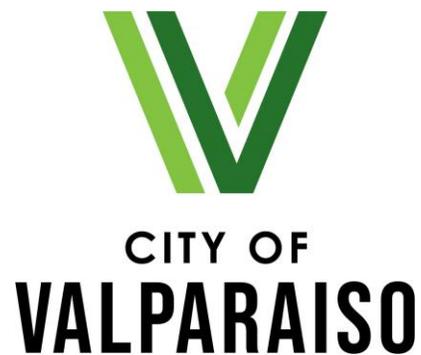


**THE CITY OF VALPARAISO, INDIANA**

**STORMWATER TECHNICAL**

**STANDARDS MANUAL**



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# Chapter One

## INTRODUCTION

This document, the City of Valparaiso Stormwater Technical Standards Manual, contains the necessary technical standards for administering the requirements of the City of Valparaiso Stormwater Management ordinance. This document should be considered as a companion document to the Ordinance. Whereas the Ordinance contains the majority of the regulatory authority and general requirements of comprehensive stormwater management, this document contains the necessary means and methods for achieving compliance with the Ordinance. In case there are conflicts between the requirements contained in this document and the ordinance, the requirements of the Ordinance shall prevail. In addition to the stormwater standards provided in this document, City of Valparaiso may have adopted, or may adopt in the future, separate other technical standards regarding various aspects of stormwater conveyance systems that for various reasons may not have been incorporated in this Technical Standards document. In case there are conflicts between the requirements contained in this document and the noted standards, the most restrictive requirements shall prevail.

This document contains formulas and methodologies for the review and design of both stormwater quantity and stormwater quality facilities. Chapters 2 through 6 contain stormwater conveyance and detention calculations and requirements. Chapter 7 contains standards on erosion and sediment control and other pollution prevention measures for active construction sites. Chapters 8 through 9 cover standards and calculations methods required to properly size and design stormwater features that will treat runoff long-term following construction completion. Chapter 10 contains standards regarding lot/building developments, including grading and building pad elevations, acceptable outlet and adjoining property impact requirements.

A comprehensive glossary of terms is provided in Appendix A. Appendix B contains a checklist of required information for permit application, and a form to certify completion and compliance at the end of a construction. Appendix C contains checklists for the operation, maintenance and inspection of several post-construction BMPs.

The City of Valparaiso Stormwater Management Ordinance and this Technical Standards Manual provide the general requirements and recommended/acceptable methods for design and review of stormwater quantity and quality infrastructure within the City of Valparaiso. For a comprehensive technical guidance on calculations and modeling of stormwater quantity and quality infrastructure in Indiana, refer to the latest edition of the “Indiana LTAP Stormwater Drainage Manual.”



# Chapter Two

## METHODOLOGY FOR DETERMINATION OF RUNOFF RATES

Runoff rates shall be computed for the area of the parcel under development plus the area of the watershed flowing into the parcel under development. The rate of runoff which is generated as the result of a given rainfall intensity may be calculated as follows:

**A. Development Sites Less than or Equal to 5 Acres in Size, With a Contributing Drainage Area Less than or Equal to 50 Acres and No Depressional Storage**

The Rational Method may be used. A computer model, such as XPSWMM, TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (COE), and HEC-1 (COE), that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies may also be used along with a 24-hour duration NRCS Type 2 storm. Note that for the purpose of determining the post-developed conditions curve numbers, due to significant disturbance to the upper soil layers during the construction activities, the initially determined hydrologic soil group for disturbed areas should be changed to the next less infiltrating capacity category (i.e., A to B, B to C, and C to D). In the Rational Method, the peak rate of runoff,  $Q$ , in cubic feet per second (cfs) is computed as:

$$Q = CIA$$

Where:

$C$  = Runoff coefficient, representing the characteristics of the drainage area and defined as the ratio of runoff to rainfall.

$I$  = Average intensity of rainfall in inches per hour for a duration equal to the time of concentration ( $t_c$ ) for a selected rainfall frequency.

$A$  = Tributary drainage area in acres.

Values for the runoff coefficient " $C$ " are provided in **Table 2-1** and **Table 2-2**, which show values for different types of surfaces and local soil characteristics. The composite " $C$ " value used for a given drainage area with various surface types shall be the weighted average value for the total area calculated from a breakdown of individual areas having

different surface types. **Table 2-3** provides runoff coefficients and inlet times for different land use classifications.

Rainfall intensity shall be determined from the rainfall frequency data shown in **Table 2-4**.

In general, the time of concentration ( $t_c$ ) methodology to be used for all stormwater management projects within City of Valparaiso shall be as outlined in the U.S. Department of Agriculture (USDA) - NRCS TR-55 Manual. In urban or developed areas, the methodology to be used shall be the sum of the inlet time and flow time in the stormwater facility from the most remote part of the drainage area to the point under consideration. The flow time in the storm sewers may be estimated by the distance in feet divided by velocity of flow in feet per second. The velocity shall be determined by the Manning's Equation (see Chapter 4). Inlet time is the combined time required for the runoff to reach the inlet of the storm sewer. It includes overland flow time and flow time through established surface drainage channels such as swales, ditches, and sheet flow across such areas as lawns, fields, and other graded surfaces.

**Table 2-1.** Urban Runoff Coefficients

Type of Surface	Runoff Coefficient “C”
<b>Hard Surfaces</b>	
Asphalt	0.82
Gravel	0.85
Concrete	0.85
Roof	0.85
<b>Lawns (Sandy)</b>	
Flat (0-2% Slope)	0.07
Rolling (2-7% Slope)	0.12
Steep (Greater than 7% Slope)	0.17
<b>Lawns (Clay)</b>	
Flat (0-2% Slope)	0.16
Rolling (2-7% Slope)	0.21
Steep (Greater than 7% Slope)	0.30

Source: Highway Extension and Research Project for Indiana Counties (HERPICC, now LTAP) Stormwater Drainage Manual, July 1995, and other sources.

**Table 2-2. Rural Runoff Coefficients**

<b>Type of Surface</b>	<b>Runoff Coefficient “C”</b>
<b>Woodland (Sandy)</b>	
Flat (0-2% Slope)	0.10
Rolling (2-7% Slope)	0.25
Steep (Greater than 7% Slope)	0.30
<b>Woodland (Clay)</b>	
Flat (0-2% Slope)	0.30
Rolling (2-7% Slope)	0.35
Steep (Greater than 7% Slope)	0.50
<b>Pasture (Sandy)</b>	
Flat (0-2% Slope)	0.10
Rolling (2-7% Slope)	0.16
Steep (Greater than 7% Slope)	0.22
<b>Pasture (Clay)</b>	
Flat (0-2% Slope)	0.30
Rolling (2-7% Slope)	0.36
Steep (Greater than 7% Slope)	0.42
<b>Cultivated (Sandy)</b>	
Flat (0-2% Slope)	0.30
Rolling (2-7% Slope)	0.40
Steep (Greater than 7% Slope)	0.52
<b>Cultivated (Clay)</b>	
Flat (0-2% Slope)	0.50
Rolling (2-7% Slope)	0.60
Steep (Greater than 7% Slope)	0.72

*Source: HERPICC Stormwater Drainage Manual, July 1995, and other sources.*

**Table 2-3.** Runoff Coefficients “C” by Land Use and Typical Inlet Times

Land Use	Runoff Coefficient “C”			Inlet Times (Minutes) <sup>4</sup>
	Flat <sup>1</sup>	Rolling <sup>2</sup>	Steep <sup>3</sup>	
Commercial (CBD)	0.75	0.83	0.91	5
Commercial (Neighborhood)	0.54	0.60	0.66	5-10
Industrial	0.63	0.70	0.77	
Garden Apartments	0.54	0.60	0.66	
Churches	0.54	0.60	0.66	
Schools	0.31	0.35	0.39	10-15
Semi Detached Residential	0.45	0.50	0.55	
Detached Residential	0.40	0.45	0.50	
Quarter Acre Lots	0.36	0.40	0.44	
Half Acre Lots	0.31	0.35	0.39	
Parkland	0.18	0.20	0.22	To be Computed

Source: HERPICC Stormwater Drainage Manual, July 1995, and other sources.

- <sup>1</sup> Flat terrain involves slopes of 0-2%.
- <sup>2</sup> Rolling terrain involves slopes of 2-7%.
- <sup>3</sup> Steep terrain involves slopes greater than 7%.
- <sup>4</sup> Interpolation, extrapolation and adjustment for local conditions shall be based on engineering experience and judgment.

**Table 2-4.** Rainfall Intensities for Various Return Periods and Storm Durations (Inches/Hour)

Duration	Return Period (Years)					
	2	5	10	25	50	100
5 Min.	4.20	5.16	6.12	7.56	8.76	10.20
10 Min.	3.66	4.56	5.34	6.60	7.68	9.00
15 Min.	3.12	3.88	4.56	5.64	6.60	7.68
30 Min.	2.14	2.68	3.12	3.86	4.52	5.26
1 Hr.	1.36	1.70	1.98	2.45	2.87	3.35
2 Hrs.	0.84	1.05	1.23	1.52	1.77	2.07
3 Hrs.	0.62	0.77	0.90	1.11	1.30	1.52
6 Hrs.	0.36	0.45	0.53	0.65	0.76	0.89
12 Hrs.	0.21	0.26	0.31	0.38	0.44	0.52
18 Hrs.	0.15	0.19	0.22	0.27	0.32	0.37
24 Hrs.	0.12	0.15	0.18	0.22	0.25	0.30

Data used in the determination of these values obtained from "Rainfall Frequency Atlas of the Midwest", by Floyd A. Huff and James R. Angel, 1992, Midwestern Climate Center and Illinois State Water Survey.

**B. Development Sites Greater Than 5 Acres in Size or Contributing Drainage Area Greater than 50 Acres or With Significant Depressional Storage**

The runoff rate for these development sites and contributing drainage areas shall be determined by a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies. Note that for the purpose of determining the post-developed conditions curve numbers, due to significant disturbance to the upper soil layers during the construction activities, the initially determined hydrologic soil group for disturbed areas should be changed to the next less infiltrating capacity category (i.e., A to B, B to C, and C to D).

The 24-hour NRCS Type 2 Rainfall Distribution shall be utilized for runoff calculations. 24-hour Rainfall depth for various frequencies shall be taken from **Table 2-5**. The NRCS Type 2 distribution ordinates are found in **Table 2-6**. Examples of computer models that can generate such hydrographs include XPSWMM, TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (COE), and HEC-1 (COE). Many of these programs may be downloaded free of charge from the associated agencies' web sites. Other models may be acceptable and should be accepted by the City of Valparaiso City Engineer prior to their utilization.

**Table 2-5.** Rainfall Depths for Various Return Periods (*Inches*)

Duration	Return Period (Years)					
	2	5	10	25	50	100
24-hr	2.90	3.75	4.60	5.50	6.75	8.10
12-hr	2.60	3.20	3.80	5.00	5.55	7.00
6-hr	2.20	2.75	3.25	4.50	5.00	5.60
3-hr	1.90	2.40	2.85	3.75	4.55	5.00
2-hr	1.70	2.15	2.60	3.20	3.50	4.50
1-hr	1.40	1.75	2.10	2.60	3.25	3.90

*This data obtained from the Spatial Distribution Maps in "Rainfall Frequency Atlas of the Midwest", by Floyd A. Huff and James R. Angel, 1992, Midwestern Climate Center and Illinois State Water Survey.*

**Table 2-6. NRCS Type II Rainfall Distribution Ordinates**

<b>Cumulative Percent of Storm Time</b>	<b>Cumulative Percent of Storm Depth</b>
0	0
5	1
10	3
15	4
20	6
25	8
30	10
35	13
40	17
45	22
50	64
55	78
60	84
65	87
70	90
75	92
80	94
85	96
90	98
95	99
100	100

*Source: National Resources Conservation Service (NRCS), "TR-20 Computer Program for Project Formulation Hydrology", page F9, May 1982.*

**C. Development Sites with Drainage Areas Greater than or Equal to One Square Mile**

For the design of any major drainage system, as defined in **Appendix A**, the discharge must be obtained from, or be accepted by, the IDNR. Other portions of the site must use the discharge methodology in the applicable section of this Chapter.



