

Genesee County Storm Water and Flood Control Design Standard Requirements



Effective date June 1, 2011

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INTRODUCTION

The intent of this document is to provide information specific to Genesee County Drain Commissioner's design standards to address storm water quantity and quality. This manual will provide the policy framework, implementation procedures and design standards for storm water controls. **Note:** additional standards and requirements not in this document are required for storm systems that are to be dedicated to this office as public.

This document outlines design requirements for storm water quantity and storm water quality. The Drain Commissioner's office has adopted the *State's Low Impact Development (LID) Manual for Michigan* to guide the design of proposed Best Management Practices (BMPs) for water quality that target the standards provided in this document.

This edition of the design standards and requirements of the Genesee County Drain Commissioner reflects a storm water management philosophy that considers not only flood control, but also stream channel protection and storm water quality management. These revisions are based upon the most current State Permit requirements concerning storm water management. This manual will be updated periodically as additional BMPs are developed and/or as requirements change.

The following section outlines basic ideas and principals of storm water management, and provides a conceptual foundation for the design standards contained in this document.

THE ROLE OF THE GENESEE COUNTY DRAIN COMMISSIONER

The Office of the Drain Commissioner will review all plans submitted to the standards outlined in this document. Those sites that must submit to this office for review are listed on page 3. This office exercises authority over permitted activities of structural facilities that convey and treat storm water runoff that will be generated from a site as a result of its design. The Drain Commissioner's Rules will govern the design of such management facilities with the following objectives:

- Incorporate design standards to control both water quantity and quality.
- Encourage innovative storm water management practices that meet the criteria contained within these rules.
- Ensure future maintenance of facilities by planning for it as a part of system design.
- Make the safety of facilities a priority.
- Strengthen the protection of natural features.
- Encourage more effective soil erosion and sedimentation control measures.



The preferred hierarchy discussed above and summarized in Table 1, below, provides a comprehensive framework for evaluating the place and function of individual BMPs within a storm water management system. While the most important BMPs are source controls that preserve and protect the natural environment, the Genesee County Drain Commissioner cannot mandate these. We must look to the staff and officials of local governments, as well as to developers and their design engineers and planners, to implement source reduction approaches.

Table 1: Hierarchy of Preferred Best Management Practices (BMPs)

Non-Structural (Source) Controls	Structural (Site) Controls
<ol style="list-style-type: none"> 1. Preservation of the natural environment 2. Minimization of impervious surfaces 3. Use of vegetated swales and natural storage 	<ol style="list-style-type: none"> 1. Infiltration of runoff on-site (trenches, etc.) 2. Structural (Site) Controls 3. Storm water detention structures 4. Storm water retention ponds * 5. Conveyance off-site 6. Proper maintenance

*Storm water retention is allowed when no acceptable outlet is available and soil conditions allow.

APPLICABILITY

To prevent an increase in non-point source pollution, these Standards requirements shall apply to any earth-disturbing activities greater than or equal to 1-acre (≥ 1 ac.) on new development or redevelopment projects. Earth disturbing activities less than 1-acre but are a part of a larger plan or development apply because the earth disturbance activities are considered cumulative. For those individual parcels with earth disturbing activities less than 1-acre but have more than > 0.5 acres of impervious surface shall apply.



Typically these sites require approval of a plat, a site development plan, building permit, and other permits to be obtained. The aforementioned requirements will include storm water plans that shall be designed, constructed, and maintained to prevent flooding, minimize stream channel impacts, protect water quality, and achieve the purposes of each local community's storm water ordinance for managing the quantity and quality of storm water runoff.

DESIGN MANUAL AND STANDARD DETAILS

Local communities may furnish additional policy, criteria and information, for the proper implementation of their own local ordinance. This document together with the State Low Impact Development manual (State LID manual) (Chapter 5 through 9 with relevant appendices) will provide information on water quality and quantity standards as well a list of acceptable storm water treatment practices, including the specific design criteria for each storm water practice. This document and the State LID manual may be updated and expanded from time to time based on federal and state requirements, improvements in engineering, science, monitoring, and local maintenance experience. Storm water treatment practices that are designed and constructed in accordance with these design and sizing criteria contained in the State LID manual should meet the minimum water quality and channel protection performance standards outlined in this document. Calculations to demonstrate that BMP designs will perform to meet required water quality, channel protection and flood control standards are to be submitted to the appropriate reviewing agency. Failure to construct storm water treatment practices in accordance with these standards may subject the violator to a civil penalty as described in section 6 of the storm water ordinance.

