paved	0.018	7
100% Paved	0.013	7
Concrete Culverts	0.013	10
HDPE or PVC	0.012	10
˜ **Open Channels**		
Concrete, Trowel Finish	0.013	10
Concrete, Broom Finish	0.015	10
Gunite	0.018	10
Riprap Placed	0.030	10
Riprap Dumped	0.035	10
Gabion	0.028	10
New Earth **(1)**	0.025	4
Existing Earth **(2)**	0.030	4
Dense Growth of Weeds	0.040	4
Dense Weeds and Brush	0.040	4
Swale with Grass	0.035	4

Source of manning "n" values: HERPICC Stormwater Drainage Manual, July 1995.
(1) New earth (uniform, sodded, clay soil)
(2) Existing earth (fairly uniform, with some weeds).

SECTION 305 INLETS & CATCH BASINS

305.01 Introduction

Inlets or drainage structures shall be utilized to collect surface water through grated openings and convey it to storm sewers, channels, or culverts. The inlet grate opening provided shall be adequate to pass the design 10-year flow with 50% of the sag inlet areas clogged. An overload channel from sag inlets to the overflow channel or basin shall be provided at sag inlets. Inlet design and spacing may be done using the hydraulic equations by manufacturers or orifice/weir equations. Use of the U.S. Army Corps of Engineers HEC-12 computer program is also an acceptable method. Gutter spread on continuous grades may be determined using the Manning's equation, or by using **Figure 300-11**.

Further guidance regarding gutter spread calculation may be found in the latest edition of HERPICC Stormwater Drainage Manual, available from the Local Technical Assistance Program (LTAP). At the time of printing of this document, contact information for LTAP was:

Indiana LTAP
Purdue University
Toll-Free: (800) 428-7369 (Indiana only)
Phone: (765) 494-2164
Fax: (765) 496-1176
Email: inltap@ecn.purdue.edu
Website: www.purdue.edu/INLTAP/

305.02 Curb Inlets & Catch Basins

Curb inlets and catch basins shall be placed at all low points, points of change to a flatter street grade, the dead end of descending streets, and at the Point of Curvature and Point of Tangency of all intersection radius curves where the street grade descends toward the radius curve and at all intersections. Under normal conditions, curb inlets shall be placed on both sides of the street at intervals indicated by the street grade. Approximate spacing ranges from 150 feet to 300 feet maximum under

Figure 300-11: Street and Gutter Capacities (continuous gutter).

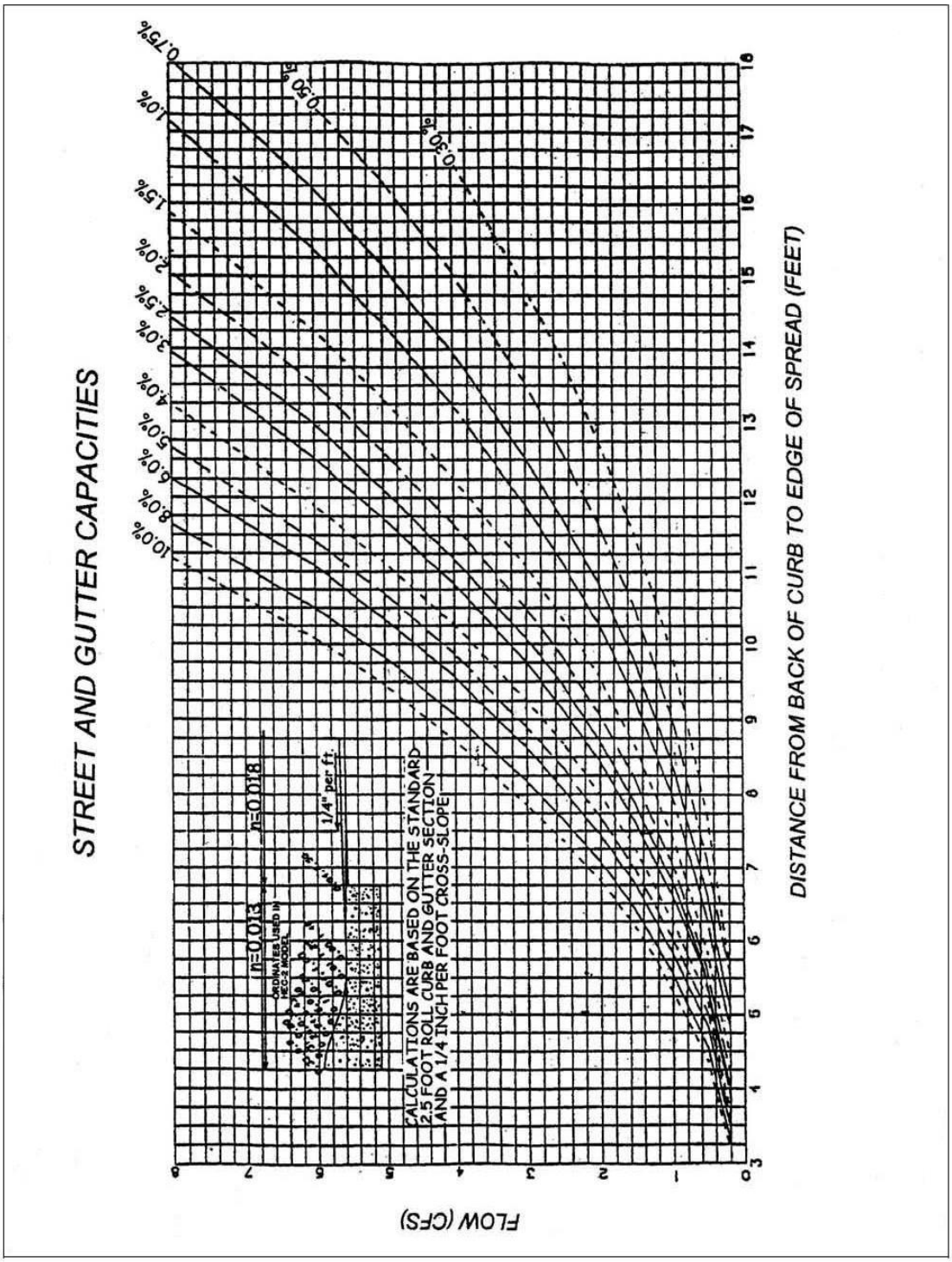


Figure 300-6: Street and Gutter Capacities (continuous gutter).

normal conditions for the spread of flow-in gutters. Curb inlets shall be placed on the property lines if at all possible.

The basis for the design and spacing of curb inlets shall conform to the Bureau of Road Hydraulic engineering Circular No. 12, ñDrainage of Highway Pavementsò.

Catch basins not placed in the street shall be selected and placed so that they blend with the surrounding and not appear unsightly. Catch basin types shall be consistent with the types shown in the standard drawings.

305.03 Manholes

Manholes shall be installed at the end of each line, at all changes in grade, size, alignment, and at all pipe intersections. Manholes shall be installed at distances not greater than 400 foot intervals. Intervals of more than 400 feet may be approved in sewers 42 inches and larger by the City Engineer. Manholes may be either poured in place or pre-cast concrete. Concrete construction shall conform to ASTM C-478.

The flow channel through manholes should be made to conform in shape, slope, and smoothness to that of the sewers. All manhole covers shall be adjusted to grade by the use of no more than 12 inches of pre-cast adjusting collars. Manholes shall be consistent with those shown in the standard drawings.

Manholes shall be constructed large enough to allow access to all sewers. The minimum diameter of manholes shall be 48 inches. Where large sewers require the use of manholes diameters greater than 48 inches, the manhole shall be returned to the 48-inch diameter as soon as practical above the sewer crown. Manhole openings of 24 inches or larger are recommended for easy access with safety equipment and to facilitate maintenance.

In addition to the above requirements, a minimum drop of 0.1 foot through manholes and inlet structures shall be provided. Pipe slope should not be so steep that inlets surcharge (i.e. hydraulic grade line should remain below rim elevation).

SECTION 306: CULVERTS/BRIDGES

306.01 Introduction

The basis of design for highway culverts shall be the Bureau of Roads Hydraulic Engineering Circular No. 5, ñHydraulic Charts for the Selection of Highway Culvertsò. Design shall be based on a 25-year storm for full

flow capacity and an overtopping capacity of at least a 100-year storm. Computer models such as Federal Highway Administrationôs HY-8 may be used to perform culvert/bridge design computations.

Culverts under roadways, involving backwater and/or road overflow during the 100-year design storm, shall be analyzed utilizing the methodologies set forth in Section 303.04 of this manual for determination of the depth of flow over the culvert/roadway during the peak discharge from the 100-year design storm event, backwater elevations, downstream flow velocities and resulting channel scour impacts.

The maximum allowable headwater depth for culverts shall be 2 feet below pavement surfaces and/or finish floor elevations.