# Chapter Three

## METHODOLOGY FOR DETERMINATION OF RETENTION/DETENTION STORAGE VOLUMES

### A. Development Sites Less than or Equal to 5 Acres in Size, With a Contributing Drainage Area Less than or Equal to 50 Acres and No Depressional Storage

The required volume of stormwater storage may be calculated using the Rational Method and based on the runoff from a 100-year return period storm. A computer model, such as XPSWMM, TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (COE), and HEC-1 (COE), that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies may also be used along with a 24-hour duration NRCS Type 2 storm.

The following 9-step procedure, based on the Rational Method, may be used to determine the required volume of storage:

1. Determine the parcel area in acres "A" tributary to each outlet.
2. Compute 100-year frequency allowable release rate ( $Q_u$ ) to each outlet based on methodologies provided in Chapter 6 of these technical standards.
3. Determine composite runoff coefficient "C<sub>d</sub>" based on developed conditions and a 100-year return period.
4. Determine 100-year return rainfall intensity "I<sub>d</sub>" for various storm durations "t<sub>d</sub>" up through 24 hours for the developed area using **Table 2-4**.
5. Determine developed inflow rates "Q<sub>d</sub>" for various storm durations "t<sub>d</sub>", measured in hours.

$$Q_d = (C_d)(I_d)(A_d)$$

6. Compute a storage rate "S(t<sub>d</sub>)" for various storm durations "t<sub>d</sub>" up through 24 hours for the developed area.

$$S(t_d) = (Q_d) - (Q_u)$$

7. Compute required storage volume "S<sub>R</sub>" in acre-feet for each storm duration "t<sub>d</sub>". This assumes a triangular hydrograph of duration (2t<sub>d</sub>) hours with a peak flow of S(t<sub>d</sub>) at t<sub>d</sub> hours.

$$S_R = S(t_d) \left( \frac{t_d}{12} \right)$$

8. Select largest storage volume computed in Step 7 for any storm duration "t<sub>d</sub>" for detention basin design.
9. Repeat Steps 2-8 of this process for the post-developed 10-year storm.

**B. Development Sites Greater Than 5 Acres in Size or Contributing Drainage Area Greater than 50 Acres or With Significant Depressional Storage**

All runoff detention storage calculations for these development sites shall be prepared using a computer model that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies. The 24-hour NRCS Type 2 Rainfall Distribution shall be utilized to determine the required storage volume. The allowable release rates shall be determined based on the methodologies provided in Chapter 6 of these Technical Standards document. Examples of computer models that can generate such hydrographs include XPSWMM, TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (COE), and HEC-1 (COE). Many of these programs may be downloaded free of charge from the associated agencies' web sites. Other models may be acceptable and should be accepted by the City of Valparaiso City Engineer prior to their utilization.



# Chapter Four

## STORM SEWER DESIGN STANDARDS AND SPECIFICATIONS

All storm sewers, whether private or public, and whether constructed on private or public property shall conform to the design standards and other requirements contained herein. Proposed storm sewer systems must be sized and designed to convey at least the 10-year frequency on-site stormwater runoff, as well as the anticipated 10-year frequency tributary off-site stormwater runoff based on the future developed condition (using **Table 6-1** of the Technical Standards). An analysis of the emergency routing of stormwater runoff through the subject development must be provided to confirm that the development will not obstruct the free flow of floodwaters from the tributary off-site property in its current condition and after development. In addition, the Drainage System Overflow Design must be completed in accordance with Section M of this chapter to ensure the safe routing of flood waters through the subject development with the tributary off-site property in its current condition and after development.

### A. Design Storm Frequencies

1. All storm sewers, inlets, catch basins, and street gutters shall accommodate (subject to the “allowable spread” provisions discussed later in this Section), as a minimum, peak runoff from a 24-hour, 10-year return frequency storm calculated based on methodology described in Chapter 2. Additional discharges to storm sewer systems allowed in Section L below of this Section must be considered in all design calculations. For Rational Method analysis, the duration shall be equal to the time of concentration for the drainage area. In computer-based analysis, the duration is as noted in the applicable methodology associated with the computer program.
2. Culvert capacities for conveyance under interior local, collector, or arterial streets without roadway overtopping shall be the runoff resulting from the 25-year, 50-year, and 100-year frequency storms, respectively, for off-site areas under existing condition and on-site areas under post-developed conditions. Driveway culvert capacities shall be capacities required for the street classification to which the driveway connects. Greater culvert capacity shall be required to protect the finished floor elevation of buildings from the post-developed 100-year frequency storm when, in the opinion of the design engineer or the City of Valparaiso City Engineer, the finished floor elevation is threatened. If the street or road provides the only access to or from any portion of any commercial or residential development, the crossing shall be designed for a minimum of 100-year frequency storm.
3. For portions of the system considered minor drainage systems, the allowable spread of water on Collector Streets for the design storm is limited to maintaining two

clear 10-foot moving lanes of traffic. One lane is to be maintained on Local Roads, while other access lanes (such as a subdivision cul-de-sac) can have a water spread equal to one-half of their total width.

4. To ensure access to buildings and allow the use of the roadway by emergency vehicles during storms larger than the design storm, an overflow channel/swale between sag inlets and overflow paths or basin shall be provided at sag inlets so that the maximum depth of water that might be ponded in the street sag shall not exceed 7 inches measured from elevation of gutter. All water shall be contained in the right-of-way for a 100-year storm.
5. Facilities functioning as a major drainage system as defined in **Appendix A** must also meet IDNR design standards in addition to the City's standards. In case of discrepancy, the most restrictive requirements shall apply.

## **B. Determination of Hydraulic Capacity for Storm Sewers using Manning's Equation**

Determination of hydraulic capacity for storm sewers sized by the Rational Method analysis must be done using Manning's Equation.

$$V = (1.486/n)(R^{2/3})(S^{1/2})$$

Then:

$$Q = (V)(A)$$

Where:

Q = capacity in cubic feet per second

V = mean velocity of flow in feet per second

A = cross sectional area in square feet

R = hydraulic radius in feet

S = slope of the energy grade line in feet per foot

n = Manning's "n" or roughness coefficient

The hydraulic radius, R, is defined as the cross-sectional area of flow divided by the wetted flow surface or wetted perimeter. Allowable "n" values and maximum permissible velocities for storm sewer materials are listed in **Table 4-1**.

**Table 4-1.** Typical Values of Manning’s “n”

<b>Material</b>	<b>Manning’s “n”</b>	<b>Maximum Velocities (feet/second)</b>
<b>Closed Conduits</b>		
Concrete	0.013	10
Vitrified Clay	0.013	10
HDPE	0.012	10
PVC	0.011	10
<b>Circular CMP, Annular Corrugations, 2 2/3 x 1/2 inch</b>		
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
<b>Open Channels</b>		
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 <sup>1</sup>	0.025	4
Existing Earth <sup>2</sup>	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.*

<sup>1</sup> New earth (uniform, sodded, clay soil)

<sup>2</sup> Existing earth (fairly uniform, with some weeds).

### C. **Backwater Method for Pipe System Analysis**

For hydraulic analysis of existing or proposed storm drains which possess submerged outfalls, a more sophisticated design/analysis methodology than Manning's equation will be required. The backwater analysis method provides a more accurate estimate of pipe flow by calculating individual head losses in pipe systems that are surcharged and/or have submerged outlets. These head losses are added to a known downstream water surface elevation to give a design water surface elevation for a given flow at the desired upstream location.

Tailwater conditions assumed for this computation should be verified by appropriate calculation. Total head losses may be determined as follows:

$$\text{Total head loss} = \text{frictional loss} + \text{manhole loss} + \text{velocity head loss} + \text{junction loss}$$

Various computer modeling programs such as HYDRA, ILLUDRAIN, and STORMCAD are available for analysis of storm drains under these conditions. Computer models to be utilized, other than those listed, must be accepted by the City Engineer.

### D. **Minimum Size for Storm Sewers**

The minimum diameter of all storm sewers shall be 12 inches. Smaller diameter pipes may be considered on a case-by-case basis and must be approved by the City of Valparaiso City Engineer. When the minimum 12-inch diameter pipe will not limit the rate of release to the required amount, the rate of release for detention storage shall be controlled by an orifice plate or other device, subject to acceptance of the City of Valparaiso City Engineer.

### E. **Pipe Cover, Grade, and Separation from Sanitary Sewers**

Pipe grade shall be such that, in general, a minimum of 2.0 feet of cover is maintained over the top of the pipe. If the pipe is to be placed under pavement, or within 5 feet of the pavement, then the minimum pipe cover shall be 2.5 feet from top of pavement to top of pipe. Pipe cover less than the minimum may be allowed per manufacturer's specifications or recommendation and used only upon written acceptance from the City of Valparaiso City Engineer. 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. Minimum and maximum allowable slopes shall be those capable of producing velocities of between 2.5 and 10 feet per second, respectively, when the sewer is flowing full. Maximum permissible velocities for various storm sewer materials are listed in **Table 4-1**. A minimum of 2.0 feet of vertical separation between storm sewers and sanitary sewers shall be required. When this is not possible, the sanitary sewer must be encased in concrete or ductile steel within 5 feet, each side, of the crossing centerline.

**F. Alignment**

Storm sewers shall be straight between manholes and/or inlets.

**G. Manholes/Inlets**

Manholes and/or inlets shall be installed to provide human access to continuous underground storm sewers for the purpose of inspection and maintenance. The casting access minimum inside diameter shall be no less than 24 inches or a rectangular opening of no less than 22 inches by 22 inches. When grade adjustments of manholes are required in the field to meet finish design or existing curb grade, adjustment rings with a maximum height of 12 inches may be used. Manholes shall be provided at the following locations:

1. Where two or more storm sewers converge.
2. Where pipe size or the pipe material changes.
3. Where a change in horizontal alignment occurs.
4. Where a change in pipe slope occurs.
5. At intervals in straight sections of sewer, not to exceed the maximum allowed. The maximum distance between storm sewer manholes shall be as shown in **Table 4-2**.

**Table 4-2.** Maximum Distance Between Manholes

<b>Size of Pipe (<i>Inches</i>)</b>	<b>Maximum Distance (<i>Feet</i>)</b>
12 through 48	400
> 48	600

In addition to the above requirements, a minimum drop of 0.1 foot through manholes and inlet structures should be provided. When changing pipe size, match crowns of pipes, unless detailed modeling of hydraulic grade line shows that another arrangement would be as effective. Pipe slope should not be so steep that inlets surcharge (i.e. hydraulic grade line should remain below rim elevation).

Plans should note that all inlets and castings must be pre-stamped with a “clean water” message.

Manhole/inlet inside sizing shall be as shown in **Table 4-3**.

**Table 4-3. Manhole/Inlet Inside Sizing**

<b>Depth of Structure</b>	<b>Minimum Diameter</b>	<b>Minimum Square Opening</b>
Less than 5 feet	36 inches	36" x 36"
5 feet or more	48 inches	48" x 48"

## **H. Inlet Sizing and Spacing**

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. Inlets shall be provided so that surface water is not carried across or around any intersection nor for a distance greater than three hundred (300) feet. 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 4-1**. 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  
Email: [inltap@ecn.purdue.edu](mailto:inltap@ecn.purdue.edu)  
Website: [www.purdue.edu/INLTAP/](http://www.purdue.edu/INLTAP/)

## **I. Installation and Workmanship**

The point of commencement for laying a storm sewer pipe shall be the lowest point in the proposed sewer line. All pipes shall be laid, without break, upgrade from structure to structure. All storm sewer pipe outlets shall have poured in place toewalls with anchor bolts. Bedding and backfill materials around storm sewer pipes, sub-drains, and the associated structures are limited to: #8 crushed stone, hand-tamped or walked-in; "B" borrow, compacted to 95% Standard Proctor density; flowable fill; and native or structural backfill, compacted to 95% Standard Proctor density. The specific location requirements for the use of these materials are dependent on pipe location in relation to pavement structures and on pipe material as detailed in **City Standards for Municipal Improvements**. 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 INDOT "Standard Specifications".