STORM WATER PLAN Submittal Requirements

These requirements have been developed in the context of plat submittal under Act 288 of the Public Acts of 1967, as amended, the Michigan Land Division Act. However, they shall also be followed for all other categories of development, including site condominiums and site plans.

The following developments will be submitted to the Genesee County Drain Commissioner's Office for review and approval:

1. Plats submitted under Act 288 of the Public Acts of 1967, as amended, the Michigan Land Division Act
2. Applications for permits to discharge to or perform work on a county drain under P.A. 40 of 1956, as amended. Permits are required for any work done to a drain, work within the drain easement or work done that will increase flow to a county drain.
3. All new and redevelopment projects undertaken by Genesee County that disturb one (1) acre or more, including projects less than one (1) acre that are part of a larger common plan of development or sale that would disturb one (1) acre or more. This includes Genesee County Road Commission plans that include changes to the storm water system that serves the road.
4. Review of storm water system plans in other classes of developments or redevelopments, when required by local municipalities.
5. Site Condominium plans prepared under Act 59, P.A. 1978, as amended, where local government ordinances require.
6. Mobile home plans prepared under Act 96, PA. 1987.

The developer will describe the mechanism to be established for long-term maintenance of the development's private storm water management system, including maintenance schedule and enforcement. County enforcement of private development is limited to permitted activities. (See Requirement E)

Should the proprietor plan to subdivide or develop a given area but wishes to begin with only a portion of the total area, the original preliminary plan will include the proposed general layout for the entire area. The first phase of the subdivision will be superimposed upon the overall plan in order to illustrate clearly the method of development that the proprietor intends to follow. Each subsequent plat or phase will follow the same procedure until the entire area controlled by the proprietor is developed.

Final acceptance by the Drain Commissioner of only one portion or phase of the development does not ensure final acceptance of any subsequent phases or the overall general plat for the entire area; nor does it mandate that the overall general plat or plan be followed as originally proposed, if deviations or modifications acceptable to the Drain Commissioner are proposed.

Preliminary plan approval shall remain in effect for one year. Extensions must be requested in writing.

SUBMITTAL PROCESS

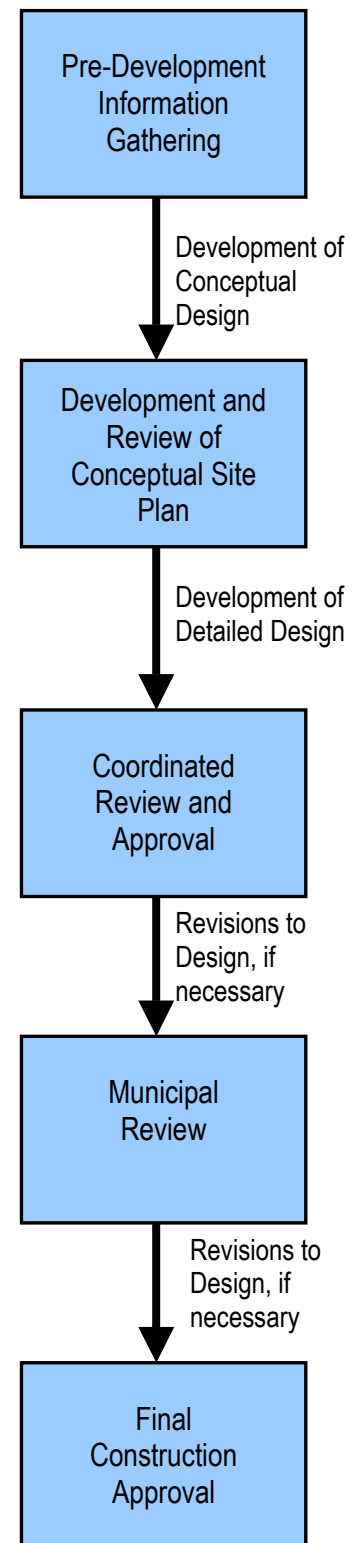
STEP 1: Pre Development Information Gathering - For all applicable projects, developers (or their designated design representatives) will contact representatives from each of the following: the County Road Commission, Health Department, municipal officials (zoning, planner, engineer, DPW, building official), and Drain Commissioner's office (Water and Waste Services and Surface Water). The purpose will be to gather information on design standards, development guidelines, and to identify the type of information developers and their representatives must furnish to comply with this ordinance. In some instances it may be expedient to hold one conference with all the involved parties. Communication between the project designer and developer, as well as the relevant local officials and developer, are two key components of this framework.