SECTION 307: STORMWATER DETENTION

Detention storage should be provided to eliminate excessive runoff during heavy storm periods. Where impervious areas are planned or contemplated, it is the intent that detention be provided by the following provisions. It is proposed that well maintained landscaped areas would be provided to act jointly as detention reservoirs and recreation facilities as aesthetic focal points in new developments. Other acceptable control methods to regulate the rate of storm water discharge may include detention on parking lots, streets, lawns, underground storage, oversized storm sewers with restricted outlets, etc. However, these methods must be approved by the City Engineer.

Normal detention of storm water shall be required for all developments and proposed development which would alter storm runoff as to flow, velocity or time of concentration. Current detention standards require control of 10-year and 100-year storms. These basins are required to detain the 100-year peak post-developed runoff, and not exceed the release runoff rate of a 10-year storm under pre-developed condition. The City reserves the option to require more stringent detention requirements based upon the estimated capacity of the existing storm sewers, and/or outlet receiving waters.

307.01 Stormwater Detention Design

Design of storm water detention facilities shall be computed using the Rational Method and Manning Formula as determined in Section 304.02 of this document for areas less than 20 acres. The Runoff Coefficient C for various storm durations is given in **Figure 300-12** for each land use.

The percentage of impervious area is used to calculate the detention required. Generally 30% may be used for single-family residences, 50%

Figure 300-12: Runoff Coefficient for various storm durations.

Storm Duration t_d (hrs)	30% of Impervious Area	50% of Impervious Area	70% of Impervious Area	90% of Impervious Area
0.17	0.28	0.36	0.44	0.51
0.33	0.36	0.45	0.53	0.61
0.50	0.42	0.50	0.59	0.67
0.67	0.46	0.54	0.63	0.71
0.83	0.49	0.57	0.66	0.74
1.0	0.51	0.59	0.68	0.77
1.5	0.56	0.65	0.73	0.82
2.0	0.59	0.69	0.76	0.84
3.0	0.64	0.72	0.79	0.86

for multi-family residences, 70% for industrial sites, and 90% for commercial property.

Storage volume shall not be less than the storm runoff created by the post-developed site during a 100-year storm event. The storage volume may be computed by using **Figure 300-13**, ñComputation Worksheet for Detention Storage Using Rational Methodò. Special detention consideration may be given by the City Engineering Department for high impervious areas that are smaller than 2 acres. All calculations must be submitted to the City for approval. Calculations must include a profile of the existing storm sewer from the proposed connection point to a point 500 feet downstream or the first out-fall structure nearest to or beyond the required 500 feet. The calculated full flow capacity of the existing storm water out-fall shall also be provided.

Also, basins shall be constructed to provide adequate capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings.

307.02 Allowable Release Rates

The release rate from on-site detention shall not be greater than the storm runoff created by the pre-developed site during a ten-year frequency storm. The allowable outflow rate used in **Figure 300-13** ñComputation Worksheet for Detention Storage Using Rational Methodò is derived using a C coefficient of 0.2 and a rainfall intensity of 3.65 inches based on 10 years with a duration of 15 minutes multiplied by the site area. Consideration may be given for different intensity and coefficient based on the situation. If runoff from off-site areas flow through the detention basin, storage volume should be calculated using **Figure 300-13** for the

Figure 300-13: COMPUTATION WORKSHEET FOR DETENTION STORAGE (USING RATIONAL METHOD).

Project Information:

Project _____

Designer _____

Determination of Allowable Outflow Rate

Watershed Area (A) _____ acres

Allowable Outflow Rate (O) _____ cfs

Storm Duration t_d (hrs)	Runoff Coefficient C ___ % Impervious	Rainfall Intensity I (inches/hr)	Post Inflow Rate (100 year) I (t_d) (CiA) (cfs)	Pre Allowable Outflow Rate (10 year) O (.2) (3.65) (A) (cfs)	Storage Rate I(t_d)-O (cfs)	Required Storage [I(t_d)-O]t_d/12 (acre-ft)
0.17		6.97				
0.33		5.36				
0.50		4.28				
0.67		3.58				
0.83		3.05				
1.0		2.61				
1.5		2.01				
2.0		1.55				
3.0		1.16				

on-site area only. After the volume has been calculated, the allowable outflow rate should be calculated using the area of the entire area draining across the site.

Outlet size shall be determined by using the orifice equation as defined by:

$$\mathbf{Q = CA}\sqrt{2gH}$$

C = 0.6
A = Area in square feet
g = 32.2 ft./s^2
H = height from the center of the pipe to the top of the water surface

For sites where the pre-developed area has more than one (1) outlet, the release rate should be computed based on pre-developed discharge to each outlet point. The computed release rate for each outlet point shall not be exceeded at the respective outlet point even if the post developed conditions would involve a different arrangement of outlet points.

In the event the downstream receiving channel or storm sewer system is inadequate to accommodate the post-developed release rate provided above, then the allowable release rate may need to be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by City Engineer, may be required to store that portion of the runoff exceeding the capacity of the receiving sewers or waterways. When such downstream restrictions are suspected, the City Engineer may require additional analysis to determine the receiving systemôs limiting downstream capacity.

If a project site is within a Howard County regulated drainage easement, or outlets into a legal drain, the applicant will also need to abide by the Howard County Surveyorôs Office applicable detention and permit requirements, whether the site is located in an incorporated area or not.

307.03 General Detention Basin Recommendations

A. RECOMMENDATIONS COMMON TO EITHER DRY DETENTION BASINS OR RETENTION BASINS WITH PERMANENT WATER

1. A 20 foot-wide City easement shall be provided for access to all storm-water storage ponds.

2. All basins shall have an emergency overflow.

3. Any constructed dam and/or levee utilized as part of a basin design, shall be of properly compacted suitable soils, including an adequate clay core, with no gravel or foreign material which might cause improper settling or failure.

4. All excavated spoils should be spread so as to provide for aesthetic and recreational features such as sledding hills, sports fields, etc. Slopes of 6 horizontal to 1 vertical are recommended except where recreation uses call for steeper slopes. Even these features should have a slope no greater than 3 horizontal to 12 vertical for safety, minimal erosion, stability, and ease of maintenance.

5. When conduits are used for the outlet of the reservoir, they shall be protected by bar screens or other suitable provisions so that debris or similar trash will not interfere with the operation of the basin.

6. Safety screens should also be provided for any pipe or opening to prevent children or large animals from crawling into the structures. For safety, a suggested maximum opening is 6 inches.

7. Grass or other suitable vegetative cover should be maintained throughout the entire reservoir area. Grass should be cut regularly no less than five times a year.

8. Debris and trash removal and other necessary maintenance should be performed after each storm to assure continued operation in conformance to the design.

B. INSPECTION OF BASINS

1. Record drawings will be required for all basins to assure compliance with all applicable requirements.

2. The City may inspect all private detention basins and if problems exist, report these to the owner. The owner shall be given a reasonable amount of time to correct the problem, weather permitting.

3. The City shall perform such work as it deems necessary and charge owner if the owner fails to correct the problem.

C. DETENTION BASIN OWNERSHIP

1. Detention basin maintenance and ownership shall remain private unless the City accepts ownership through a variance from the Subdivision Regulations approved by City of Kokomo Common Council.

2. Owners will be responsible for routine maintenance of the development detention basin located on their lots. Grass mowing, ornamental landscaping, and fencing are considered routine maintenance. No activity which will interrupt the operation of the detention basin will be allowed.

No accessory buildings or gardens will be permitted. The City will be responsible for fixed structures such as piping, manholes, and inlets. This statement shall be added to each deed of transfer.

307.04 Recommendations for Dry Detention Basin Facilities

A. RECOMMENDATIONS FOR DRY DETENTION BASINS

1. Where water quality during dry weather periods in a small basin would be a potential problem due to lack of adequate dry weather flow, direct pollution from surface water runoff, or high nutrients in the flow; the basin should be designed to remain dry except when in flood use.

2. Dry detention basins shall be designed to minimize the wetness of the bottom so that water does not remain standing in the bottom; thereby harboring insects and limiting the potential use of the basin. This shall be accomplished by means of a concrete low flow channel between inlet and outlet structures and the surface above the under-drain shall be grass sod.

3. The detention basin should be designed to have a multi-purpose function. Recreational facilities, aesthetic qualities, etc., as well as flood water storage should be considered in planning the basin.

4. Side slopes shall be 3 to 1 or flatter.

5. There shall be a minimum of a 3-foot berm at 2 percent between right-of-way and top basin slopes.

307.05 Recommendations for Wet Basin Facilities

A. RECOMMENDATIONS FOR BASINS CONTAINING PERMANENT WATER

1. In order to provide better management for water quality, retention basins containing permanent lakes should have a water area of at least on-half acre. The lake area should be an average depth of 5 feet to inhibit weed and insect growth, and should have no extension shallow areas. A system to augment storm flows into the lake with water from other sources should be provided to enhance the water quality, if necessary. These systems would include the use of public water supplies or wells on site.