Dips/sags on newly installed storm systems will not be allowed. Also, infiltration from cracks, missing pieces, and joints would not be allowed. Variations from these standards must be justified and receive written acceptance from the City of Valparaiso City Engineer.

To verify that all enclosed drains and sewers are functioning properly, all storm sewers including sub drains shall be cleaned and televised with visual recording (via closed circuit television). Visual recording will be scheduled 30 days after installation and at least 90 days prior to the expiration of the maintenance bond. Reports summarizing the results of the noted visual recordings shall be reviewed and accepted by the City of Valparaiso City Engineer before maintenance sureties would be recommended to be released.

Based on the review of visual recording, the City Engineer shall determine the need for additional inspection of the storm sewers or sub-drains to assess the condition of the system. Newly installed storm systems covered under the maintenance bond shall meet the minimum requirements established in the AASHTO Culvert and Storm Drain Inspection Guide constituting a Condition Rating of 1 or "Good" as established below in **Table 4-4**.

Following installation of storm sewer facilities, Contractor shall also provide locations of catch basins, inlets, outfalls, manholes, pipe locations with diameter noted with Global Positioning System (GPS). GPS information shall utilize the State Plane Coordinate System (NAD 1983 State Plane Indiana West). Data shall be provided in digital form using either ArcGIS Pro compatible shape files or Microsoft Excel.

**Table 4-4. Pipe Inspection Criteria**

Material	Good Rating Condition
HDPE, PVC or PP	Barrel maintains round shape with less than 5% vertical deformation of original ID. No indication of wear, abrasion, splits or cracking.
Concrete	No measurable crack width greater than 0.01 in. No spalling, slabbing, delamination, scaling or abrasion.

**J. Materials**

Storm sewer manholes and inlets shall be constructed of precast reinforced concrete. Material and construction shall conform to the latest edition of INDOT's "Standard Specifications", Sections 702 and 720.

Pipe and fittings used in storm sewer construction shall conform to the latest edition of the INDOT "Standard Specifications", Sections 907 and 908. In addition, ductile iron pipe and fittings shall conform to AWWA C-151. Polyethylene pipe used for private storm sewers shall conform to ASTM F2648 or INDOT specifications. Other pipe and fittings not specified herein or in Sections 907-908 of the latest edition of the INDOT "Standard Specifications" may be used only when specifically authorized by the City of Valparaiso 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". **If the storm sewer pipe is to be placed within a road right-of-way or in an area subject to loading, the pipe and fittings shall be concrete. Plastic pipe use must be justified and receive written acceptance from City Engineer.**

#### **K. Special Hydraulic Structures**

Special hydraulic structures required to control the flow of water in storm runoff drainage systems include junction chambers, drop manholes, stilling basins, and other special structures. The use of these structures shall be limited to those locations justified by prudent planning and by careful and thorough hydraulic engineering analysis. Certification of special structures by a certified Structural Engineer may also be required.

#### **L. Connections to Storm Sewer System**

To allow any connections to the storm sewer system, provisions for the connections shall be shown in the drainage calculations for the system. Specific language shall be provided in the protective covenants, on the record plat, or with the parcel deed of record, noting the ability or inability 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 placed 10' minimum behind property line and discharged into a designated storm drainage channel/swale. Sump pumps installed to receive and discharge floor drain flow or other sanitary sewage shall be connected to the sanitary sewers. A stormwater sump pump shall only be used for the discharge of stormwater.
2. **Footing drains and perimeter drains** shall be placed 10' minimum behind property line and toward a designated storm sewers or discharged into designated storm drainage channels/swales.
3. All **roof downspouts**, roof drains, or roof drainage piping shall discharge onto the ground and shall not be directly connected to the storm drainage system. Variation from this requirement may be requested and granted by the City of Valparaiso City Engineer in special circumstances. No downspouts or roof drains shall be connected to the sanitary sewers.

4. **Garage and Basement floor drains** shall not be connected to the storm sewers.
5. **Swimming Pool drains** shall not be connected to the storm sewers unless the water is dechlorinated, as defined in Appendix A, prior to being connected to the storm sewer.

In addition, none of the above-mentioned drains shall be connected to any road sub-drain/street underdrains, unless specifically authorized by the City of Valparaiso City Engineer.

#### **M. Drainage System Overflow Design**

Overflow path/ponding areas throughout the development resulting from a 100-year storm event, calculated based on all contributing drainage areas, on-site and off-site, in their proposed or reasonably anticipated land use and with storm pipe system assumed completely plugged, shall be determined.

The centerline of this 100-year overflow path shall be clearly shown as a distinctive line symbol on the plans, and a minimum width of 30 feet flow width along the centerline of the flow path (15 feet from centerline on each side) designated as permanent drainage easements. A continuous flood route from the sag inlets to the final outfall shall be shown and the minimum 30-feet along the centerline contained within an easement or road right-of-way regardless of the 100-year storm event ponding elevation. This overflow path/easement area shall be shown on the plans as hatched area or another distinctive symbol. No fences or landscaping should be constructed within the easement areas. These areas are easements that are to be maintained by the property owners or be designated as common areas to be maintained by the homeowners association.

The minimum adjacent grade of the portion of any residential, commercial, or industrial building (the ground elevation next to the building after construction is completed that sits adjacent to the emergency flood route or may be subject to flooding by the emergency flood route) shall be a minimum of 1 foot above the estimated 100-year elevation of the emergency flood route assuming that all stormwater pipes are fully clogged. The required minimum adjacent grade of buildings adjacent to an overflow path is provided in **Table 4-5** or as alternatively calculated as discussed below.

As an alternative to using default values in **Table 4-5**, the overflow path/ponding may be modeled as successive series of natural ponds and open channel segments. For simplification, occasional ponding along the overflow path may be ignored. If explicitly modeled, ponds should be modeled similar to that discussed for modeling depressional areas in Chapter 6. Channels should be modeled according to modeling techniques discussed in Chapter 5. 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 XPSWMM, TR-20, HEC-HMS,

and HEC-1, combined with HEC-RAS. Other models may be acceptable and should be accepted by the City of Valparaiso City Engineer prior to their utilization.

Simply using the values in **Table 4-5** is preferred over the much more complicated detailed modeling of the overflow/ponding areas. However, regardless of the methodology used, the City of Valparaiso City Engineer reserves the right to require independent calculations to verify that the proposed building minimum adjacent grade facing the flood route or the portion of building having a potential to be subject to flooding by the flood route provide adequate freeboard above the anticipated overflow path/ponding elevations.

The Lowest Adjacent Grade (LAG) requirements for buildings adjacent to other flooding sources are discussed in Chapter 10 of this Manual. In case there are more than one flooding sources applicable to a building site, the highest calculated LAG for the building shall govern the placement of the building on that site.

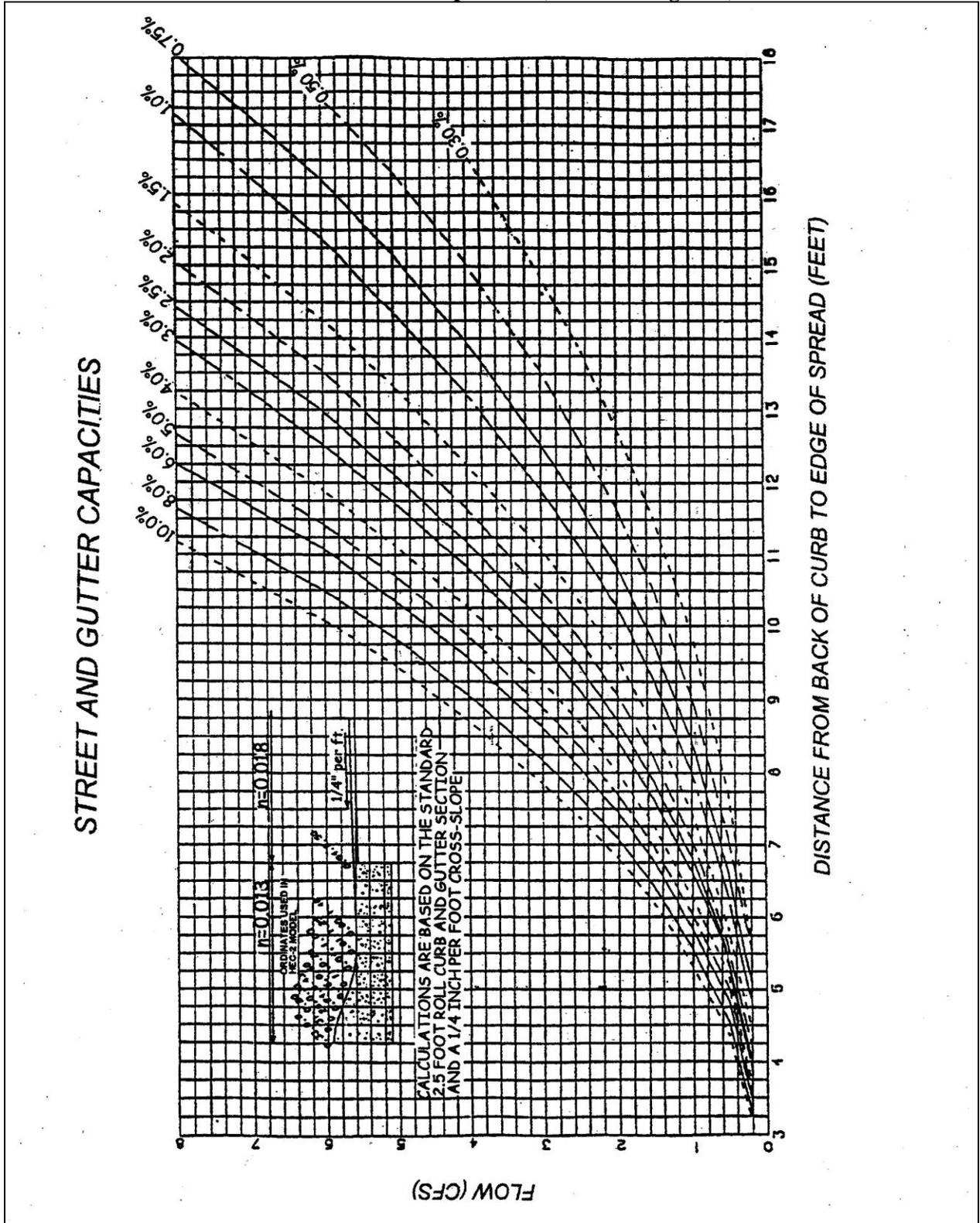
In the case of existing upstream detention, an allowance equivalent to the reduction in flow rate provided may be made for upstream detention only when: (1) such detention and release rate have previously been accepted by the City of Valparaiso City Engineer or other official charged with the approval authority at the time of the acceptance, and (2) evidence of its construction and maintenance can be shown.