STEP 2: Development and Review of Conceptual Site Plan - Review of the conceptual site plan for approval at the County level by the appropriate personnel in Water & Waste Services, soil erosion, surface water, the Road Commission and the Health Department. Comments are returned to the owner/client and designer. **At this time the developer will have his design engineer submit a statement that their site has been reviewed to determine if it's size is capable of accommodating soil erosion and soil conservation measures during construction.**

STEP 3: Coordinated Review and Approval: Review of the Storm Water Plan and the proposed BMPs will occur at the same time as the review of the site plan by representatives from the appropriate agencies. All required documentation should be submitted two weeks prior to the meeting.

STEP 4: Municipal Review and Approval - Developers shall provide a storm water plan for post-construction management of storm water to the Municipality for review and approval. Guidance will be provided to zoning administrators and local planning commission members on the ordinance and design standards and they will be provided with a checklist for reference during site plan review. At this stage all necessary permits should have been obtained from Federal, State, and County agencies. Once all of the above documents have been obtained construction approval will be given by the municipality.

Figure 1:
Submittal Process Flow Chart



GENERAL INFORMATION REQUIREMENTS

All preliminary plans will include the following information:

1. The location of the proposed development by means of a small location map.
2. The township, city, or village in which the parcel is situated.
3. The section and part of section in which the parcel is situated.
4. The number of acres to be developed.
5. Contours, at 2-foot intervals or less, shown in a U.S.G.S. datum that is marked on prints.
6. The proposed drainage system for the development.
7. The proposed street, alley and lot layouts and approximate dimensions.
8. The location and description of all on-site and adjacent off-site features that may be relevant in determining the overall requirements for the development. These features may include, but are not limited to, the following:
 - Adjoining roads, subdivisions, and other developments
 - Schools, parks, and cemeteries
 - Drains, sewers, water mains, septic fields and wells
 - High tension power lines, underground transmission lines, gas mains, pipelines, or other utilities
 - Railroads
 - Existing and proposed easements
 - Natural and artificial watercourses, wetlands and wetland boundaries, floodplains, lakes, bays, and lagoons
 - Designated natural areas
 - Soils description in accordance with the USDA NRCS standard soils criteria
 - Any proposed environmental mitigation features
9. Soil borings, may be required at various locations including the sites of proposed retention/detention facilities, and in areas where high ground water tables exist.



STORM WATER MASTER PLAN INFORMATION REQUIREMENTS

All plans will include the following storm water management information:

A. Stormwater Plan Preparation

The Stormwater Plan shall be prepared by a registered civil engineer. Other persons and professionals may assist in the preparation of the plan.

B. Scale for Mapping

The Stormwater Plan shall be drawn at an appropriate scale to be legible

C. Required Information

1. The Stormwater Plan must be sufficiently detailed to specify the type, location, and size of stormwater management facilities, using preliminary calculations. Detailed construction drawings are not required at the Stormwater Plan review stage.
2. The storm water management plan for the proposed development will indicate and where the drainage will outlet.
3. If it is proposed to develop a parcel in two or more phases, the Stormwater Plan shall be prepared and submitted for the total project.
4. The location by means of a small location map, drawn to a scale no less than 1" = 2000'.
5. Zoning classification of petitioner's parcel and all abutting parcels.