2. In excavated lakes, the underwater side slopes in the lake should be stable.

3. A safety ledge 4 to 6 feet in width is recommended and should be installed in all lakes approximately 18 to 24 inches below the permanent water level to provide a footing if people fall into the water. In addition, there shall be

a minimum of a 5-foot berm at 2 percent slope beginning at least 1 foot above normal pond elevation. The slope between two ledges should be stable and of a material which will prevent erosion due to wave action. Walkways consisting of a non-erosive material should be provided in areas where extensive population use tramples growth. One area in particular would be along the shoreline of a heavily fished lake. Side slopes above the berm shall be 3 to 1 or flatter.

4. Side slopes of the pool shall be 2 to 1 or flatter.

5. To obtain additional recreational benefits from developed water areas and provide for insect control, ponds may be stocked with fish. For best results, stocking should follow recommendations for warm water sport fishing by the Indiana Fishpond Management brochure available from the Indiana Department of Natural Resources, Division of Fish & Wildlife, or similar organizations.

6. Periodic maintenance will be required in lakes to control weed and larval growth. The basin should also be designed to provide for the easy removal of sediment which will accumulate in the lake during periods of basin operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather is also recommended. One suggested method is to have a water hydrant near the pond site.

7. No rubble or construction refuse shall be disposed of at any time into any portion of a basin.

8. No pond with a permanent water elevation shall be placed within one mile of a runway approach or landing approach to an airport.

307.06 Design of Detention Facility Emergency Spillways

An emergency overflow from the basin to a major storm system must be provided to protect the facility and adjacent properties. The designer should investigate the capacity of the downstream drainage facilities to determine if they will be adequate to handle the design flow from this particular development. If the downstream facilities are inadequate, it may be necessary to provide on-site retention or ponding basins to limit the flow to an amount which the downstream system can accept.

Emergency overflow facilities shall be designed to convey, without overtopping the detention facility banks, one and one-quarter (1.25) times the peak inflow discharge and peak flow velocity resulting from the 100-year design storm event runoff from the entire contributing watershed draining to the detention/retention facility, assuming post-development condition on-site and existing condition off-site.

The emergency overflow routing from the emergency overflow facility to an adequate receiving system must be positive (by gravity) and shown on the construction plans and on the secondary plat.

307.07 Parking Lot Storage

Paved parking lots may be designed to provide temporary detention storage of stormwater on all or a portion of their surfaces. Depths of storage shall be limited to a maximum depth of (12) inches. Ponding should in general, be confined to those positions of the parking lots farthest from the area served. Before such detention method is allowed, a perpetual maintenance agreement must be executed by the owner or the developer and filed with the City of Kokomo. In addition, the 100-year inundation boundary should be determined and clearly shown on the construction plans.

307.08 Detention Facilities in Floodplains

The placement of detention facilities within the floodplain of any watercourse, whether designated as such on FEMA maps or not, is highly discouraged. All floodplain boundaries must be clearly shown with any calculations or plans submitted to the City Engineer prior to approval.

SECTION 308 EASEMENTS

308.01 Introduction

Guidelines for minimum easement widths are provided below. More stringent requirements for stormwater easement size and additional covenants may be made by the City of Kokomo based upon individual size conditions.

Detention/retention basins shall be constructed within a common area either platted or legally described and recorded as a perpetual stormwater easement. A minimum of fifteen (15) feet horizontally from the top of bank of the facility shall be dedicated as permanent stormwater easement if the boundary of the above-noted common area does not extend that far.

Public street rights-of-ways will not be acceptable areas for construction of detention/retention facilities.

308.02 Easement Requirements

There shall be no trees or shrubs planted, nor any structures or fences erected, in any drainage easement, unless otherwise accepted by the City

of Kokomo.

1. All new channels, drain tiles equal to or greater than 12 inches in diameter, inlet and outlet structures of detention and retention ponds, and appurtenances thereto as required by this Article, that are installed in subdivisions requiring a stormwater management permit from the City of Kokomo MS4 entity shall be contained within a minimum 16 feet of drainage easement (8 feet from centerline on each side) and shown on the recorded plat. New drain tiles refer to all sub-surface stormwater piping, tubing, tiles, manholes, inlets, catch basins, risers, etc.

2. A minimum of 25 feet from top of the bank on each side of a new channel shall be designated on the recorded plat as a Drainage Easement. If the top of bank is not vegetated according the developmentôs landscape plan, a minimum 25-foot width of filter strip shall be installed within the drainage easement.

3. Rear-yard swales and emergency overflow paths associated with detention ponds shall be contained within a minimum of 20 feet width (10 feet from centerline on each side) of drainage easement.

4. A minimum of 15 feet beyond the actual footprint (top of the bank or the 100-year pond elevation if no top of bank is present) of stormwater detention facilities shall be designated as drainage easement. A minimum 20-foot width easement shall also be required as access easement from a public right-of-way to the facility, unless the pond is immediately next to a public right-of-way.

5. The statutory 75-foot (each side) drainage easement for regulated drains already within the Howard County legal drain system may be reduced if the drain is re-classified by the County Surveyor as an Urban Drain.

6. Any outlet to, crossing, and/or encroachment unto a Regulated Howard County Drain Easement requires permit application and acceptance from the Howard County Drainage Board.

SECTION 309: WATERCOURSE MAINTENANCE

309.01 Watercourse Improvement

Whenever a residential subdivision or commercial development constructs improvements upon lands, which is traversed by a watercourse, the landowner/developer, shall keep and maintain that part of the watercourse within the property.

In addition, the owner or lessee shall maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse.

These improvements shall consist of the following:

1. Clean all debris, trash, excessive vegetation, and other obstacles that would pollute, contaminate, or significantly retard the flow of water through the watercourse.

2. All stream bank erosion shall be repaired in an acceptable manner approved by the jurisdictional entity.

3. The above required improvements must be reflected on the overall design plans for the development and submitted to the City of Kokomo MS4 Operator, or said designee, for prior approval.

309.02 Watercourse Maintenance

Entities owning property through which a watercourse passes, or an Entityôs lessee, shall keep and maintain that part of the watercourse in accordance any applicable City of Kokomo jurisdictional codes. In addition, the Entity or lessee shall maintain existing privately owned structures within or adjacent to a watercourse, so that such structures will not become a hazard to the use, function, or physical integrity of the watercourse. The Entity or lessee shall not place or construct a privately owned structure(s) or other impairment within or adjacent to the watercourse that is an impairment or a detriment, or in such a location that is in violation of the City of Kokomo jurisdictional codes.

Regulated Drain Considerations

If the water course is a Howard County Regulated Drain, the applicant will also need to abide by the Howard County Surveyorôs Office applicable requirements, whether the site is located in an incorporated area or not.

CHAPTER 400: EROSION AND SEDIMENT CONTROL FOR CONSTRUCTION SITES

SECTION 401: INTRODUCTION

401.01 Purpose and Background

The requirements contained in this Chapter are intended to prevent stormwater pollution resulting from soil erosion and sedimentation or from mishandling of solid and hazardous waste. Practices and measures included herein should assure that no foreign substance, (e.g. sediment, construction debris, chemicals) be transported from a site and allowed to enter any drainage way, whether intentionally or accidentally, by machinery, wind, rain, runoff, or other means.

The major pollutant of concern during construction is sediment. Natural erosion processes are accelerated at a project site by the construction process for a number of reasons, including the loss of surface vegetation and compaction damage to the soil structure itself, resulting in reduced infiltration and increased surface runoff. Clearing and grading operations also expose subsoils which are often poorly suited to re-establish vegetation, leading to long term erosion problems.

Problems associated with construction site erosion include: transport of pollutants attached to displaced sediment; increased turbidity (reduced light) in receiving waters; and recreational use impairment. The deposited sediment may pose direct toxicity to wildlife, or smother existing spawning areas and habitat. This siltation also reduces the flow capacity of waterways, resulting in increased flood hazards to the public.

Other pollutants of concern during the construction process are hazardous wastes or hydrocarbons associated with the construction equipment or processes. Examples include concrete wash off, paints, solvents, and hydrocarbons from refueling operations. Poor control and handling of toxic construction materials pose an acute (short-term) or chronic (long-term) risk of death to aquatic life, wildlife, and the general public.

401.02 Abbreviations & Definitions

Construction activity: Means land disturbing activities, and land disturbing activities associated with the construction of infrastructure and structures. This term does not include routine ditch maintenance or minor landscaping projects.

Construction plan: A representation of a project site and all activities associated with the project. The plan includes the location of the project site, buildings and other infrastructure, grading activities, schedules for

implementation and other pertinent information related to the project site. A storm water pollution prevention plan is a part of the construction plan.