**Table 4-5.** Minimum Building Adjacent Grade with Respect to Overflow Path Invert Elevations

<b>Drainage Area (acres)</b>	<b>Minimum Building Adjacent Grade Above Overflow Path Invert (ft.)</b>	<b>Minimum Building Adjacent Grade Above Overflow Path Invert, if Overflow Path is in the Street (ft.)</b>
Up to 5	2.5	1.5
6-10	3.0	1.5
11-15	3.25	1.75
16-20	3.5	1.75
21-30	4.0	2.0
30-50	4.25	2.0

*Notes: The overflow path invert refers to the elevation of the flow line of the emergency flow route (typically in the form of a channel, swale, or gutter) nearest to the upstream end of a building.*

Figure 4-1  
Street and Gutter Capacities (continuous grade)





# Chapter Five

## OPEN CHANNEL DESIGN STANDARDS AND SPECIFICATIONS

All channels, whether private or public, and whether constructed on private or public land, shall conform to the design standards and other design requirements contained herein. Unless specifically referenced in a particular provision, the standards contained in this Chapter refer to open channels and not swales. Proposed open channels must be sized and designed to convey at least the 10-year frequency on-site stormwater runoff, as well as the anticipated 10-year frequency tributary off-site stormwater runoff based on the future developed condition (using **Table 6-1** of the Technical Standards). An analysis of the emergency routing of stormwater runoff through the subject development must be provided to confirm that the development will not obstruct the free flow of floodwaters from the tributary off-site property in its current condition and after development. In addition, the Drainage System Overflow Design must be completed in accordance with Section M of Chapter 4 to ensure the safe routing of flood waters through the subject development with the tributary off-site property in its current condition and after development.

### A. Design Storm Frequencies

1. All channels and swales shall accommodate, as a minimum, peak runoff from a 24-hour, 10-year return frequency storm calculated based on methodology described in Chapter 2. For Rational Method analysis, the storm duration shall be equal to the time of concentration for the drainage area. In computer-based analysis, the duration is as noted in the applicable methodology associated with the computer program.
2. Channels with a carrying capacity of more than 30 cfs at bank-full stage shall be capable of accommodating peak runoff for a 24-hour, 50-year return frequency storm within the drainage easement.
3. Channel facilities functioning as a major drainage system, as defined in **Appendix A**, must also meet IDNR design standards in addition to the City's standards. In case of discrepancy, the most restrictive requirements shall apply.
4. The 10-year storm design flow for residential rear and side lot swales shall not exceed 4 cfs. Unless designed as a post-construction stormwater quality BMP, the maximum length of rear and side lot swales before reaching any inlet shall not exceed 400 feet.

5. Regardless of minimum design frequencies stated above, the performance of all parts of drainage system shall be checked for the 100-year flow conditions to ensure that all buildings are properly located outside the 100-year flood boundary and that flow paths are confined to designated areas with sufficient easement.

**B. Determination of Channel Waterway Area using Manning's Equation**

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

$$A = Q/V$$

where:

A = Waterway area of channel in square feet

Q = Discharge in cubic feet per second (cfs)

V = Steady-State channel velocity, as defined by Manning's Equation (See Chapter 4)

**C. 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 XPSWMM, 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 Valparaiso City Engineer.

**D. Channel Cross-Section and Grade**

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 for the design storm are not acceptable, as siltation will take place and ultimately reduce the channel cross-section area. The maximum permissible velocities in vegetated-lined channels are shown in **Table 5-1**. 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 shall 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. Use of open channels and swales within the road right of way is only allowed in special circumstances when no other viable option exists. The applicant must consult with the Valparaiso City Engineer prior to design.

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.

**Table 5-1.** Maximum Permissible Velocities in Vegetal-Lined Channels<sup>1</sup>

Cover	Channel Slope Range (Percent) <sup>3</sup>	Permissible Velocity <sup>2</sup>	
		Erosion Resistant Soils (ft. per sec.) <sup>4</sup>	Easily Eroded Soils (ft. per sec.) <sup>4</sup>
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	0-5 <sup>3</sup> 5-10	5 4	4 3
Lespedeza Sericea Weeping Lovegrass Yellow Bluestem Redtop Alfalfa Red Fescue	0-5 <sup>4</sup> 5-10	3.4	2.5
Common Lespedeza <sup>5</sup> Sudangrass <sup>5</sup>	0-5 <sup>6</sup>	3.5	2.5

<sup>1</sup> From Soil Conservation Service, SCS-TP-61, "Handbook of Channel Design for Soil and Water Conservation".

<sup>2</sup> Use velocities exceeding 5 feet per second only where good channel ground covers and proper maintenance can be obtained.

<sup>3</sup> 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.

<sup>4</sup> 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.

<sup>5</sup> Annuals - use on mild slopes or as temporary protection until permanent covers are established.

<sup>6</sup> Use on slopes steeper than 5 percent is not recommended.

## **E. Side Slopes**

1. Earthen channel 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.
2. Where channels will be lined with riprap, concrete, or other acceptable lining method, side slopes shall be no steeper than 2 horizontal to 1 vertical (2:1) with adequate provisions made for weep holes.
3. Side slopes steeper than 2 horizontal to 1 vertical (2:1) may be used for lined channels provided that the side lining is designed and constructed as a structural retaining wall with provisions for live and dead load surcharge.
4. When the design discharge produces a depth of greater than three (3) feet in the channel, appropriate safety precautions shall be added to the design criteria based on reasonably anticipated safety needs at the site.

## **F. Channel Stability**

1. 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.
2. 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 **Tables 4-1 and 5-1**. In no case is it necessary to check channel stability for discharges greater than that from a 100-year frequency storm.
3. 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" 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.

#### **G. Drainage of Swales**

All swales shall meet the following requirements and the specifications of the City of Valparaiso or designee:

1. Minimum swale flow line slopes are 1%. Slope less than 1% shall be permitted on a case-by-case basis per approved by City Engineer.
2. 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.
3. Unless designed to act as a stormwater quality BMP or lined with concrete, vegetated swales shall have a double-walled 8-inch sub-surface drain with a minimum cover of 18 inches to dry the swales. Typical detail of a swale with sub-surface drain is shown in **City Standards for Municipal Improvements**. Tile lines may be outletted through a drop structure at the ends of the swale or through a standard tile outlet. Before reaching an open channel, the perforated drain shall be connected to 10 feet of SDR # 40. Also, cleanout risers are to be installed at the high point as well as end of run.
4. Further guidance regarding this subject may be found in the latest edition of the Indiana Drainage Handbook.

#### **H. Appurtenant Structures**

The design of channels will include provisions for operation and maintenance and the proper functioning of all channels, laterals, travelways, 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 floodgates, water level control devices, and any other appurtenance structure affecting the functioning of the channels and the attainment of the purpose for which they are built.

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 and laterals thereto 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 shall have a minimum capacity equal to the design discharge or governmental agency design requirements, whichever is greater.

**I. Disposal of Spoil**

Spoil material resulting from clearing, grubbing, and channel excavation shall be disposed of in a manner that will:

1. Minimize overbank wash.
2. Provide for the free flow of water between the channel and floodplain boundary unless the valley routing and water surface profiles are based on continuous dikes being installed.
3. Not hinder the development of travelways for maintenance.
4. Leave the right-of-way in the best condition feasible, consistent with the project purposes, for productive use by the owner.
5. Be acceptable by the IDEM, IDNR or USACE, if applicable.

**J. Materials**

Materials acceptable for use as channel lining are:

1. Grass
2. Revetment Riprap
3. Concrete
4. Hand Laid Riprap
5. Precast Cement Concrete Riprap
6. Gabions
7. Glacial Boulders
8. Straw or Coconut Mattings, or other accepted material (only until grass is established)

Other lining materials must be accepted in writing by the City of Valparaiso City Engineer. Materials shall comply with the latest edition of the INDOT, "Standard Specifications".

**K. Drainage System Overflow Design**

See Chapter 4, Section M.



# Chapter Six

## STORMWATER DETENTION DESIGN STANDARDS FOR PEAK FLOW CONTROL

The following shall govern the design of any improvement with respect to the detention of stormwater runoff. Basins shall be constructed to retain and/or temporarily detain the stormwater runoff that exceeds the maximum peak release rate authorized by the Ordinance and these technical standards. The required volume of storage provided in these basins, together with such storage as may be authorized in other on-site facilities, shall be sufficient to control excess runoff from the 10-year or 100-year storm as explained below in Section “B.”. 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.

### A. Acceptable Detention Facilities

The increased stormwater runoff resulting from a proposed development should be retained (if possible) and detained on-site (if retention is not feasible due to limited infiltration capacity) by the provisions of appropriate above- or below- ground wet bottom or dry bottom detention facilities, parking lots, or other acceptable techniques. Measures that retard the rate of overland flow and the velocity in runoff channels shall also be used to partially control runoff rates.

### B. Allowable Release Rates

#### 1. General Release Rates

Control devices shall limit the discharge to a rate such that the post-developed release rate from the site is no greater than 0.5 cfs per acre of development for 0-100 year return interval storms.

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.

#### 2. Site-Specific Release Rates for Sites with Depressional Storage

For sites where depressional storage exists, the general release rates provided above may have to be further reduced. If depressional storage exists at the site, site-

specific release rates must be calculated according to methodology described in Chapter 2, accounting for the depressional storage by modeling it as a pond whose outlet is a weir at an elevation that stormwater can currently overflow the depressional storage area. Post developed release rate for sites with depressional storage shall be the 2-year pre-developed peak runoff rate for the post-developed 10-year storm and 10-year pre-developed peak runoff rate for the post-developed 100-year storm. In no case shall the calculated site-specific release rates be larger than general release rates provided above.

Note that by definition, the depressional storage does not have a direct gravity outlet but if in agricultural production, it is more than likely drained by a tile and should be modeled as “empty” at the beginning of a storm. The function of any existing depressional storage should be modeled using an event hydrograph model to determine the volume of storage that exists and its effect on the existing site release rate. To prepare such a model, certain information must be obtained, including delineating the tributary drainage area, the stage-storage relationship and discharge-rating curve, and identifying the capacity and elevation of the outlet(s).

The tributary area should be delineated on the best available topographic data. After determining the tributary area, a hydrologic analysis of the watershed should be performed, including, but not limited to, calculation of the appropriate composite runoff curve number and time of concentration. Stage-storage data for the depressional area should be obtained from the site topography. The outlet should be clearly marked, and any calculations performed to create a stage-discharge rating curve must be included with the stormwater submittal.

Also note that for determining the post-developed peak runoff rates, the depressional storage must be assumed to be filled unless the City of Valparaiso City Engineer can be assured, through dedicated easement, that the noted storage will be preserved in perpetuity.

3. Management of Off-site Runoff

Runoff from all upstream tributary areas (off-site land areas) may be bypassed around the detention/retention facility without attenuation. Such runoff may also be routed through the detention/retention facility, provided that a separate outlet system or channel is incorporated for the safe passage of such flows, i.e., not through the primary outlet of a detention facility. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized and the invert elevation of the emergency overflow weir determined according to the on-site runoff only. Once the size and location of primary outlet structure and the invert elevation of the emergency overflow weir are determined by considering on-site runoff, the 100-year pond elevation is determined by routing the entire inflow, on-site and off-site, through the pond.

Note that the efficiency of the detention/retention facility in controlling the on-site runoff may be severely affected if the off-site area is considerably larger than the

on-site area. As a general guidance, on-line detention may not be effective in controlling on-site runoff where the ratio of off-site area to on-site area is larger than 5:1. Additional detention (above and beyond that required for on-site area) may be required by the City of Valparaiso City Engineer when the ratio of off-site area to on-site area is larger than 5:1.

4. Downstream Restrictions

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 shall be reduced to that rate permitted by the capacity of the receiving downstream channel or storm sewer system. Additional detention, as determined by the City of Valparaiso City Engineer, shall 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 of Valparaiso City Engineer may require additional analysis to determine the receiving system's limiting downstream capacity.

If the proposed development makes up only a portion of the undeveloped watershed upstream of the limiting restriction, the allowable release rate for the development shall be in direct proportion to the ratio of its drainage area to the drainage area of the entire watershed upstream of the restriction.