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6. The location and description of all on-site features and all adjacent off-site features within 50 feet, and all other off-site features that may be impacted in determining the overall requirements for the development. This includes:
 - (a) Existing site topography with contours at two-foot intervals or less based on the NAVD88 datum
 - (b) Adjoining roads and developments
 - (c) Railroads
 - (d) High tension power lines or underground transmission lines
 - (e) Cemeteries
 - (f) Parks
 - (g) Natural and artificial watercourses, wetlands and wetland boundaries, environmental feature boundaries,
 - (h) floodplains, lakes, bays, existing stormwater storage facilities, conveyance swales (natural or artificial) with identification of permanent water elevations
 - (i) Information supporting that the outlet is acceptable. An acceptable outlet is a natural watercourse under regulation of Act 451 part 301 Inland Lake and Stream, county drain, county road ditch, or a regulated wetland with an acceptable outlet. The development may discharge across a neighboring private property with the appropriate written approvals/easements.
 - (j) Location of woodlands
 - (k) Designated natural areas
 - (l) Any proposed environmental mitigation features
 - (m) Drains, sewers, and water mains
 - (n) Existing and proposed easements
 - (o) A map, at the U.S.G.S. scale, showing the drainage boundary of the proposed development and its relationship with existing drainage patterns
 - (p) Boundaries of any off-site drainage area contributing flow to the development
 - (q) Any watercourse passing through the development, along with the following:
 - (i) Area of upstream watershed and current zoning
 - (ii) Calculations of runoff from the upstream area for both the 100-year and two-year 24-hour design storms, for fully developed conditions according to the current land use plan for the area.
 - (iii) A description of how drainage, which originates outside of the development boundaries and flows onto or across the development, will be managed.
 - (r) Soil borings may be required at various locations including the sites of proposed retention/detention and infiltration facilities, and as needed in areas where high groundwater tables or bedrock near the surface exist
 - (s) Proposed site improvements including lot divisions and building footprints
 - (t) Stormwater BMP information including:
 - (i) Location of all stormwater BMPs

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- (ii) Identification of stormwater quality and quantity treatment facilities and method of stormwater conveyance
 - (iii) Sizing calculations for stormwater quality and quantity, including preliminary estimates of runoff volume captured by BMPs, (e.g., infiltration losses,) for treatment facilities
 - (iv) Tributary area map for all stormwater management facilities indicating total size and average runoff coefficient for each subarea
 - (v) Analysis of existing soil conditions and groundwater elevation and bedrock depth (including submission of soil boring logs) as required for proposed retention and infiltration facilities

D. Landscaping plan for stormwater BMPs

E. Easements for stormwater management facilities

F. Required natural features setbacks

G. Drinking water wells, public wellheads, Wellhead Protection Areas (WHPAs), underground storage tanks, and brownfields

Proposed drainage for the development will conform to any established County drainage districts. Proposed drainage should complement any local storm water management plans that may exist and/or comply with any ordinance in effect in the municipality/ies where the proposed development is located.

GENESEE COUNTY DESIGN CRITERIA

In an effort to standardize design procedures for storm sewers and open channels in Genesee County, the Genesee County Drain Commissioner has developed these standards. It is hoped that these standards will facilitate planning from both the position of the design and reviewing engineer.



It is recognized that design conditions vary and there is no substitute for the professional judgment of an experienced engineer. In all cases this judgment should be applied.

The development shall meet the following storm water *design requirements*:

A A minimum treatment volume standard to minimize water quality impacts.

B Channel protection criteria to prevent resource impairment resulting from flow volumes and rates.

C Flood Control

D Operation and maintenance requirements.

E Enforcement mechanisms with recordkeeping procedures.

EXPLANATION OF REQUIREMENTS

Requirement A: “A minimum treatment volume standard to minimize water quality impacts.”

There are several different ways to calculate a minimum treatment volume (commonly referred to as first flush). The developers design representative shall determine the minimum treatment volume for water quality by one of the following methods:

- using 1” of runoff from the entire site
- the statewide analysis by region for the 90-percent annual non-exceedance storms that is summarized in the March 24 2006 MDEQ memo. (Genesee County is considered to be part of the Detroit Metro Area for calculating runoff) A copy of this memo is available on the Drain Commissioner’s website. www.gcdcswm.com

Treatment methods shall be designed on a site-specific basis to achieve the following:

- A minimum of 80 percent removal of total suspended solids (TSS), as compared with uncontrolled runoff, or
- Discharge concentrations of TSS not to exceed 80 milligrams per liter (mg/l).

A minimum treatment volume standard is not required where site conditions are such that TSS concentrations in storm water discharges will not exceed 80 mg/l.

Sites are in compliance with this permit requirement if the minimum treatment volume from the site is treated by properly designed BMPs that achieve either 80% removal of total suspended solids, or discharge 80 mg/l or less of total suspended solids according to accepted literature. It is also important to note that new development will often be in compliance with this permit requirement if the volume control specified in the channel protection requirement of this permit is achieved.