Construction site access: A stabilized stone surface at all points of ingress or egress to a project site, for the purpose of capturing and detaining sediment carried by tires of vehicles or other equipment entering or exiting the project site.

Contractor or subcontractor: Any individual or company hired by the project site or individual lot owner, their agent, or the individual lot operator to perform services on the project site.

COE: United States Army Corps of Engineers.

Developer: Any person financially responsible for construction activity; or an owner of property who sells or leases, or offers for sale or lease, any lots in a subdivision.

Erosion: The detachment and movement of soil, sediment, or rock fragments by water, wind, ice, or gravity.

Erosion and sediment control measure: A practice or a combination of practices, to control erosion and resulting sedimentation.

Erosion and sediment control system: means the use of appropriate erosion and sediment control measures to minimize sedimentation by first reducing or eliminating erosion at the source and then as necessary, trapping sediment to prevent it from being discharged from or within a project site.

Final stabilization: The establishment of permanent vegetative cover or the application of a permanent non-erosive material to areas where all land disturbing activities have been completed and no additional land disturbing activities are planned under the current permit.

Grading: The cutting and filling of the land surface to a desired slope or elevation.

IDEM: Indiana Department of Environmental Management.

IDNR: Indiana Department of Natural Resources.

INDOT: Indiana Department of Transportation.

Impervious surface: Surfaces, such as pavement and rooftops, which prevent the infiltration of storm water into the soil.

Individual building lot: A single parcel of land within a multi-parcel development.

Individual lot operator: A contractor, subcontractor, or lot owner working on an individual lot.

Individual lot owner: A person who has financial control of construction activities for an individual lot.

Land disturbing activity: Any manmade change of the land surface, including removing vegetative cover that exposes the underlying soil, excavating, filling, transporting, and grading.

Larger common plan of development or sale: A plan, undertaken by a single project site owner or a group of project site owners acting in concert, to offer lots for sale or lease; where such land is contiguous, or is known, designated, purchased or advertised as a common unit or by a common name, such land shall be presumed as being offered for sale or lease as part of a larger common plan. The term also includes phased or other construction activity by a single entity for its own use.

Measurable storm event: A precipitation event that results in a total measured precipitation accumulation equal to, or greater than, one-half (0.5) inch of rainfall.

MS4 area: A land area comprising one (1) or more places that receives coverage under one (1) NPDES storm water permit regulated by 327 IAC 15-13 or 327 IAC 5-4-6(a)(3) and 327 IAC 5-4-6(a)(4).

MS4 Operator: The person responsible for development, implementation, or enforcement of the minimum control measures for a designated MS4 area regulated under 327 IAC 15-13.

Municipal separate storm sewer system: Also called ñMS4ò, has the same meaning set forth at 327 IAC 15-13-5(42).

NRCS: USDA-Natural Resources Conservation Service.

Peak discharge: The maximum rate of flow during a storm, usually in reference to a specific design storm event.

Permanent stabilization: The establishment, at a uniform density of seventy percent (70%) across the disturbed area, of vegetative cover or permanent non-erosive material that will ensure the resistance of the soil to erosion, sliding, or other movement.

Phasing of construction: The sequential development of smaller portions

of a large project site, stabilizing each portion before beginning land disturbance on subsequent portions, to minimize exposure of disturbed land to erosion.

Project site: The entire area on which construction activity is to be performed.

Project site owner: The person required to comply with the terms of this chapter, including either a developer, or the person who has financial and operational control of construction activities, and project plans and specifications, including the ability to make modifications to those plans and specifications.

Sediment: Any solid material (both mineral and organic) that is in suspension, is being transported, or has been moved from its site of origin by air, water, gravity, or ice and has come to rest on the earthôs surface.

Sedimentation: The settling and accumulation of unconsolidated sediment carried by storm water run-off.

Soil: The unconsolidated mineral and organic material on the surface of the earth that serves as the natural medium for the growth of plants.

Soil and Water Conservation District: Also called ñSWCDò, means a political subdivision established under IC 14-32.

Stormwater pollution prevention plan: The (SWPPP) is a plan developed to minimize the impact of storm water pollutants resulting from construction activities.

Stormwater quality measure: Any practice, or a combination of practices, to control or minimize pollutants associated with storm water run-off.

Strip development: A multi-lot project where building lots front on an existing road.

Subdivision: Any land that is divided or proposed to be divided into lots, whether contiguous or subject to zoning requirements, for the purpose of sale or lease as part of a larger common plan of development or sale.

Temporary stabilization: The covering of soil to ensure its resistance to erosion, sliding, or other movement. The term includes vegetative cover, anchored mulch, or other non-erosive material applied at a uniform density of seventy percent (70%) across the disturbed area.

Tracking: The deposition of soil that is transported from one (1) location to another by tires, tracks of vehicles, or other equipment.

Trained individual: An individual who is trained and experienced in the principles of storm water quality, including erosion and sediment control.

USDA: United States Department of Agriculture.

SECTION 402: POLICY AND PROCEDURES

402.01 Applicability

The City of Kokomo MS4 will require a Stormwater Pollution Prevention Plan (SWPPP), which includes erosion and sediment control measures and materials handling procedures, to be submitted as part of the construction plans and specifications. Any project located within the City of Kokomo MS4 which conducts clearing, grading, excavation, and other land disturbing activities resulting in the disturbance of 1 acre or more of total land area is subject to the requirements of this Chapter. This includes both new development and re-development. This chapter also applies to disturbances of less than one 1 acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one (1) or more acres of land. Projects meeting the coverage requirements of 327 IAC 15-5 (Rule 5) shall also be in compliance with 327 IAC 15-5.

For an individual lot where land disturbance is expected to be one (1) acre or more, the individual lot owner must complete their own notice of intent letter, apply for a stormwater permit from City of Kokomo MS4, and ensure that a sufficient construction and stormwater pollution prevention plan is completed and submitted in accordance with Chapter 100; regardless of whether the individual lot is part of a larger permitted project site.

An individual lot with land disturbance less than one (1) acre, located within a larger permitted project site, is considered part of the larger permitted project site, and the individual lot operator must comply with the terms and conditions of the stormwater permit approved for the larger project site. The stormwater permit application for the larger project site must include typical detailed erosion and sediment control measures for individual lots. In addition, these individual lots are required to submit Individual Lot Plot Plan Permit applications prior to receiving a building permit. Details of the permitting process are contained in Chapter 100.

It will be the responsibility of the project site owner to complete a stormwater permit application, and ensure that a sufficient construction plan is completed and submitted in accordance with Chapter 100. It will further be the responsibility of the project site owner to ensure compliance

during the construction activity and implementation of the construction plan, and to notify City of Kokomo MS4 with a sufficient notice of termination letter upon completion of the project and stabilization of the site. All persons engaging in construction and land disturbing activities on a permitted project site must comply with the requirements of this manual and the all applicable ordinances.

402.02 Exemptions

The requirements under this Chapter do not apply to the following activities:

a. agricultural farming activities; or
b. forest harvesting activities.

The requirements under this Chapter do not apply to the following activities, provided other applicable State permits contain provisions requiring immediate implementation of soil erosion control measures:

a. Landfills that have been issued a certification of closure under 329 IAC 10.

b. Coal mining activities permitted under IC 14-34.

c. Municipal solid waste landfills that are accepting waste pursuant to a permit issued by the Indiana Department of Environmental Management under 329 IAC 10 that contains equivalent stormwater requirements, including the expansion of landfill boundaries and construction of new cells either within or outside the original solid waste permit boundary.

402.03 Policy on Stormwater Pollution Prevention

Effective stormwater pollution prevention on construction sites is dependent on a combination of preventing movement of soil from its original position (erosion control), intercepting displaced soil prior to entering a water body (sediment control), and proper on-site materials handling. The developer must submit to the jurisdictional entity a SWPPP with detailed erosion and sediment control plans as well as a narrative describing materials handling and storage, and construction sequencing. The following principles apply to all land-disturbing activities and should be considered in the preparation of a Stormwater Pollution Prevention Plan within City of Kokomo MS4.

A. Minimize the potential for soil erosion by designing a development that fits the topography and soils of the site.

Deep cuts and fills in areas with steep slopes should be avoided wherever possible, and natural contours should be followed as closely as possible.

B. Existing natural vegetation should be retained and protected wherever possible. Areas immediately adjacent (within 35 feet of top of bank) to watercourses and lakes also should be left undisturbed wherever possible. Unvegetated or vegetated areas with less than 70% cover that are scheduled or likely to be left inactive for 15 days or more must be temporarily or permanently stabilized with measures appropriate for the season to reduce erosion potential. Alternative measures to site stabilization may be acceptable if the project site owner or their representative can demonstrate they have implemented and maintained erosion and sediment control measures adequate to prevent sediment discharge from the inactive area.

C. All activities on a site should be conducted in a logical sequence so that the smallest practical area of land will be exposed for the shortest practical period of time during development.