As an alternative to reduction of release rates, the City of Valparaiso may require the applicant to pursue alleviating downstream restrictions. The applicant would be responsible for obtaining all permits and consents required and for incurring all expenses involved in such undertaking.

5. Direct Release Provisions

Due to unknowns regarding the future development patterns and the associated proposed stormwater quantity and quality management systems within a watershed, it is the policy of the City of Valparaiso to discourage direct release of runoff from a new development or redevelopment without providing detention. However, in rare circumstances, where a comprehensive watershed-wide hydrologic study or watershed plan of a major stream adopted by the City Engineer (not a "beat the peak" analysis) substantiates the benefits of (or allows for) direct release for a proposed development located adjacent to a major stream, the detention requirements set in this Ordinance may be waived. Other special circumstances when such a waiver may be considered by the City Engineer include situations where the design of a regional pond has already taken into account the provision of direct release in certain areas in the watershed or when the subject development is immediately next to a major stream that has a larger than 100 square miles drainage area.

6. Documentation of Results

The results of the allowable release rate determinations (if retaining the entire required peak flow rate volume is not feasible) as well as the modeling simulation

results must be summarized in a table that shall be included in the Stormwater Drainage Technical Report and on the Drainage Plan. The table must include, 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 post-developed 10-year and 100-year events, pre-developed 2-year flow rates in cfs as well as pre- and post-developed flow rates for 2-, 10-, and 100-year events. The worksheet provided as **Table 6-1** should be filled for each final site outlet.

**Table 6-1.** Final Site Outlet Worksheet

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)									0.5	0.5
	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)										
	Contributing Area of Development Site (ac) and Allowable Release Rate (cfs)										
	Total Contributing DA (ac) and Modeling Results (cfs)							no			

**C. General Detention Basin Design Requirements**

1. The retention/detention facility shall be designed in such a manner that a minimum of 90% of the maximum volume of water stored and subsequently released at the design release rate (if not retaining the entire peak flow rate volume) shall not result

in a storage duration in excess of 48 hours from the start of the storm unless additional storms occur within the period. In other words, the design shall ensure that a minimum 90% of the original retention/detention capacity is restored within 48 hours from the start of the design 100-year storm.

2. The 100-year elevation of stormwater retention/detention facilities shall be separated by not less than 25 feet from any building or structure to be occupied. The Lowest Adjacent Grade (including walkout basement floor elevation) for all residential, commercial, or industrial buildings 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 normal water level of any wet-bottom pond or the ground local groundwater table, whichever is higher, to avoid the overuse of sump pumps and frequent flooding of the basement.
3. No detention facility or other water storage area, permanent or temporary, shall be constructed under or within twenty (20) feet of any pole or high voltage electric line. Likewise, poles or high voltage electric lines shall not be placed within twenty (20) feet of any detention facility or other water storage area.
4. All stormwater detention facilities shall be separated from any road right-of-way by no less than one right-of-way width, measured from the top of bank or the 100-year pool if no defined top of bank is present, using the most restrictive right-of-way possible. If the width of the right-of-way is less than 50 feet, then the minimum distance between top of bank and road right-of-way shall be increased to 50 feet. Use of guard rails, berms, or other structural measures may be considered in lieu of the above-noted setbacks.
5. Slopes no steeper than 3 horizontal to 1 vertical (3:1) for safety, erosion control, stability, and ease of maintenance shall be permitted.
6. Safety screens having a maximum opening of six (6) inches shall be provided for any pipe or opening end sections 12-inch in diameter or larger. Storm drain pipes outletting into the pond shall not be submerged.
7. Use of fences around all retention/detention ponds is encouraged to assure safety. Unless specifically required by the Valparaiso City Engineer, the decision to use fencing around retention/detention ponds are left to the owner or the developer. Recommendations contained within this document do not relieve the applicant and owner/developer from the responsibility of taking all necessary steps to ensure public safety with regards to such facilities.
8. Outlet control structures shall be designed to operate as simply as possible and shall require little or no maintenance and/or attention for proper operation. For maintenance purposes, the outlet from the pond (if any) shall be a minimum of 0.5 foot above the normal water level of the receiving water body. They shall limit

discharges into existing or planned downstream channels or conduits so as not to exceed the predetermined maximum authorized peak flow rate. If an outlet control structure includes an orifice to restrict the flow rate, such orifice shall be no less than 6 inches in diameter.

9. Emergency overflow facilities such as a weir or spillway shall be provided for the release of exceptional storm runoff or in emergency conditions should the normal discharge devices become totally or partially inoperative. The overflow facility shall be of such design that its operation is automatic and does not require manual attention.
  - a) Off-site flows greater than the allowable release rate for the pond shall be conveyed through the emergency spillway, not through the primary outlet structure. Unless the pond is being designed as a regional detention facility, the primary outlet structure shall be sized and the invert elevation of the emergency overflow weir determined according to the on-site runoff only and all other flows shall be either retained or safely bypassed through the emergency overflow weir.
  - b) 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 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 length of the weir is to be determined using the weir equation, with the overflow weir control elevation at the Pond's 100-year elevation (pond is assumed full to the overflow weir control elevation), discharge equal to 1.25 times the peak 100-year inflow, and the maximum head being the difference between the weir control elevation and the top of the bank.
  - c) 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. It must be sized to accommodate the design flow of the pond's emergency overflow weir. A minimum of thirty (30) feet width along the centerline of this emergency overflow route or the flow width required to accommodate the emergency spillway design flow, whichever is greater, shall be designated as permanent drainage easement. This emergency overflow path/easement area shall be shown on the plans as hatched area or another distinctive symbol. No fences or landscaping can be constructed within the easement areas. The Lowest Adjacent Grade of all residential, commercial, or industrial buildings along this emergency overflow route shall be set a minimum of 2 feet above the flood elevation along the route, calculated based on the pond's emergency overflow weir design discharge.

10. Grass or other suitable vegetative cover shall be provided along the banks of the retention/detention storage basin. Vegetative cover around detention facilities should be maintained as appropriate.
11. Debris and trash removal and other necessary maintenance shall be performed on a regular basis to assure continued operation in conformance to design.
12. No residential lots or any part thereof shall be used for any part of a detention basin assumed full to the 100-year water surface elevation or the emergency overflow weir elevation, whichever is higher. Detention basins, assumed full to the 100-year water surface elevation or the emergency overflow weir elevation, whichever is higher, shall be placed within a common area either platted or legally described and recorded as a perpetual stormwater easement.

#### **D. Additional Requirements for Wet-Bottom Facility Design**

Where part of a detention facility will contain a permanent pool of water, all the items required for detention storage shall apply. Also, a controlled positive outlet will be required to maintain the design water level in the wet bottom facility and provide required detention storage above the design water level. However, the following additional conditions shall apply:

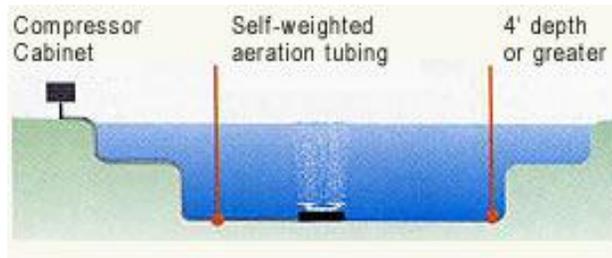
1. Facilities designed with permanent pools or containing permanent lakes shall have a water area of at least one-half (0.5) acre with a minimum depth of eight (8) feet over the majority of pond area. If fish are to be used to keep the pond clean, a minimum depth of approximately ten (10) feet shall be maintained over at least 25 percent of the pond area. The remaining pond area shall have no extensive shallow areas, except as required to install the safety ramp, safety ledge, and BMPs as required below. Construction trash or debris shall not be placed within the permanent pool.
2. All wet detention/retention ponds must be constructed in as natural a shape (footprint) as possible and have a vegetated safety ledge (approximately 6 inches below normal pool) and/or have native vegetation planted on the pond banks to create a riparian buffer (minimum 10 feet wide). Native vegetation can be installed as container grown plants or as seed at the time of construction. If native vegetation is planted on the pond banks, signage must be provided indicating that it is a natural "Do Not Mow" area. The vegetation should be planted in a manner so as not to hide or disguise the ponds edge. Maintenance of the vegetated barrier shall be the responsibility of the owner or the homeowners' association. All pond slopes shall be 3:1 (horizontal to vertical) or flatter.
3. For wet-bottom facilities without a security fence, a maintenance ledge ten (10) feet in width is required and shall be installed approximately 12 inches above the permanent water level and a safety ledge ten (10) feet in width is required and shall be installed approximately 6 inches below the permanent water level. If a non-

vegetated safety ledge is installed, the depth of the safety ledge shall be approximately 18 inches below normal pool. The slope between the two ledges shall be stable and protected from erosion with hard armoring or bioengineered techniques.

For wet-bottom facilities with a security fence, a maintenance ledge six (6) feet in width is required and shall be installed approximately 12 inches above the permanent water level and a safety ledge six (6) feet in width is required and shall be installed approximately 6 inches below the permanent water level. If a non-vegetated safety ledge is installed, the depth of the safety ledge shall be approximately 18 inches below normal pool. The slope between the two ledges shall be stable and protected from erosion with hard armoring or bioengineered techniques.

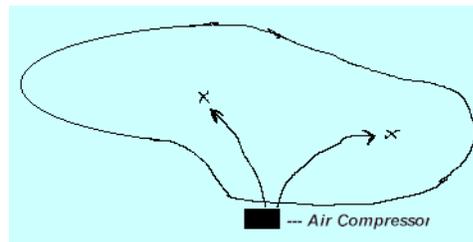
The maintenance ledge may be waived if pond side slopes above normal water are 6:1 or flatter.

4. A safety ramp exit from the lake shall be required in all cases and shall have a minimum width of twenty (20) feet and exit slope of 6 horizontal to 1 vertical (6:1). The safety ramp shall be constructed of suitable material to prevent structural instability due to vehicles or wave action. Adequate access to the safety ramp shall be provided by locating it adjacent to public right-of-way or by providing a clear route recorded within an access easement or a common area.
5. In addition to provisions specified in Section C.4 of this Chapter (if applicable), parks, playgrounds, and athletic fields shall be separated from all stormwater detention facilities by no less than 100 feet, measured from the 100-year pool of the pond. Trails and sidewalks shall be separated from all stormwater detention facilities by no less than 25 feet, measured from the 100-year pool of the pond.
6. Periodic maintenance is required in lakes to control weed and larval growth. The facility shall also be designed to provide for the easy removal of sediment that will accumulate during periods of reservoir operation. A means of maintaining the designed water level of the lake during prolonged periods of dry weather may also be required.
7. For maintenance purposes, the outlet of storm sewers entering the pond shall be a minimum of 0.5 foot above the normal pool level.
8. Methods to prevent pond stagnation, including but not limited to surface or sub-surface aeration or destratification facilities that can, at the minimum, achieve one complete pond volume turnover per day should be considered. **Figure 6-1** below shows a typical diffuser aeration system that consists of a quiet air compressor at the shore, aeration tubing, and one or more sets of diffuser head(s).



**Figure 6-1. Typical diffuser aeration system**

Irregularly shaped ponds should be treated as two or three separate ponds, as shown in **Figure 6-2**. Likewise, larger ponds will also need multiple aeration units.



**Figure 6-2. Aeration system for Irregularly shaped ponds**

Design calculations to substantiate the effectiveness of proposed aeration facilities shall be submitted with final engineering plans. Design calculations should, at a minimum, indicate that the device and/or series of devices are providing a minimum volume turnover of once per 24 hours over the majority of the pond volume (i.e. pump radius of influence calculations, etc.). Agreements for the perpetual operation and maintenance of aeration facilities by the property owner or the HOA shall be prepared similar to that noted for post-construction BMPs noted in Chapter 8 of these Technical Standards.