Compliance may be shown through calculation or through direct measurement. Calculations or measurements must show reductions to the calculated TSS concentration in uncontrolled runoff using the data provided here or another acceptable literature source. Table 7.1 (pp. 122) in the State LID Manual summarizes the potential application and the quantity and quality function for most BMPs, When designed correctly, either individually or as a suite of BMPs, the treatments listed in Table 7 will meet the permit’s stormwater requirements.

Requirement B: “Channel protection criteria to prevent resource impairment resulting from flow volumes and rates.”

The channel protection criteria established in the NPDES Ph II permit is necessary to maintain post-development site runoff volume and peak flow rate at or below existing levels for all storms up to the **2-year, 24-hour event**.

“Existing levels” means the runoff flow volume and rate for the last land use prior to the planned new development or redevelopment.

An acceptable source of rainfall data for calculating runoff volume and peak flow rate is: *Rainfall Frequency Atlas of the Midwest*, Huff & Angel, NOAA Midwest Climate Center and Illinois State Water Survey, 1992. A copy of this is available on the Drain Commissioner’s website. www.gcdcswm.com

Methods for estimating pre-development and post-development runoff shall follow curve number evaluations. Any of the following methods are allowed:

- Computing Flood Discharges for Small Ungaged Watersheds
- TR55
- Hec-Raz
- Hec-HMS
- SWIM

Requirement C: “Flood Control Requirements”

Flood Control requirements are for all storms events between the **2-year, 24-hour event** and the **100-year 24-hour event**.

Many streams located in this county do not have stream gauging data available or the period of record is not of sufficient length to allow the design engineer to estimate flood flows by using flood-frequency analysis as developed by U.S.G.S. Prior to design of any storm drain improvement or enclosure, the developer or their designated design representative shall investigate any gauging station, partial record gauging station, or crest stage gages on the drainage basin for available pertinent data on flood flows.

Where insufficient data is available to develop basin hydrology by the above method, the developer shall determine flows along the watercourse by the S.C.S. method, the rational method, the brater method, or a combination of these methods. The basin hydrology shall be approved by the Genesee County Drain Commissioner's office prior to proceeding with the final design of a given project.

Implementing stormwater control BMPs can reduce the frequency and intensity of flooding even on C and D soils. And while the State LID manual does provide guidance on designing BMPs to address flooding the standard is more restrictive than Genesee County standards. Therefore, developments/Flood controls shall be developed in accordance with the following flood frequencies. For each of the frequency categories below:

- A. The following basin development projects are to be designed to the 100 year storm:
 - 1. Culverts or bridges crossing state highways or expressways where the upstream drainage area is in excess of 2 square miles;
 - 2. Detention ponds;
 - 3. Drainage enclosures in excess of 100 feet where the upstream drainage area is in excess of 2 square miles.
- B. The following basin development projects are to be designed to the 25 year storm:
 - 1. County road cross culverts and bridges.
 - 2. Open channel development or improvement (flow to be contained within the channel).
 - 3. Drain enclosures where the drainage area is greater than 300 acres but less than 2 square miles.
- C. The following basin development projects are to be designed to the 10 year storm:
 - 1. Open channels, culverts or drain enclosures where the drainage area is not in excess of 300 acres.
 - 2. Enclosed storm sewers flowing full under gravity conditions in proposed plats/developments.

Flow Estimation: Hydrology:

Many different methods of arriving at a given flow (cfs) for a selected spot in a drainage outlet have been developed over the years. Because of its general recognition and wide use within the county, the drain commissioner will accept the rational method for flow computation where the drainage area is less than 100 acres. Engineers electing to use this method for larger drainage area will be requested to also use an alternate method for comparison.