D. The length and steepness of designed slopes should be minimized to reduce erosion potential. Drainage channels and swales must be designed and adequately protected so that their final gradients and resultant velocities will not cause erosion in the receiving channel or at the outlet (See Section 303.07).

E. Sediment-laden water which otherwise would flow from the project site shall be treated by erosion and sediment control measures appropriate to minimize sedimentation. A stable construction site access shall be provided at all points of construction traffic ingress and egress to the project site.

F. Appropriate measures shall be implemented to prevent wastes or unused building materials, including, garbage, debris, packaging material, fuels and petroleum products, hazardous materials or wastes, cleaning wastes, wastewater, concrete truck washout, and other substances from being carried from a project site by runoff or wind. Identification of areas where concrete truck washout is permissible must be clearly posted at appropriate areas of the site. Wastes and unused building materials shall be managed and disposed of in accordance with all applicable State statutes and regulations. Proper storage and handling of materials such as fuels or hazardous wastes, and spill prevention and cleanup

measures (including having spill response equipment on-site) shall be implemented to minimize the potential for pollutants to contaminate surface or ground water or degrade soil quality.

G. Public or private roadways shall be kept cleared of accumulated sediment that is a result of runoff or tracking. Bulk clearing of accumulated sediment shall not include flushing the area with water. Cleared sediment shall be redistributed or disposed of in a manner that is in accordance with all applicable statutes and regulations.

H. Collected runoff leaving a project site must be either discharged directly into a well-defined, stable receiving channel, or diffused and released to adjacent property without causing an erosion or pollutant problem to the adjacent property owner.

I. Natural features, including wetlands, shall be protected from pollutants associated with stormwater runoff.

402.03 Calculating Total Area of Land Disturbance

In calculating the total area of land disturbance, for the purposes of determining applicability of this Chapter to the project, the following guidelines should be used:

A. Off-site construction activities that provide services (for example, road extensions, sewer, water, other utilities, etc.) to a land disturbing project site, must be considered as a part of the total land disturbance calculation for the project site.

B. Strip developments will be considered as one (1) project site and must comply with this Chapter unless the total combined disturbance on all individual lots is less than one (1) acre and is not part of a larger common plan of development or sale.

C. To determine if multi-lot project sites are regulated under the City of Kokomo Ms4, the area of land disturbance shall be calculated by adding the total area of land disturbance for improvements, such as, roads, utilities, or common areas, and the expected total disturbance on each individual lot, as determined by the following:

i. For a single-family residential project site where the lots are one-half (0.5) acre or more, one-half (0.5) acre of land disturbance must be used as the expected

lot disturbance.

ii. For a single-family residential project site where the lots are less than one half (0.5) acre in size, the total lot must be calculated as being disturbed.

iii. To calculate lot disturbance on all other types of projects sites, such as industrial and commercial projects project sites, a minimum of one (1) acre of land disturbance must be used as the expected lot disturbance, unless the lots are less than one (1) acre in size, in which case the total lot must be calculated as being disturbed.

402.04 Common Erosion and Sediment Control Practices

All erosion control and stormwater pollution prevention measures required to comply with the jurisdictional entityôs Ordinance shall meet the design criteria, standards, and specifications similar to or the same as those outlined in the latest editions of the ñ*Indiana Drainage Handbook*ò and ñ*Indiana Handbook for Erosion Control in Developing Areas*ò, both published by the Indiana Department of Natural Resources, or other comparable and reputable references. **Figure 400-1** lists some of the more common and effective practices for preventing stormwater pollution from construction sites. Details of each practice can be found in the *Indiana Storm Water Quality Manual.* These practices should be used to protect every potential pollution pathway to stormwater conveyances. Details for additional construction BMPôs not shown in the *Indiana Storm Water Quality Manual* are shown in **Appendix-2**.

402.05 Individual Lot Controls

From the time construction on an individual lot begins, until the individual lot is stabilized, the builder must take steps to:

Åprotect adjacent properties from sedimentation
Åprevent mud/sediment from depositing on the street
Åprotect drainage ways from erosion and sedimentation
Åprevent sediment laden water from entering storm sewer inlets.

A standard erosion control plan for individual lots is provided as **Figure 400-2**. The standard plan includes perimeter silt fence, stabilized construction entrance, curb inlet protection, drop inlet protection, stockpile containment, stabilized drainage swales, downspout extensions, temporary seeding and mulching, and permanent vegetation. Every relevant measure

shall be installed at each individual lot site.

Practice No.	BMP Description	Applicability	Fact Sheet
1	Site Assessment	All Sites.	ISWQM (Ch. 2)
2	Development of a Construction Sequence	All Sites.	ISWQM (Ch. 5)
3	Tree Preservation & Protection	As needed on applicable sites.	ISWQM (Ch. 5)
4	Temporary Construction Entrance	All Sites.	ISWQM (Ch. 7
5	Wheel Wash	May be utilized on problem sites where heavy tracking is anticipated.	CN-101
6	Silt Fence	Used on bare areas when soil temperatures are too low for germination, or when soils are in a freeze-thaw stage.	ISWQM (Ch. 7
7	Surface Roughening	Used to stabilize slopes prior to planting vegetation.	ISWQM (Ch. 7
8	Temporary Seeding	Areas of bare soil where additional work is not planned to be performed for a minimum of 15 days.	ISWQM (Ch. 7
9	Mulching	Temporary surface stabilization.	ISWQM (Ch. 7
10	Erosion Control Blankets	Temporary surface stabilization, anchor for mulch	ISWQM (Ch. 7
11	Temporary Diversion	Up-slope and down-slope sides of a construction site, above disturbed slopes within site.	ISWQM (Ch. 7
12	Rock Check Dam	1 acre maximum contributing drainage area	ISWQM (Ch. 7
13	Temporary Slope Drain	Sites with cut or fill slopes.	ISWQM (Ch. 7
14	Straw Bale Check Dam	Small drainage areas.	ISWQM (Ch. 7
15	Geotextile Drop Inlet Protection	1 acre maximum contributing drainage area.	ISWQM (Ch. 7
16	Insert (Basket) Curb Inlet Protection	1 acre maximum contributing drainage area.	ISWQM (Ch. 7
17	Stone Bag Curb Inlet Protection	1 acre maximum contributing drainage area.	ISWQM (Ch. 7
18	Temporary Sediment Trap	5 acre maximum contributing drainage area.	ISWQM (Ch. 7
19	Temporary Dry Sediment Basin	30 acre maximum contributing drainage area.	ISWQM (Ch. 7
20	Dewatering Structures	Sites that require dewatering.	CN-102
21	Dust Control	All Sites.	ISWQM (Ch. 7)
22	Spill Prevention	All Sites.	CN-103
23	Solid Waste Management	All Sites.	CN-104
24	Hazardous Waste Management	All Sites.	CN-105

Figure 400-1: Common Stormwater Pollution Control Practices for Construction Sites.
*See Indiana Storm Water Quality Manual, 2007, or later (http://www.in.gov/idem/stormwater).

The Construction sequence on individual lots should be as follows:

1. Clearly delineate areas of trees, shrubs, and vegetation that are to be undisturbed. To prevent root damage, the areas delineated for tree protection should be at least the same diameter as the crown.

2. Install perimeter silt fence at construction limits. Position the fence to intercept runoff prior to entering drainage swales.

3. Avoid disturbing drainage swales if vegetation is established. If drainage swales are bare, install erosion control blankets or sod to immediately stabilize.

4. Install drop inlet protection for all inlets on the property.

5. Install curb inlet protection, on both sides of the road, for all inlets along the property frontage and along the frontage of adjacent lots, or install temporary catch basin inserts in each inlet and frequently clean.

6. Install gravel construction entrance that extends from the street to the building pad. [discuss type of material and thickness].

7. Perform primary grading operations.

8. Contain erosion from any soil stockpiles created on-site with silt fence around the base.

9. Establish temporary seeding and straw mulch on disturbed areas.

10. Construct the home and install utilities.

11. Install downspout extenders once the roof and gutters have been constructed. Extenders should outlet to a stabilized area.

12. Re-seed any areas disturbed by construction and utilities installation with temporary seed mix within 15 days of completion of disturbance.