If the detention pond is also proposed to be used as a post-construction stormwater BMP, alternative means of aeration (such as diffuser aeration systems) shall be used that would not result in re-suspension of sediment particles and would not prevent the efficient settling of sediment particles.

9. If the facility is being located near an airport, a minimum horizontal separation distance between the airport property and the pond will need to be provided in accordance to Federal Aviation Administration (FAA) advisory Circular 150/5200-33, titled "Hazardous Wildlife Attractions On or Near Airports" and dated 8/28/2007, or the latest update of the same.

#### **E. Additional Requirements for Dry-Bottom Facility Design**

In addition to general design requirements, detention facilities that will not contain a permanent pool of water shall comply with the following requirements:

1. Provisions shall be incorporated into facilities for complete interior drainage of dry bottom facilities, including the provisions of natural grades to outlet structures (if any), longitudinal and transverse grades to perimeter drainage facility, paved gutters, or the installation of subsurface drains.
2. For residential developments, unless the facility is fully fenced in and gated, the maximum planned depth of stormwater stored shall not exceed four (4) feet.
3. In excavated retention/detention facilities, a minimum side slope of 3:1 shall be provided for stability. In the case of valley storage, natural slopes may be considered to be stable.

#### **F. Detention Facilities in Floodplains**

No detention facilities are allowed within FEMA regulatory floodplains.

#### **G. Joint Development of Control Systems**

Stormwater control systems may be planned and constructed jointly by two or more developers as long as compliance with the Ordinance and these standards are maintained.

#### **H. Diffused Outlets**

When the allowable runoff is released in an area that is susceptible to flooding or erosion, the developer may be required to construct appropriate storm drains through such area to avert increased flood hazard caused by the concentration of allowable runoff at one point instead of the natural overland distribution. The requirement of diffused outlet drains shall be at the discretion of the City of Valparaiso City Engineer.

#### **I. IDNR Requirements**

Any construction in the floodway of a stream with a drainage area of one square mile or more must satisfy IDNR permit requirements.

#### **J. Allowance for Sedimentation**

Retention/detention basins shall be designed with an additional ten (10) percent of available capacity to allow for sediment accumulation resulting from development and to permit the pond to function for reasonable periods between cleanings. Basins should be designed to collect sediment and debris in specific locations, such as a forebay, so that removal costs are kept to a minimum. For wet-bottom ponds, the sediment allowance may be provided below the permanent pool elevation. No construction trash or debris shall be allowed to be placed within the permanent pool. If the pond is used as a sediment control measure during active construction, the performance sureties will not be released until sediment has been cleaned out of the pond and elevations and grades have been reestablished as noted in the accepted plans.

**K. Maintenance**

The routine maintenance of stormwater detention facilities (i.e. trash pickup, aeration, weed control, sediment removal, etc.) is the responsibility of the Homeowners' Association.



# Chapter Seven

## CONSTRUCTION SITES STORMWATER POLLUTION PREVENTION STANDARDS

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 drainageway, whether intentionally or accidentally, by machinery, wind, rain, runoff, or other means.

### A. POLLUTANTS OF CONCERN DURING CONSTRUCTION

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 longer-term erosion problems.

Problems associated with construction site erosion include transport of pollutants attached to transported sediment; increased turbidity (reduced light) in receiving waters; recreational use impairment. The deposited sediment may pose direct toxicity to wildlife or smother existing spawning areas and habitat. This siltation also reduces the 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 washoff, 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 both aquatic life, wildlife, and the general public.

### B. EROSION AND SEDIMENT CONTROL REQUIREMENTS

**General and Implementation Requirements** - The following general and implementation requirements apply to all land-disturbing activities and shall be considered in the preparation of a SWPPP within the corporate boundaries of the City of Valparaiso.

1. Trained Individuals must be utilized for activities associated with the development and design of the SWPPP, stormwater measure implementation, and stormwater project management.
2. Minimize the potential for soil erosion by designing a development that fits the topography and soils of the site. Unless needed to meet requirements and goals of the development, steep slopes should be avoided, and natural contours should be followed.
3. All activities on a site should be conducted in a logical sequence and in accordance with the site's construction phasing plan so that the smallest practical area of land will be exposed for the shortest practical period of time during development.
4. 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. Methods for determining acceptable velocities are included in this Stormwater Technical Standards Manual as well as the IDEM Storm Water Quality Manual.
5. Sediment-laden water which otherwise would flow from the project site shall be managed by appropriate erosion and sediment control measures to minimize sedimentation to receiving waters and adjacent properties as discussed in the IDEM Storm Water Quality Manual and other authoritative sources.
6. Public roadways and roadways not exclusive to construction traffic shall be kept cleared of accumulated sediment that is a result of runoff or tracking. The following minimum conditions are applicable:
  - a. Clearing of sediment must not include the utilization of mechanical methods that will result in mobilization of dust off the project site or flushing the area with water unless the flushed water is directed to an appropriate sediment control measure.
  - b. Cleared sediment must be redistributed or disposed of in a manner that is in accordance with all applicable statutes and regulations.
  - c. Sediment discharged or tracked onto roadways that are open to traffic must be removed as directed by a regulatory authority or at a minimum, removed by the end of the same day.
7. Phasing of construction activities must be used, when feasible, to minimize the footprint of disturbed unstable areas.

8. 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.
9. Natural features, including wetlands and sinkholes (karst features), shall be protected from pollutants associated with stormwater runoff, through appropriate stormwater management and/or treatment measures.
10. Soil compaction is to be minimized, especially in areas where permanent vegetation will be re-established and/or areas that are designated to infiltrate stormwater for the post-construction phase.
11. Topsoil must be preserved, unless infeasible.
12. Existing natural buffers that are adjacent to waters of the state must be preserved to promote infiltration and provide protection of the water resource, unless infeasible. Activities performed by a county drainage board under IC 36-9-27 are excluded.
  - a. Natural buffers must be preserved, including the entire buffer bordering and/or surrounding the water resource. Existing buffers:
    - i. 50 feet or more in width must be preserved to a minimum of 50 feet.
    - ii. less than 50 feet in width must be preserved in their entirety. May be enhanced with vegetation that is native and promotes ecological improvement and sustainability.
  - b. Runoff directed to the natural buffer must be:
    - i. treated with appropriate erosion and sediment control measures prior to discharging to the buffer.
    - ii. managed with appropriate runoff control measures to prevent erosion from occurring within the buffer area.
  - c. Further information regarding buffer requirements is contained in IDEM's "Implementation of Buffers" guidance document.
13. Minimize the generation of dust through dust suppression techniques to prevent deposition into waters of the state and areas located beyond the permitted boundaries of the site as discussed in the IDEM Storm Water Quality Manual and other authoritative sources.
14. A stable construction site access measure must be provided at all points of construction traffic ingress and egress to the project site. Where the selected measure is not effective, an alternative measure or additional controls must be utilized to minimize tracking. Alternative measures may include, but are not limited to, wheel wash systems and rumble strips.

15. During the period of construction activities, all stormwater management measures necessary to meet the requirements of this permit must be maintained. Alternative measures must be selected and implemented, as necessary.
16. Discharge water from dewatering of ground water from excavations, trenches, foundations, etc. must not be discharged when:
  - a. Sediment-laden water is not first directed to an appropriate sediment control measure or a series of control measures, as per IDEM Storm Water Quality Manual and other authoritative sources, that minimizes the discharge of the sediment.
  - b. A visible sheen and/or pollutants are present at a level that requires additional treatment and/or an alternate permit.
17. Appropriate measures must be implemented to eliminate wastes or unused building materials including, but not limited to garbage, debris, cleaning wastes, wastewater, concrete washout, mortar/masonry products, soil stabilizers, lime stabilization materials, and other substances from being carried from a project site by runoff or wind. Waste and unused building materials must be managed and disposed of in accordance with all applicable statutes and regulations.
18. Construction and domestic waste must be managed to prevent the discharge of pollutants and windblown debris. Surplus plastic or hardened concrete/cementitious materials are not required to be placed in trash receptacles and are considered clean fill that may be reused, disposed of on-site, or recycled in accordance with applicable state and federal regulations. Management of waste materials may include, but are not limited to:
  - a. Waste containers (trash receptacles), when selected to manage waste, must be managed to reduce the discharge of pollutants and blowing of debris. Receptacles that are not appropriately managed will require alternatives that include but are not limited to:
    - i. A cover (e.g., lid, tarp, plastic sheeting, temporary roof) to minimize exposure of wastes to precipitation or
    - ii. A similarly effective method designed to minimize the discharge of pollutants.
  - b. Waste that is not disposed of in trash receptacles must be protected from exposure to the weather and/or removed at the end of the day from the site and disposed of properly.
19. Concrete and cementitious wash water areas, where cementitious fluids are permissible, must be identified for the site and the locations clearly posted. Wash water must be directed into leak-proof containers or leak-proof containment areas which are located and designed to divert runoff away from the measure and sized to

prevent the discharge and/or overflow of the cementitious wash water. If not evaporated, wash water must be removed (pumped) for appropriate off-site disposal.

20. Fertilizer applications associated with the stabilization plan for the project must meet the following requirements:
  - a. Apply fertilizer at a rate and amount as determined by a soil analysis or in accordance with the Indiana Stormwater Quality Manual or similar guidance documents.
  - b. Apply fertilizer at an appropriate time of year for the project location, taking into consideration proximity to a waterbody, and preferably timed to coincide with the period of maximum vegetative uptake and growth.
  - c. Avoid applying fertilizer immediately prior to precipitation events that are anticipated to result in stormwater runoff from the application area.
  
21. Proper storage and handling of materials, such as fuels or hazardous wastes, and spill prevention and clean-up measures must be implemented to minimize the potential for pollutants to contaminate surface or ground water or degrade soil quality. To meet this requirement:
  - a. A spill prevention and response plan, meeting the requirements in 327 IAC 2-6.1, must be completed.
  - b. Proper project management and the utilization of appropriate measures including, but not limited to, eliminating a source or the exposure of materials must be completed.
  - c. Manage the following activities:
    - i. Fueling and maintenance of equipment.
    - ii. Washing of equipment and vehicles.
    - iii. Storage, handling, and disposal of construction materials, products, and wastes.
    - iv. Application of pesticides, herbicides, insecticides, and fertilizers
    - v. Dispensing and utilization of diesel fuel, oil, hydraulic fluids, other petroleum products, and other chemicals.
    - vi. Handling and disposal of hazardous wastes, including, but not limited to paints, solvents, petroleum-based products, wood preservatives, additives, curing compounds, and acids.

- vii. Washing of applicators and containers used for paint, grout, or other materials.
- 22. Personnel associated with the project must be informed of the terms and conditions of this permit and the requirements within the SWPPP. The permittee is required to document this process. Information must be provided through written notification, contracts, or other means (i.e., pre-construction meetings) that effectively communicates the provisions and requirements of the permit and SWPPP. Personnel may include, but are not limited to:
  - a. General contractors, construction management firms, grading or excavating contractors, and trade industry representatives (i.e. concrete industry) associated with the overall project.
  - b. Contractors or individual lot operators that have primary oversight on individual building lots.
  - c. Those responsible for the implementation of the SWPPP, and the installation, repair, and maintenance of stormwater measures.
  - d. Those responsible for the application and storage of treatment chemicals.
  - e. Those responsible for administering the self-monitoring program (SMP).
- 23. A notice must be posted near the main entrance of the project site or at a publicly accessible location. For linear project sites, such as a pipeline or highway, the notice must be placed in a publicly accessible location near the project field office. The notice must be maintained in a legible condition and include:
  - a. A copy of the completed IDEM NOI or a document, such as the Permit Summary Report & Notice of Sufficiency letter produced by IDEM's online ePortal system.
  - b. The NPDES permit number(s), upon receipt.
  - c. The location of the construction plan/SWPPP if the project site does not have an on-site location to store the plan.
- 24. The use of anionic polymers (cationic polymers are not authorized for use) on the project site are authorized for sediment control provided their use is in conformance with current State of Indiana standards and specifications and the use is identified in the SWPPP. If use of a polymer is not in the SWPPP and is selected at a later date, notification to IDEM and the City of Valparaiso is required. An email notification prior to the use of the polymer to the IDEM Stormwater Program is acceptable. For projects regulated by a MS4 notification must follow the local process for the use of polymers.