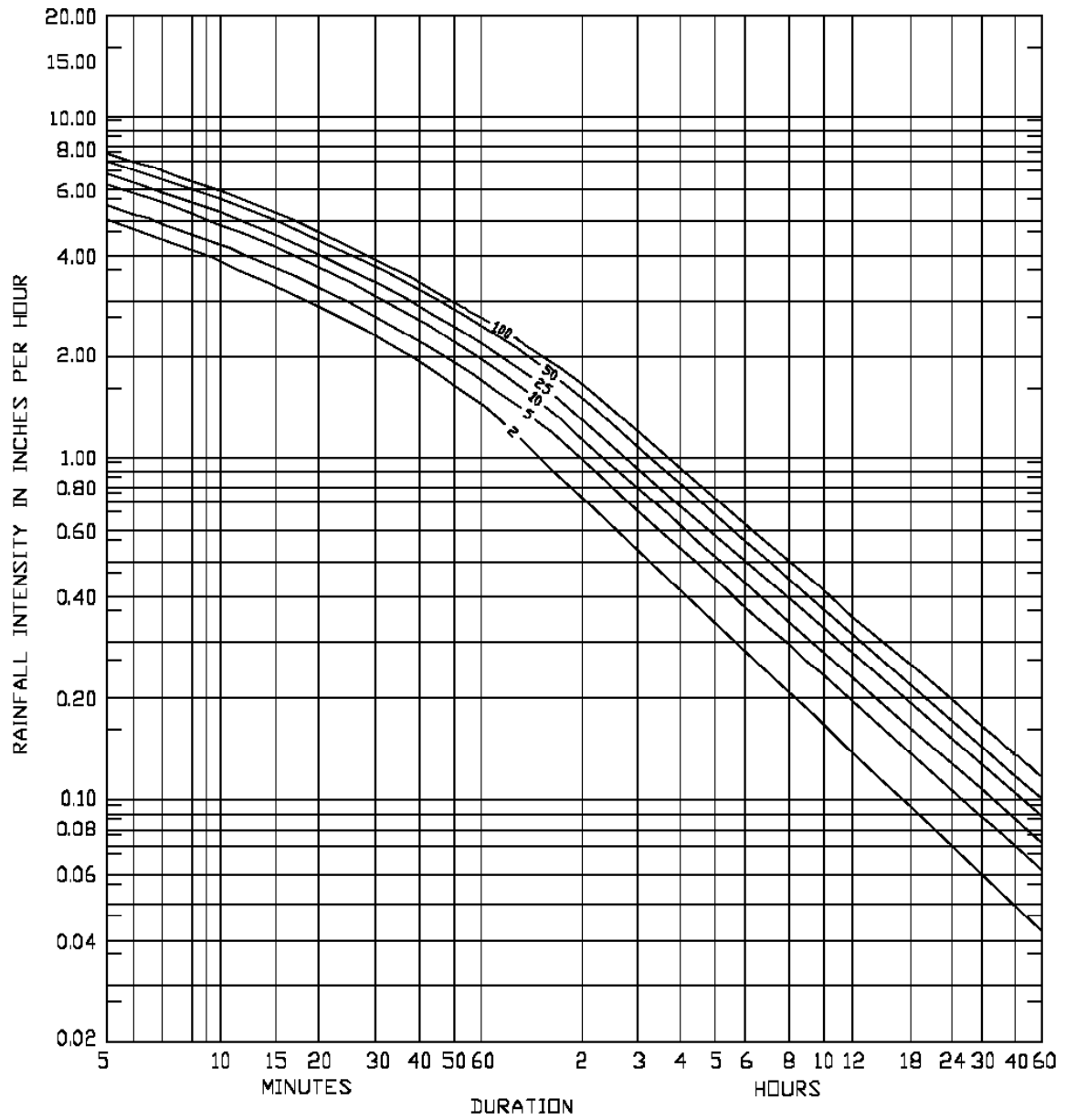
The following criteria shall be used in determining the variables of the rational formula $Q=CIA$.

1. Runoff coefficient - the runoff coefficient must be determined on the basis of this projected development using the following:

	C-factor
- Flat undeveloped lands, farms, non-wooded	0.25
- Woodlands & sloped undeveloped land	0.30
- Parks, cemeteries, playgrounds, disturbed ground*	0.35
- Residential*	0.40
- Apartments, condominiums or light manufacturing*	0.50
- Commercial and industrial*	0.70
- Impervious areas (parking, roof, etc.)	0.95
- Open water	1.00

*These are average C-factors for typical types of development. A C-weighted value may be calculated to more accurately reflect the site conditions.