13. Grade the site to final elevations. Add topsoil as needed to minimize erosion and quickly establish grass.

14. Install permanent seeding or sod.

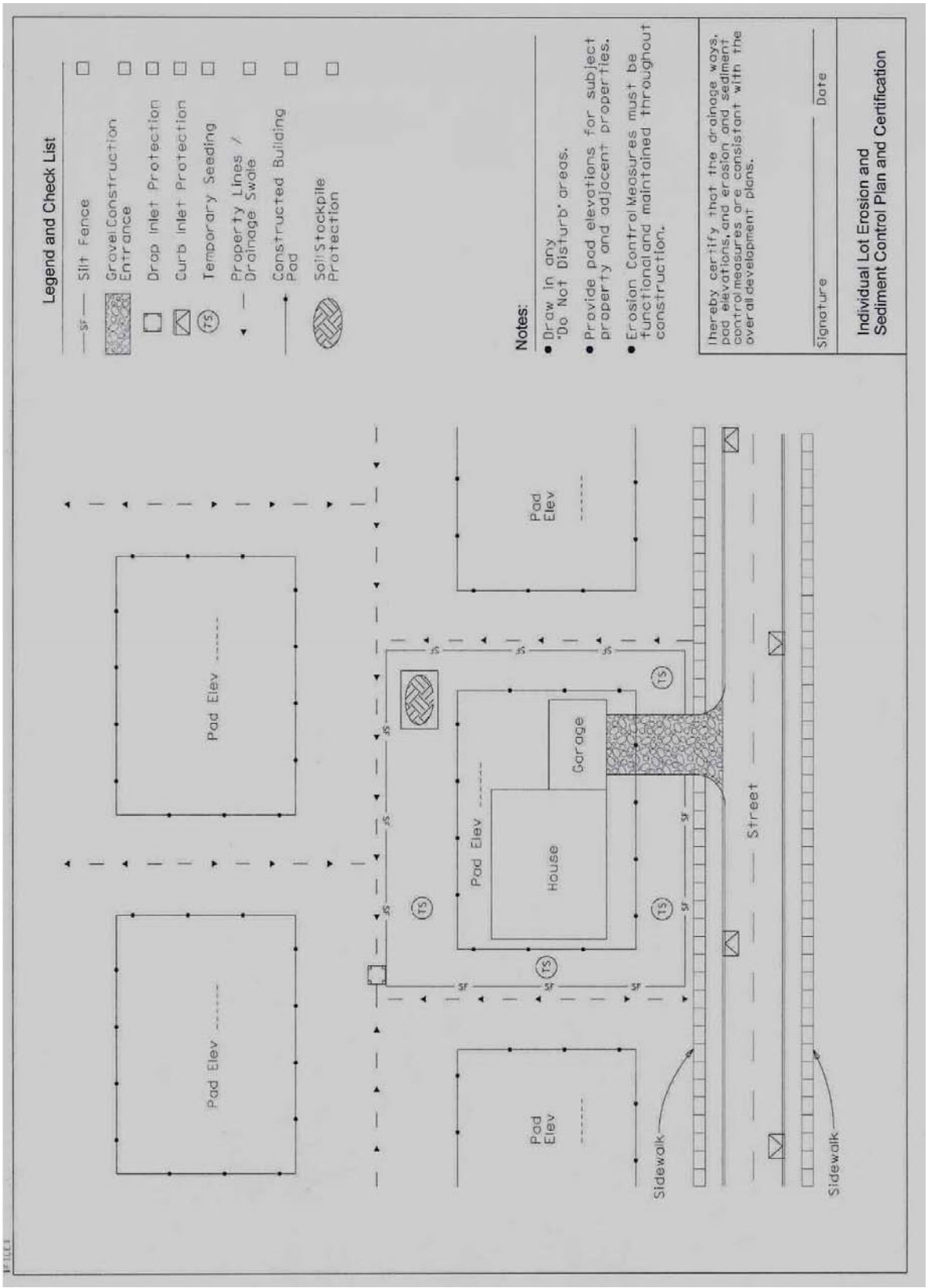


Figure 400-2: Individual Lot Typical Erosion & Sediment Control Plan and Certification

All erosion and sediment control measures must be properly maintained throughout construction. Temporary and permanent seeding should be watered as needed until established. For further information on individual lot erosion and sediment control, please see the ñ*Individual Lot Erosion and Sediment Control Plan and Certification*ò form in **Figure 400-2** or the pamphlet titled ñ*Erosion and Sediment Control for Individual Building Sites*ò.

402.06 Inspection, Maintenance, Record Keeping, and Reporting

Following approval of the stormwater permit and commencement of construction activities, the City of Kokomo Ms4 has the authority to conduct inspections of the site to ensure full compliance with the provisions of this Chapter, the *Indiana Handbook for Erosion Control in Developing Areas,* and the terms and conditions of the approved permit.

A self-monitoring program must be implemented by the project site owner to ensure the stormwater pollution prevention plan is working effectively. A trained individual, shall perform a written evaluation of the project site by the end of the next business day following each measurable storm event. If there are no measurable storm events within a given week, the site should be monitored at least once in that week. Weekly inspections by the trained individual shall continue until the entire site has been stabilized and a ñverifiedò copy of the Notice of Termination has been issued.

The trained individual should look at the maintenance of existing stormwater pollution prevention measures, including erosion and sediment control measures, drainage structures, and construction materials storage/containment facilities, to ensure they are functioning properly. All maintenance and repairs shall be conducted in accordance with the accepted site plans.

The trained individual should also identify additional measures, beyond those originally identified in the stormwater pollution prevention plan, necessary to remain in compliance with all applicable statutes and regulations. A standard form to record the self-monitoring/inspection results is provided in **Appendix- 4**.

The resulting evaluation reports must include the name of the individual performing the evaluation, the date of the evaluation, problems identified at the project site, and details of maintenance, additional measures, and corrective actions recommended and completed.

The stormwater pollution prevention plan shall serve as a guideline for stormwater quality, but should not be interpreted to be the only basis for

implementation of stormwater quality measures for a project site. The project site owner is responsible for implementing, in accordance with this Chapter, all measures necessary to adequately prevent polluted stormwater runoff. Recommendations by the trained individual for modified stormwater quality measures should be implemented.

Although self-monitoring reports do not need to be submitted to the MS4 Operator, the MS4 Operator (or designee) has the right to request complete records of maintenance and monitoring activities involving stormwater pollution prevention measures. All evaluation reports for the project site must be made available to the MS4 Operator, or said designee, in an organized fashion, within forty-eight (48) hours upon request.

CHAPTER 500 POST-CONSTRUCTION STORMWATER QUALITY MANAGEMENT

SECTION 501: INTRODUCTION

501.01 Purpose and Background

It is recognized that developed areas, as compared to undeveloped areas, generally have increased imperviousness, decreased infiltration rates, increased runoff rates, and increased concentrations of pollutants such as fertilizers, herbicides, greases, oil, salts and other pollutants.

The City of Kokomo MS4 has adopted a policy to control stormwater quality, based on the management of Total Suspended Solids (TSS). Through the use of Best Management Practices (BMP), stormwater runoff will be filtered and harmful amounts of sediment, nutrients, and contaminants will be removed prior to reaching regional creeks, streams, and rivers.

This chapter establishes minimum standards and performance criteria for the selection and design of post construction water quality BMPs. These post-construction BMPôs are incorporated as a permanent feature into the site plan, and continue to treat stormwater runoff from the stabilized site following completion of construction activities. A set of standard detail drawings will be included in **Appendix- 3** that provides guidance on the design and installation of various hydraulic structures that may not have been covered in this chapter. Adherence to the noted standard details shall be required in addition to other requirements in this chapter. In case of discrepancy, the most restrictive requirement shall apply.

It will be the responsibility of the project site owner to ensure proper design, construction, and installation of all stormwater BMPs in

compliance with this manual and with the approved stormwater management permit, and to notify the jurisdictional entity with a Notice of Termination letter upon completion of the project and stabilization of the site. However, all eventual property owners of stormwater quality facilities meeting the applicability requirements must comply with the requirements of this Chapter.

501.02 Abbreviations & Definitions

BMP: Best management practices can refer to structural measures (wetlands, ponds, sand filters, etc.) or non-structural measures (restrictive zoning, reduced impervious areas, etc.). BMPs are designed for the benefit of water quality and quantity. For the purposes of this chapter, BMPs refer to structural water quality BMPs.

BMP Owner: The owner of the BMP, typically the property owner. The BMP owner may also be the leasee of property in the case of long term leases of commercial or industrial zoned properties. The leasee is considered the BMP owner only if the lease specifically states that construction by the leasee must meet applicable local codes and regulations.

BOD: Biochemical oxygen demand.

Contributing Drainage Area: Contributing drainage area refers to the total drainage area coming into a given point, including offsite drainage.

Effective Drainage Area: Effective drainage area refers to the drainage area from a specific site, excluding offsite drainage, where offsite drainage either does not exist or where offsite drainage bypasses the site through culverts or other means.

Impervious Area: Impervious areas are those where the land surface has been altered to decrease the amount of rainwater infiltration. Impervious surfaces include paved roads, concrete driveways and rooftops.

Offline Structure: Offline structures are BMPs that treat only the water quality volume (WQv). Flows exceeding the WQv bypass the structure and re-enter the watercourse below the BMP.

Redevelopment: Redevelopment means any construction, alteration, or improvement where structures are removed and/or replaced.