25. Restoration and/or clean-up may be required for those areas impacted by sediment or other pollutant discharges. These activities will be performed as directed by the inspecting authority and may require:
  - a. Development and submittal of a removal and restoration plan to ensure the methodology chosen will not result in further degradation of the resource.
  - b. Permission by a property owner when the restoration activity requires access to a property owned by another entity or individual.
  - c. Additional permits prior to initiation of the work.

**Stabilization Requirements** - The following stabilization requirements apply to all land-disturbing activities:

1. Un-vegetated areas that are left idle or scheduled to be left inactive must be temporarily or permanently stabilized with measures appropriate for the season to minimize erosion potential. To meet this requirement, the following apply:
  - a. Stabilization must be initiated by the end of the seventh day the area is left idle. The stabilization activity must be completed within fourteen (14) days after initiation. Initiation of stabilization includes, but is not limited to, the seeding and/or planting of the exposed area and applying mulch or other temporary surface stabilization methods where appropriate. Areas that are not accessible due to an unexpected and disruptive event that prevents construction activities are not considered idle.
  - b. Areas that have been compacted may be excluded from the stabilization requirement when the areas are intended to be impervious surfaces associated with the final land use, provided runoff from the area is directed to appropriate sediment control measures.
2. Final stabilization of a project site is achieved when:
  - a. All land-disturbing activities have been completed and a uniform (evenly distributed, without large bare areas) perennial vegetative cover with a density of seventy percent (70%) has been established on all unpaved disturbed areas, and areas not covered by permanent structures, or equivalent permanent stabilization measures have been employed. This requirement does not apply to:
    - i. Landscaping that is part of the final project plan is considered stable when the plan has been fully implemented and areas not being vegetated are stable with a non-erosive material and/or product.
    - ii. Projects or specific stormwater measures that utilize native vegetation and/or special vegetative plantings that are either required by a water

quality permit/authorization or part of the design and functionality of a stormwater measure provided the activity does not pose a threat that will result in off-site sedimentation.

- iii. Projects on land used for agricultural purposes when:
  - a) Stabilization is completed in accordance with the above Stabilization Requirements (in 1. a. and b.) as land-disturbance progresses. Land that is returned to agricultural production must be temporarily or permanently seeded upon completing land-disturbing activities. Stabilization requirements may be waived by the inspecting authority if the project site does not pose a threat of discharging sediment.
  - b) Disturbed areas, not previously used for agricultural production, such as filter strips, must be returned to their pre land disturbance use.
- b. Specific projects, due to function and/or operation may necessitate that an area remain disturbed. Only the minimum operational area is allowed to remain disturbed. This option primarily applies to off-road recreational commercial operations but may apply to other land use types upon determination by the regulating entity.

**Design Requirements** - The following design requirements apply to all land-disturbing activities and shall be considered in the selection, design, and implementation of all stormwater quality and management measures contained in the SWPPP:

1. Sound engineering, agronomic, and scientific principles must be utilized for measures contained in the SWPPP.
2. Appropriate measures must be planned, designed, and installed as part of an erosion and sediment control system and in accordance with the site's construction phasing plan.
3. Stormwater runoff leaving the project site must be discharged in a manner that is consistent with this ordinance, state, or federal law.
4. Collected runoff leaving the project site must be directed to an established vegetated area, when feasible and applicable, to increase pollutant removal and maximize stormwater infiltration and then either discharged directly into a well-defined, stable receiving conveyance or diffused and released without causing erosion at the point of discharge.
5. Conveyance systems must be designed taking into consideration both peak flow and total volume and must be adequately protected so that their final gradients and resultant velocities are unlikely to cause erosion at the outlet or in the receiving

channel, based on known conditions of the discharge at the time of design to accommodate post-construction conditions.

6. Sediment basins, where feasible, must withdraw water from the surface of the water column unless equivalent sediment reduction can be achieved by use of alternative measures. Alternative measures include but are not limited to increasing the basin length to width ratio to 4:1 or greater, implementation of porous baffles, use of flocculants/polymers, and/or phasing of project land disturbance that also incorporates a rapid stabilization program. During freezing conditions, the implementation of alternative withdrawal methods may be utilized.

**Monitoring and Management Requirements** - A trained individual, acceptable to the City of Valparaiso, shall monitor project construction and stormwater activities. These shall include:

1. A written evaluation of the entire project site, with the exception of those areas that are considered unsafe. The evaluation must be performed by a trained individual and completed:
  - a. Twenty-four (24) hours prior to a qualifying precipitation event or by the end of the next business day following each measurable storm event (excludes accumulated snow events); which is defined as a precipitation accumulation equal to, or greater than, one-half (0.50) inch of rainfall within a 24-hour period. If no rain event occurs within the work week a minimum of one inspection must occur. In the event of multiple qualifying events during the work week, no more than three (3) inspections would be required to meet the self-monitoring commitment.
  - b. At a minimum of one (1) time per month for specific areas within the project which are stabilized with permanent vegetative cover at seventy (70) percent density and/or erosion resistant armoring is installed. A reduction to once per month is also applicable for the entire project site for stabilized common areas, basins, conveyances, outfalls, and inactive building sites. Prior to reducing the monitoring to monthly, records must identify the area and the date the area became eligible for monthly monitoring. Weekly monitoring as identified in (a) above must resume if one or more of the following occurs:
    - i. The vegetative cover fails or there is evidence of erosion in the identified area.
    - ii. The City of Valparaiso requires monitoring to resume.
2. A complete written evaluation report which must include:
  - a. Name of the individual performing the evaluation, including printed name, title, and signature (electronic signatures are acceptable).
  - b. Date of the evaluation.

- c. Amount of precipitation when the evaluation is conducted after a measurable storm event. Recorded rainfall may be documented utilizing an on-site rain gauge or storm event information from a weather station that is representative of the project location.
- d. Observations of project performance in relation to:
  - i. Implementation of the stormwater pollution prevention plan.
  - ii. Assessment of existing stormwater measures based on industry standards and maintenance standards as identified SWPPP to ensure each measure is operational and functioning properly.
  - iii. Additional measures necessary in the event an existing measure fails or is not present in the landscape.
  - iv. Impacts including, but not limited to, sediment discharges, erosion, discharges that results in bank erosion, and operational activities that have the potential to generate pollutants and unauthorized discharges.
- e. Documentation of an actual discharge that is visible during the assessment, the location of the discharge and a visual description of the discharge. The visual description includes, but is not limited to, color (turbidity reading is an option), odor, floatables, settled/suspended solids, foam, oil sheen, and any other visible sign that may be attributed to operations occurring on the project site.
- f. Detail of corrective action recommended and/or completed. Corrective action includes, but is not limited to:
  - i. Repairing, modifying, or replacing any stormwater management measure.
  - ii. Clean-up and proper disposal of spills, releases, or other deposits.
  - iii. Remediating a permit violation.
  - iv. Taking reasonable steps to remediate, minimize or prevent the discharge of pollutants associated with the construction activity until a permanent corrective solution is initiated.
  - v. Restoring an impacted area and/or removing accumulated sediment, provided appropriate permission and permits are obtained to conduct the activity.
- g. A timeline for which the corrective action will occur to remediate the discharge of pollutants. The established corrective action, at a minimum, must be initiated:

- i. On the day the deficiency was discovered or when it is not practical to initiate on the discovery date, no later than forty- eight (48) hours for the repair of a measure or installation of a temporary measure until a new and/or replacement measure is installed as specified in item ii) below.
  - ii. Within seven (7) days of discovery for the installation of a new (alternative) measure or replacement of an existing measure unless a shorter timeframe is required as part of a regulatory inspection. The inspecting authority may also allow additional time to take corrective action.
  - iii. If corrective action cannot be achieved within the timelines outlined in i) or ii) above, a reason for incompleteness must be provided and documented, including the anticipated completion date.
- h. Documentation of corrective action taken from the previous self-monitoring report.
- 3. Maintaining the SMP reports at the site or at an easily accessible location (refer to Project Documentation Requirements below).
- 4. Providing all reports for the project site to City of Valparaiso within forty-eight (48) hours of a request. Electronic copies are acceptable, provided they are in a format consistent with the paper record.

**Project Documentation Requirements** – The following project documentation shall be developed and maintained:

- 1. Maintain a project management log that contains:
  - a. Information related to all off-site borrow sites, disposal areas, and staging areas, including the location of each activity as it is identified and/or selected.
  - b. Information related to all project activities including, but not limited to:
    - i. SMP reports.
    - ii. Regulatory inspections.
    - iii. Responses to a compliance action or enforcement action.
    - iv. Records showing the dates of all SWPPP modifications. The records must include the name of the person authorizing each change and a summary of all changes.
- 2. Ensure the SWPPP and supporting documentation associated with the SMP and project management log are accessible at the project site office or in the possession

of on-site individuals with responsibility for the overall project management or associated with the management and operations of construction activities. This information must be provided to the City of Valparaiso within forty-eight (48) hours of a request.

### **C. COMMON CONTROL PRACTICES**

All erosion control and stormwater pollution prevention measures required to comply with the Ordinance or these Technical Standards shall meet the design criteria, standards, and specifications similar to or the same as those outlined in the Indiana Storm Water Quality Manual or other comparable and reputable references.

### **D. INDIVIDUAL LOT OR PARCEL CONTROLS**

Although individual lots within a larger development may not appear to contribute as much sediment as the overall development, the cumulative effect of lot development is of concern. The same is true for individual parcels of land of any size that are not associated with a larger development. From the time construction on an individual lot begins, until the individual lot is stabilized, the builder must take steps to:

- protect adjacent properties from sedimentation
- prevent mud/sediment from depositing on the street
- protect drainageways from erosion and sedimentation
- prevent sediment laden water from entering storm sewer inlets.

This can be accomplished using numerous erosion and sediment control measures including but not limited to 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 should be installed at each individual lot site. Note that construction site discharge must be contained and treated within each individual lot (or a group of individual lots being constructed by one builder) and is not allowed to be discharged offsite.

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 property frontage and along the frontage of adjacent lots.
6. Install stable construction entrance that extends from the street to the building pad.
7. Perform primary grading operations.
8. Contain erosion from any soil stockpiles created on-site with an appropriate sediment control measure 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 3 days of completion of disturbance.
13. Grade the site to final elevations.
14. Install permanent seeding or sod.

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 and parcel erosion and sediment control, please see the “Residential Site Plan Checklist and Example” and “Erosion and Sediment Control Notes” provided by the City of Valparaiso Engineering Department.



# Chapter Eight

## POST-CONSTRUCTION STORMWATER QUALITY MANAGEMENT STANDARDS

### A. INTRODUCTION

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. As new development and re-development continues within the corporate boundaries of the City of Valparaiso, measures must be taken to intercept and remove pollutants from stormwater runoff prior to reaching regional creeks, streams, and rivers. Through the use of appropriate Best Management Practices (BMPs), harmful amounts of sediment, nutrients, and contaminants will be removed from stormwater.

The City of Valparaiso has adopted a policy that the control of stormwater runoff quality will be based on the management of Total Suspended Solids (TSS). A minimum of 80% TSS removal from the post-construction stormwater runoff is required. This requirement is being adopted as the basis of the City of Valparaiso stormwater quality management program for all areas of jurisdiction.