2. Intensity - the rainfall intensity - Computation of an accurate time of concentration is critical to the use of these curves. For urban storm sewers time of concentration shall be the summation of the inlet time plus the time of flow in the sewer. For urbanized area a minimum initial time of 20 minutes, plus time of travel, shall be acceptable for design and for average rural basins an initial time of concentration of 30 minutes, plus time of travel, will present an adequate time for storm flows to peak. The flow time in an enclosed system shall be calculated by standard design charts. For channel velocity the standard manning equation $v=1.486 r^{2/3} s^{1/2}$ shall be accepted. A chart based on *Technical Paper 40* listing accepted N values for storm sewer design is located on page 12 for use in design analysis.
3. Area - the area of a basin or sub-basin shall be determined by use of 2' contour maps available at the county GIS department with an appropriate field check or by use of established county drain maps on file at the Drain Office, 4608 Beecher Road.



RAINFALL INTENSITY - DURATION - FREQUENCY CURVES FOR FLINT, MI
 BASED ON U.S. DEPARTMENT OF COMMERCE TECHNICAL PAPER 40

Outlet conditions:

All storm systems shall be designed to exit into an outlet with sufficient carrying capacity to carry the additional design flow. The maximum velocity allowable for an outlet to open ditch is 5 ft/s. Maximum velocity may be reduced based on poor soil conditions.

The designer engineer shall analyze this condition and submit data substantiating his conclusions. This information shall be submitted to the drain commissioner along with the required design forms.

In the event the design engineer does not have sufficient capacity in the outlet the following criteria shall apply:

1. The system shall be designed to outlet only existing runoff. Existing runoff shall consist of all water presently contributed to the drainage district. This shall mean the 2-year storm under existing conditions using agricultural land ($c= 0.25$). All excess shall be retained on site for duration of time necessary to pass the design storm without downstream flooding. The outlet discharge shall not exceed 0.2 cfs/acre under any event.
2. The township shall petition the drain commissioner to improve the outlet to the required size to pass the additional water at the design storm. In the event this petition is not successful criteria #1 above shall apply.

Requirement D: “Operation and maintenance requirements.”

All structural and vegetative BMPs installed shall include a plan for maintaining maximum design performance through long-term operation and maintenance (O&M). The O&M plans will ensure that the BMP continues to meet the **water quality treatment, channel protection & flood** controls outlined in this manual.

O&M maintenance agreements that are required under a municipal storm water ordinance will be between the property owner and the Municipality, and contain within the maintenance agreement, at the minimum, the following factors:

- Operating instructions for the outlet component;
- Vegetation maintenance schedule;
- Responsible party designation;
- Inspection checklists;
- Maintenance checklists; and
- Tracking requirements.
- As-builts showing the storm maintenance plan was built to design.

An example of a storm water maintenance agreement can be found in Appendix G (pgs 455 – 461 of the LID Manual for Michigan).

For projects located within communities that do not have a storm water ordinance, but do drain into a Road System or County Drain and would require a Genesee County Road Commission permit or Drain Commissioner’s Office – SWM permit have to provide a maintenance plan that would provide the same above information as in a maintenance agreement. If it is found that a site is not being maintained and violates the County permit issued, the Drain Commissioner’s Office and/or Road Commission will revoke the permit allowing discharge to their system and refer the violator to the local municipality.

Requirement E: “Enforcement mechanisms with record keeping procedures.”

Enforcement of the NPDES requirements will be achieved through a combination of County agencies (the Drain Commissioner and Road Commission) and local municipalities that have a storm water ordinance. Any municipality may adopt the storm water ordinance. It is assumed that each permitted municipality will adopt a storm water ordinance (a state requirement) that supports the Genesee County storm water requirements or its own storm water requirements. The individual municipality will retain records.

Post Construction authority for the Road Commission’s and Drain Commissioner’s Office begins and ends at the right of ways or easements. If the site violates the permit the GCRC or GCDC has the right to block or deny the site access to an outlet. The laws do not give either agency the right to enter the site or do any work outside our right of ways or easements. For non-Phase II communities, where the site drains to a wetland, water of the state (not a drain or road ditch) or MDOT drainage system, the County does not have any post construction authority.

The BMP/owner operator must track and record, and if required by the permittee, report all field inspection findings to ensure proper O&M occurs for the life of the BMP.

As per the ordinance, the BMP/owner operator must maintain inspection and maintenance information for the life of the BMP and make this information available to Municipality (permittee) staff during an inspection.

Municipality will maintain records of site plan process, approvals, any post construction inspection reports and non-compliance issues and resolution.