Stormwater Quality Management: A system of vegetative, structural, and other measures that reduce or eliminate pollutants that might otherwise be carried by surface runoff.

Total P: Total phosphorus

Total N: Total nitrogen.

TSS: Total suspended solids.

Treatment train: A treatment train consists of more than one BMP in series treating stormwater runoff. Such configurations are necessary when BMPs individually cannot meet the TSS reduction goal.

Watershed: Watershed refers to the total drainage area contributing runoff to a single point.

501.03 Applicability and Exemptions

Any project located within the jurisdictional entity and includes clearing, grading, excavation, and other land disturbing activities resulting in the disturbance of 1 acre or more of total land area is subject to the requirements of this Chapter. This includes both new development and re-development, and disturbances of less than one (1) acre of land that are part of a larger common plan of development or sale if the larger common plan will ultimately disturb one (1) or more acres of land, within the area under the jurisdictional authority of the jurisdictional entity.

The requirements under this chapter do not apply to the following activities:

A. agricultural land disturbing activities; or
B. timber harvesting activities; or
C. construction activities associated with a single family residential dwelling disturbing less than 5 acres, when the dwelling is not part of a larger common plan of development or sale; or
D. single family residential developments consisting of four or less lots; or
E. a single-family residential strip development where the developer offers for sale or lease without land improvements and the project is not part of a larger common plan of development of sale; or
F. individual building lots within a larger permitted project.

The requirements under this chapter do not apply to the following activities, provided other applicable State permits contain provisions requiring immediate implementation of soil erosion control measures:

A. Landfills that have been issued a certification of closure under 329 IAC 10.

B. Coal mining activities permitted under IC 14-34.
C. Municipal solid waste landfills that are accepting waste pursuant to a permit issued by the Indiana Department of Environmental Management under 329 IAC 10 that contains equivalent stormwater requirements, including the expansion of landfill boundaries and construction of new cells either within or outside the original solid waste permit boundary.

SECTION 502: POST CONSTRUCTION PLAN REQUIREMENTS

502.01 Plan Requirements

In addition to the requirements of Chapter 400, the Storm Water Pollution Prevention Plan (SWPPP) must include post-construction stormwater quality measures, and ensure that the plan is completed and submitted in accordance with Chapter 100. Prior to design, applicants are required to consult with the MS4 Operator to determine if they are subject to additional stormwater design requirements (See Section 102.11).

The plan must show the placement of appropriate BMP(s) from a pre-approved list of BMPs specified in this chapter, which control the peak flow rates of stormwater discharge associated with specified design storms and reduce the generation of stormwater. The noted BMPs must be designed, constructed, and maintained according to guidelines provided or referenced in this chapter. Practices other than those specified in the pre-approved list may be utilized. However, the burden of proof as to whether the performance (**minimum required n 80% TSS removal rate**) and ease of maintenance of such practices will be according to guidelines provided in this chapter, would be placed with the applicant. Details regarding the procedures and criteria for consideration of acceptance of such BMPs are provided in section 504.02.

The plans should seek to utilize pervious and landscaped areas for treatment and infiltration of stormwater runoff from driveways, sidewalks, rooftops, and parking lots. Natural topography and land cover features such as natural swales, natural depressions, native soil infiltrating capacity, and natural groundwater recharge areas shall be preserved and used, to the extent possible, to meet the requirements of this section.

Installing certain BMPs, such as bioretention areas and sand filters, prior to stabilization can cause failure of the measure due to clogging from sediment. If such BMPs are installed prior to site stabilization, they should be protected by traditional erosion control measures. Conversely, detention ponds and other BMPs can be installed during construction and used as sediment control measures. In those instances, the construction sequence must require that the pond is cleaned out with pertinent

elevations and storage and treatment capacities reestablished as noted in the accepted stormwater management plan.

SECTION 503: DESIGN

503.01 Design Criteria

Selection of a BMP, or series of BMPôs, shall be designed to treat the first one inch (1ò) of rainfall, and meet a minimum performance criteria of eighty percent (80%) removal of the Total Suspended Solids (TSS).

The developer shall also submit detailed computations of runoff before and after development, redevelopment or new construction which demonstrate that runoff will not be increased to the extent that the peak runoff after development, redevelopment, or new construction for the 100-year return period storm of critical duration does not exceed the runoff before development, redevelopment, or new construction for the 10-year return period storm (Q100 post to Q10 preï critical duration storm). The critical duration storm is that storm duration which requires the greatest storm water storage.

503.02 Sizing Post Construction Best Management Practices

The calculation methods as well as the type, sizing, and placement of all stormwater quality management measures, or BMPs shall meet the design criteria, standards, and specifications outlined in the *Indiana Stormwater Quality Manual* or this chapter. The methods and procedures included in these two references are in keeping with the above stated policy and meet the requirements of IDEMôs Rule 13.

Structural Water Quality BMPs are divided into two major classifications: detention BMPs and Flow-through BMPs. Detention BMPs impound (pond) the runoff to be treated, while flow through BMPs treat the runoff through some form of filtration process. Post-Construction BMPs must be sized to treat the water quality volume, WQv, for detention-based BMPs or the water quality discharge, Qwq, for flow-through BMPs. The following provides the methodology for calculating the WQv and Qwq values:

A). DETENTION BMP SIZING

Water Quality Detention BMPs must be designed to store the water quality volume for treatment. The water quality volume, WQv, is the storage needed to capture and treat the runoff from the first one inch of rainfall. The water quality volume is equivalent to one inch of rainfall

multiplied by the volumetric runoff coefficient (Rv) multiplied by the site area, or:

$$\mathbf{WQv = \frac{(P)\,(Rv)\,(A)}{12}}$$

where:

WQv = water quality volume (acre-feet)
P = 1 inch of rainfall
Rv = volumetric runoff coefficient
A = area in acres

The volumetric runoff coefficient is a measure of imperviousness for the contributing area, and is calculated as:

$$\mathbf{Rv = 0.05 + 0.009(I)}$$

Where:
I is the percent impervious cover

For example, a proposed commercial site will be designed to drain to three different outlets, with the following drainage areas and impervious percentages:

Subarea ID	On-site Contributing Area (acres)	Impervious Area %	Off-Site Contributing Area (acres)
A	7.5	80	0.0
B	4.3	75	0.0
C	6.0	77	0.0

Calculating the volumetric runoff coefficient for subareas A, B, and C yields:

Rv (subarea A) = 0.05+0.009(80)=0.77
Rv (subarea B) = 0.05+0.009(75)=0.73
Rv (subarea C) = 0.05+0.009(77)=0.74

The water quality volumes for these three areas are then calculated as:

WQv (subarea A) = (1ò)(Rv)(A)/12=0.77(7.5)/12=0.48 acre-feet
WQv (subarea B) = 0.73(4.3)/12=0.26 acre-feet
WQv (subarea C) = 0.74(6.0)/12=0.37 acre-feet

Note that this example assumed no offsite sources of discharge through the water quality detention BMPs. If there were significant sources of off-site runoff (sometimes called runon for upstream areas draining to the site), the designer would have the option of diverting off-site runoff around the on-site systems, or the detention BMP

should be sized to treat the water quality volume for the entire contributing area, including off-site sources.

B). FLOW THROUGH BMP SIZING

Flow through BMPs are designed to treat runoff at a peak design flow rate through the system. Examples of flow through BMPs include catch basin inserts, sand filters, and grassed channels. Another flow through BMP which is gaining popularity is a dynamic separator. Dynamic separators are proprietary, and usually include an oil-water separation component.

The following procedure should be used to estimate peak discharges for flow through BMPs (adopted from Maryland, 2000). It relies on the volume of runoff computed using the Small Storm Hydrology Method (Pitt, 1994) and utilizes the NRCS, TR-55 Method.

Using the WQv methodology, a corresponding Curve Number

(CNwq) is computed utilizing the following equation:

$$CNwq = \left[\frac{1000}{10 + 5P + 10Qa - 10\sqrt{Qa^2 + 1.25QaP}}\right]$$

where:

CNwq = curve number for water quality storm event
***P* = 1" (rainfall for water quality storm event)**
***Qa* = runoff volume, in inches = 1"×Rv = Rv (inches)**
Rv = volumetric runoff coefficient (see previous section)

Due to the complexity of the above equation, the water quality curve number is represented as a function of percent imperviousness in **Figure 500-1.**

The water quality curve number, CNwq, is then used in conjunction with the standard calculated time-of-concentration, tc, and drainage area as the basis input for TR-55 calculations. Using the SCS Type II distribution for 1 inch of rainfall in 24-hours, the water quality treatment rate, Qwq, can then be calculated.