APPEAL PROCEDURES

Developments are reviewed based on the standards and requirements in this document. Approval cannot be given for developments that do not meet these requirements.

If the proprietor wishes to appeal a decision made by the Genesee County Drain Commissioner's office, a written appeal may be filed. If an appeal is filed with the Genesee County Drain Commissioner's office, an informal hearing will be scheduled.

The informational hearing will allow the proprietor an opportunity to submit additional information or re-emphasize previously submitted data. The Drain Commissioner will then review the information and make a final decision within 21 days of the informal hearing. This final decision will be forwarded to the proprietor by first class mail.

PERMITS AND FEES FOR THE GENESEE COUNTY DRAIN COMMISSIONER

A permit will be required for all activities crossing, modifying, or discharging to a county drain, or any work within a county drain easement. Submittals shall include all the following information:

3. A fully completed permit application including appropriate signatures.
4. A drawing including the following information, at a minimum:
 - a. Location of County Drain easements on the property.
 - b. Descriptions of all construction activity within drain easement.
 - c. Dimensions and elevations of all facilities being proposed for construction within the drain easement.
 - d. Type of material used for construction of facilities within drain easement.
 - e. Soil erosion and sedimentation control measures.
 - f. Any required BMP's.
5. Note: Currently there are no permit fees for permitted activities.

Inspection Fees for the Genesee County Drain Commissioner:

Inspection fees are not charged for private development. Drains that are constructed and that will be designated as a County Drain will follow the inspection fee schedule for a public storm sewer.

Example

A developer owns a 3-acre parcel. They want to place a shopping center and parking lot on a currently vacant parcel. Between the building and parking lot they would add 2.61 acres of impervious. The entire parcel drains to the road and the ground has a hydraulic soil group B. The

Requirement A

Using the 90- percent annual non-exceedance storms methodology:

$P = 0.90$ -inches [the rainfall for the “Detroit Metro” area]

The site will be 87% impervious

$R_v = 0.05 + 0.009 (87\%)$ [Volumetric runoff coefficient]

$R_v = 0.83$

$WQV = P * R_v = 0.9'' * 0.83 = 0.75$ watershed inches [Water quality volume]

Convert to cubic feet

$WQV = 0.75'' (1\text{ft}/12'') (3 \text{ acres}) (43560\text{ft}^2/1\text{acre}) = 8,168 \text{ ft}^3$

Requirement B

Using TR-55

2-year rainfall = 2.26''

The CN = 58 undeveloped

$Q = 0.17$ inches of runoff

$V = 0.17 \text{ inches } (1\text{ft}/12'') (3 \text{ acres}) (43560\text{ft}^2/1\text{acre}) = 1851.3 \text{ ft}^3$

$T_c = 0.45$

$Q_{\text{peak}} = q_u * A * WQV = (2.45\text{cfs}/\text{inch of runoff}) (0.17 \text{ inch}) = 0.42 \text{ cfs undeveloped}$

the CN = 92 developed

$Q = 1.59$ inches of runoff

$V = 1.59 (1\text{ft}/12'') (3 \text{ acres}) (43560\text{ft}^2/1\text{acre}) = 17,315.1 \text{ ft}^3$

$T_c = 0.37$ hours

$Q_p = q_u * A * WQV = (4.1\text{cfs}/\text{inch of runoff}) (1.59 \text{ inch}) = 6.52 \text{ cfs developed}$

Requirement C

$Q_{\text{out}} = 0.2 \text{ cfs/acre} * 3\text{ acres} = 0.6 \text{ cfs max discharge}$

$C_w = (2.61 * .95 + .39 * .25) / 3 = .86$

$T_c = 160$ minutes for maximum volume

$V_{\text{req}} = ((0.86 * 1.4 * 3.0) - 0.6) * 160 * 60 = 28,916 \text{ ft}^3$

- Instead of conveying the water through a pipe the parking lot is able to be sloped to a 700 long bioswale. That is able to treat 9,000 ft³ before overflowing into the detention basin.
- The proposed detention basin is over dug by 17,315-1,851 = 15,464 ft³. this will hold the additional runoff volume for the 2-year storm, with a discharge rate 0.42 cfs.
- For storms above the 2-year the additional 28,916 ft³ in the pond will detain the necessary flow for up to the 100-year storm, with a discharge of 0.60 cfs.