SECTION 504: BEST MANAGEMENT PRACTICES

504.01 Pre-Approved Best Management Practices

The City of Kokomo MS4 has designated a number of pre-approved BMP methods to be used alone or in combination to achieve the TSS removal stormwater quality goals according to the jurisdictional entityôs Ordinance. These BMP measures are listed along with their anticipated average TSS removal rates in **Figure 500-2**. Pre-approved BMPs have been proven/are assumed to achieve the average TSS removal rates indicated in **Figure 500-2**. Applicants desiring to use a different TSS removal rate for these BMPs must follow the requirements discussed above for Innovative BMPs. Details regarding the applicability and design of these pre-approved BMPs are contained within fact sheets presented in **Appendix- 3**.

Note that a single BMP measure may not be adequate to achieve the water average TSS removal rates on a given project. It is for this reason that a ñtreatment trainò, a number of BMPs in series, is often required for a project.

504.02 Innovative BMP'S

BMPs not previously accepted by the City of Kokomo MS4 entity must be certified by a professional engineer licensed in State of Indiana and accepted through the City Engineer. ASTM standard methods must be followed when verifying performance of new measures. New BMPs, individually or in combination, must meet the required 80% TSS removal rate at 50-110 micron range (silt/fine sand) without re-entrainment and must have a low to medium maintenance requirement to be considered by the jurisdictional entity. Testing to establish the TSS removal rate must be conducted by an independent testing facility, not the BMP manufacturer.

SECTION 505: EASEMENTS

505.01 Easements

All stormwater quality management systems, including detention or retention basins, filter strips, pocket wetlands, in-line filters, infiltration systems, conveyance systems, structures and appurtenances located outside of the right-of-way shall be designated as common areas or

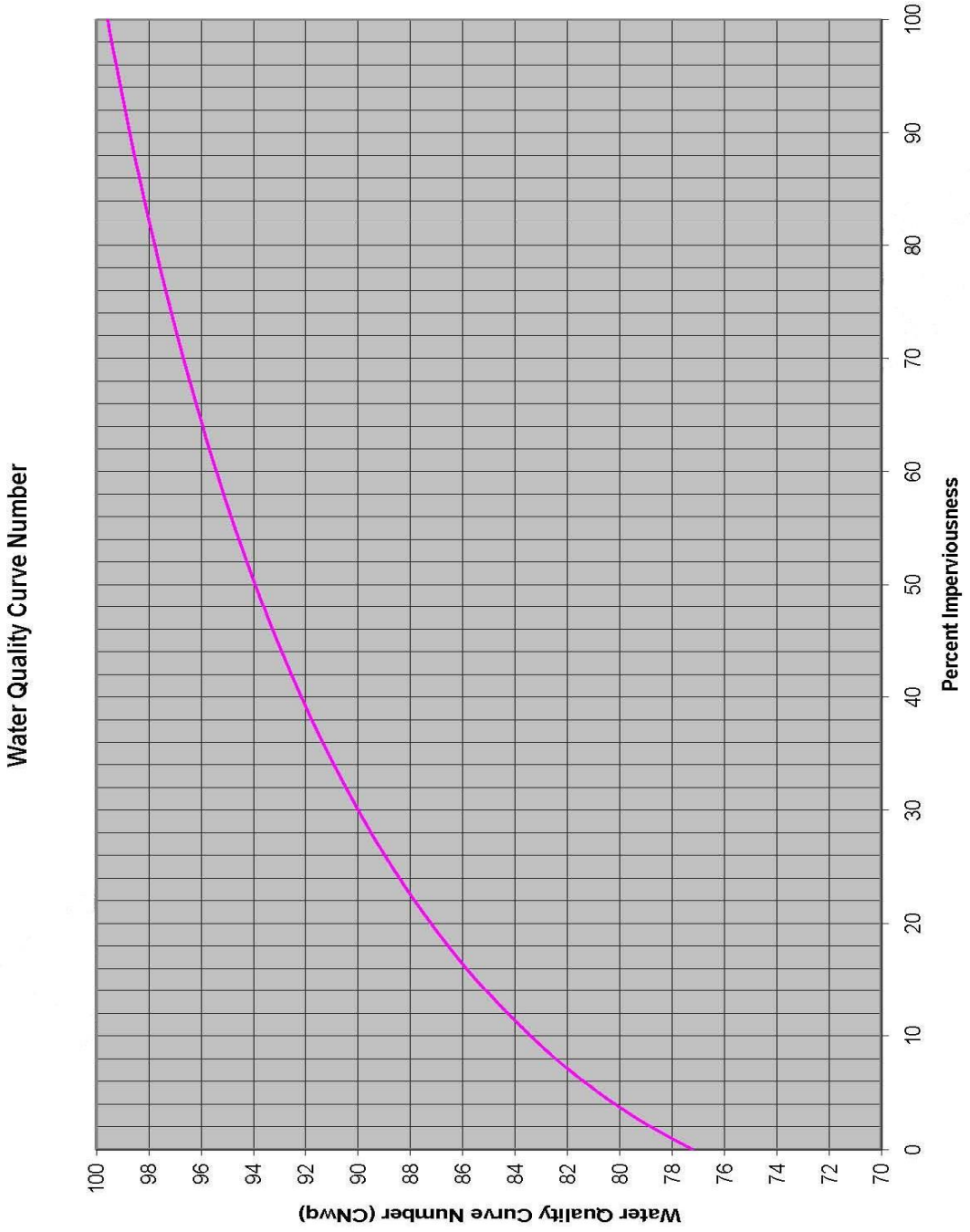


Figure 500-1: Curve Number Calculation for Water Quality Storm Event.

incorporated into permanent easements. For developments which fall under the jurisdictional authority of the jurisdictional entity, the developer shall petition to establish the noted system as a portion of regulated drainage system pursuant to the provisions of I.C.-36-9-27, and the drainage plan shall not be accepted until such petition is submitted in a form accepted by the jurisdictional entity. For the purposes of access, monitoring, inspection, and general maintenance activities, adequate easement width, as detailed in **Figure 500-2**, beyond the actual footprint of the stormwater quality management facility as well as a 20-foot wide access easement from a public right-of-way to each BMP shall be provided. The easement requirements noted in **Figure 500-2** and this section may be changed by the jurisdictional entity as deemed necessary for specific cases.

SECTION 506: INSPECTION & MAINTENANCE REQUIREMENTS

506.01 Inspection, Maintenance, Record Keeping, and Reporting

After the approval of the stormwater management permit by the jurisdictional entity and the commencement of construction activities, the jurisdictional entity has the authority to conduct inspections of the work being done to ensure full compliance with the provisions of this chapter, this document, and the terms and conditions of the approved permit.

Stormwater quality facilities shall be maintained in good condition, in accordance with the Operation and Maintenance procedures and schedules listed in the *Indiana Stormwater Quality Manual* or this document, and/or the terms and conditions of the approved stormwater permit, and shall not be subsequently altered, revised, or replaced except in accordance with the approved stormwater permit, or in accordance with approved amendments or revisions in the permit. Checklists provided in **Appendix- 4** or equivalent forms must be completed and maintained by the owner.

The City of Kokomo MS4 entity also has the authority to perform long-term, post-construction inspection of all public or privately owned stormwater quality facilities. The inspections will follow the operation and maintenance procedures included in this document and/or permit application for each specific BMP. The inspection will cover physical conditions, available water quality storage capacity and the operational condition of key facility elements. Noted deficiencies and recommended corrective action will be included in an inspection report.

BMP Description	Anticipated Average % TSS Removal Rate[D]	Fact Sheet	Maintenance Easement Requirements
Bioretention[A]	75	PC-101	25 feet wide along the perimeter
Constructed Wetland	65	PC-102	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet
Underground detention	70	PC-103	20 feet wide strip from access easement to tankôs access shaft & 30 feet wide along centerline of inlet and outlet
Extended Dry Detention	72	PC-103	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet
Infiltration Basin[A]	87	PC-104	25 feet wide along the perimeter
Infiltration Trench[A]	87	PC-105	25 feet wide along the perimeter
Media Filtration ï Underground Sand	80	PC-106	25 feet wide along the perimeter
Media Filtration ï Surface Sand	83	PC-106	25 feet wide along the perimeter
Storm Drain Insert[C]	NA[B]	PC-107	20 feet wide strip from access easement to chamberôs access shaft
Filter Strip	48	PC-108	25 feet wide along the length on the pavement side
Vegetated Swale	60	PC-109	25 feet wide along the top of bank on one side
Wet Pond	80	PC-110	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet

Notes:

A. Based on capture of 0.5-inch of runoff volume as best available data. Effectiveness directly related to captured runoff volume, increasing with larger capture volumes.
B. The removal rate for this category varies widely between various models and manufacturers. Independent testing should be provided, rather than the manufacturerôs testing data.
C. Must provide vendor data for removal rates.
D. Removal rates shown are based on typical results. These rates are also dependent on proper installation and maintenance. The ultimate responsibility for determining whether additional measures must be taken to meet the Ordinance requirements for site-specific conditions rests with the applicant.

Figure 500-2: Pre Approved Post Construction BMP's.