This Chapter establishes minimum standards for the selection and design of post-construction water quality BMPs. The information provided in this Chapter establishes performance criteria for stormwater quality management and procedures to be followed when preparing a BMP plan for compliance. Post-Construction BMPs must be sized to treat the water quality volume,  $WQ_v$ , for detention-based BMPs or the water quality flow rate,  $Qw_q$ , for flow-through BMPs. Chapter 9 provides the methodology for calculating the  $WQ_v$  and  $Qw_q$  values.

BMPs noted in this chapter refer to post-construction BMPs, which continue to treat stormwater after construction has been completed and the site has been stabilized. 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 sediment 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.

In combination with proper post-construction measure selection, Low Impact Development (LID) can also be incorporated into design and development strategies to minimize the discharge of pollutants. Low Impact Development (LID) stormwater management design approaches are fundamentally different from conventional design approaches and challenge traditional thinking regarding development standards, watershed protection, and public participation. LID combines fundamental hydrologic concepts with many of today's common stormwater strategies, practices and techniques to reshape development patterns in a way that maintains natural watershed hydrologic functions. If LID approach is desired for a development, the principle and development procedures can be discussed with City Engineer.

## **B. POLLUTANTS OF CONCERN AFTER CONSTRUCTION STABILIZATION**

There are three major sources of pollutants for a stabilized construction site:

- Deposition of atmospheric material (including wind-eroded material and dust)
- General urban pollution (thermal pollution, litter)
- Pollutants associated with specific land uses

It should be noted that some pollutants accumulate on impervious surfaces. This accumulated material is then subject to being washed into watercourses during storm events. It is for this reason that fish kills often occur during a rain event with a substantial prior rainless period. This is also the reason that the most hazardous driving conditions are realized after the initial onset of a storm event, when deposited oil has not yet washed into adjacent conveyance systems.

Pollutants of concern include:

- **Sediment** is the major pollutant of concern during active construction. 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. After the construction is completed, other chemicals that are released to surface waters from industrial and municipal discharges and polluted runoff from urban and agricultural areas continue to accumulate to harmful levels in sediments.
- **Toxic chemicals** from illegal dumping and poor storage and handling of materials. Industrial sites pose the most highly variable source of this pollution due to the dependency of the specific process to the resulting pollution amounts and constituents. As during construction, these chemicals can pose acute (short-term) or chronic (long-term) risk to aquatic life, wildlife and the general public.

- **Bacteria** from illicit sanitary connections to storm sewer systems, combined sewers, leaking septic systems, wildlife and domestic animal waste. Bacteria pathogens pose a direct health risk to humans and aquatic life.
- **Nutrients** can be released from leaking septic systems or applied in the form of fertilizers. Golf courses, manicured landscapes and agricultural sources are the primary land uses associated with excess fertilization. Excessive nutrients in the local ecosystem are the source of algal blooms in ponds and lakes. These excessive nutrients also lead to acceleration of the eutrophication process, reducing the usable lifespan of these water bodies. Nitrogen and phosphorous are the primary nutrients of concern.
- **Oxygen demand** can be impacted by chemicals transported on sediment, by nutrients, and other pollutants (such as toxic chemicals). Reduced levels of oxygen impair or destroy aquatic life.
- **Oils and hydrocarbons** accumulate in streets from vehicles. They can also be associated with fueling stations and illicit dumping activities. Oils and hydrocarbons pose health risk to both aquatic and human health.
- **Litter, including floatables**, can result in a threat to aquatic life. The aesthetic impact can also reduce the quality of recreational use.
- **Metals** can be associated with vehicular activity (including certain brake dusts), buildings, construction material storage, and industrial activities. Metals are often toxic to aquatic life and threaten human health.
- **Chlorides** (salts) are historically associated with deicing activities. Chlorides are toxic to native aquatic life (verses saltwater aquatic life). Communities should consider a combination of cinders or sand to replace or supplement their deicing activities with chlorides. In addition, chloride stockpiles should remain covered.
- **Thermal effects** can be introduced by the removal of shade provided by riparian trees, as well as impervious channel linings, such as concrete, which release stored heat to water passing over them. Other sources of elevated temperature include effluent from power plant and industrial activities. Thermal pollution can threaten aquatic habitat, including fish species and beneficial water insects. Of particular concern are salmonid streams, due to the effect of thermal pollution on spawning for this particular species.

### C. PRE-APPROVED BMPs

City of Valparaiso has designated a number of pre-approved BMP methods to be used alone or in combination to achieve the 80% TSS removal stormwater quality goals for a given project. These BMP measures are listed along with their anticipated average TSS removal rates in **Table 8-1**. Pre-approved BMPs have been proven/are assumed to achieve the average TSS removal rates indicated in **Table 8-1**. Applicants desiring to use a different TSS removal rate for these BMPs must follow the requirements discussed

below for Innovative BMPs. Details regarding the applicability and design of these pre-approved BMPs, including the effectiveness of these BMPs in treating pollutants of concern, are contained within fact sheets presented in the appendices provided in the Indiana Office of Community and Rural Affairs (OCRA) Green Infrastructure Curriculum and Training web resources (<https://www.in.gov/ocra/additional-resources/other-resources/>).

Note that a single BMP measure may not be adequate to achieve the water quality goals for a project. It is for this reason that a “treatment train”, a number of BMPs in series, is often required for a project. The pollutant removal efficiency of a number of BMPs in series may be determined from the following formula:

$$E_{\text{series}} = 1 - (1-E_1)(1-E_2)(1-E_3)\dots$$

where,

$E_{\text{series}}$  = Removal Efficiency of the BMP series combined (in decimal form)

$E_1, E_2, E_3, \dots$  = Removal Efficiency of Units 1, 2, 3, ..., respectively (in decimal form)

#### **D. INNOVATIVE BMPs**

BMPs not previously accepted by the City of Valparaiso City Engineer must be certified by a professional engineer licensed in State of Indiana and accepted through the City of Valparaiso City Engineer. ASTM standard methods must be followed when verifying performance of new measures. New BMPs, individually or in combination, must meet the 80% TSS removal rate at 50-125 micron range (silt/fine sand) without reentrainment and must have a low to medium maintenance requirement to be considered by the City of Valparaiso City Engineer. Testing to establish the TSS removal rate must be conducted by an independent testing facility, not the BMP manufacturer.

**Table 8-1. Pre-Approved Post-Construction BMPs**

<b>BMP<sup>A</sup></b>	<b>Typical % TSS Removal Rate<sup>B</sup></b>	<b>Maintenance Easement Requirements</b>
Bioretention	90 <sup>C</sup>	25 feet wide along the perimeter
Constructed Wetland	67 <sup>C</sup>	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet
Underground Detention	70	20 feet wide strip from access easement to tank's access shaft & 30 feet wide along centerline of inlet and outlet
Extended Detention/Dry Pond	72	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet
Infiltration Basin (including retention ponds with pretreatment)	90 <sup>C</sup>	25 feet wide along the perimeter
Infiltration Trench	90 <sup>C</sup>	25 feet wide along the perimeter
Constructed (Sand) Filter	70 <sup>C</sup>	25 feet wide along the perimeter
Water Quality Device <sup>D</sup>	VARIES <sup>D</sup>	20 feet wide strip from access easement to chamber's access shaft
Vegetated Filter Strip	78 <sup>C</sup>	25 feet wide along the length on the pavement side
Vegetated Swale	81 <sup>C</sup>	25 feet wide along the top of bank on one side
Wet Ponds/Detention Basin	80	25 feet wide along the outer perimeter of forebay & 30 feet wide along centerline of outlet

Notes:

- A. Detailed specifications for these BMPs are provided in the fact sheets contained in the appendices provided in the Indiana Office of Community and Rural Affairs (OCRA) Green Infrastructure Curriculum and Training web resources (<https://www.in.gov/ocra/files/Appendix-C-BMP-Fact-Sheets.pdf>).
- B. Removal rates shown are based on typical results. Unless otherwise shown, data extracted from various data sources. 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.
- C. IDEM Stormwater Quality Manual, 2007.
- D. The removal rate for this category varies widely between various models and manufacturers. The acceptable treatment rate for these devices shall be based on that currently certified by the New Jersey Department of Environmental Protection (NJDEP). Further details on acceptable Water Quality Devices and their treatment rates are provided in Chapter 9.

## **E. BMP APPLICATION LIMITATIONS**

The following requirements need to be followed when post-construction BMPs are installed in the mentioned sensitive areas.

- (1) Infiltration practices are not allowed in wellhead protection areas.
- (2) Stormwater runoff is not allowed to be discharged directly into sinkholes or fractured bedrock, without treatment that results in the discharge meeting Indiana ground water quality standards as referenced in 327 IAC 2-11.
- (3) Any stormwater practice that is a Class V injection well must ensure that the discharge from such practices meets Indiana ground water quality standards as referenced in 327 IAC 2-11.

The City of Valparaiso uses groundwater as the drinking water source. To minimize the potential routes for pollutants to directly impact the City's water supply, infiltration practices which allow potential pollutants to reach the City's water supply within a 5-year subsurface travel timeframe are not allowed. For purposes of this requirement, infiltration practices mean any practice constructed after the effective date of the City's Stormwater Management Ordinance that directs potentially polluted stormwater into the subsurface, where the public water supply can be exposed to pollutants. Prohibited infiltration practices do not include vegetated or unvegetated land surfaces, or impervious surface improvements, such as porous pavement.

To minimize the pollutant effects of stormwater discharges on subsurface aquifers, direct discharges of stormwater from new development or redevelopment projects to sinkholes and fractured bedrock are not allowed. Direct discharge means intentionally conveying surface stormwater flow to a sinkhole or fractured bedrock by altering the surrounding topography or installing a structural conveyance. A direct discharge will typically involve the use of impervious or unvegetated surfaces to convey the stormwater into a sinkhole or fractured bedrock. The primary condition being addressed by this requirement is to reduce the amount of potentially polluted stormwater run-off (i.e., run-off without any filtering or opportunity to infiltrate prior to reaching the sinkhole or other pathway to the subsurface) from entering the subsurface aquifers. If stormwater is directed to a sinkhole or fractured bedrock, appropriate structural control practices, such as sedimentation basins and vegetated berms, must be utilized to ensure that the quality of the stormwater entering the ground water interface meets ground water quality standards.

A well, as defined in Title 40 of the Code of Federal Regulations, is either a dug hole or a bored, drilled or driven shaft whose depth is greater than its largest surface dimension. Injection is defined as the subsurface emplacement of fluids in a well where a fluid is any material that flows or moves whether it is semisolid, liquid, sludge or gas. Class V injection wells generally inject nonhazardous fluid, like stormwater, into or above an Underground Source of Drinking Water.

Stormwater drainage wells are Class V injection wells used to remove stormwater or urban run-off from impervious surfaces such as roadways, roofs, and paved surfaces to typically provide treatment or prevent flooding and infiltration into basements. The primary types of stormwater drainage wells are bored wells, dug wells, and improved sinkholes. When Class V injection stormwater drainage wells are installed, the project owner must ensure that the discharge from such practices meets Indiana ground water quality standards as referenced in 327 IAC 2-11.

**F. SPECIAL PROVISIONS FOR “HOT SPOT” LAND USES**

For all projects involving land uses considered to be high pollutant producers or “hot spots” (see **Table 8-2**, e.g., vehicle service and maintenance facilities, vehicle salvage yards and recycling facilities, vehicle and equipment cleaning facilities, fleet storage areas for buses, trucks, etc., industrial/commercial or any hazardous waste storage areas or areas that generate such wastes, industrial sites, restaurants and convenience stores, any activity involving chemical mixing or loading/unloading, outdoor liquid container storage, public works storage areas, commercial container nurseries, and some high traffic retail uses characterized by frequent vehicle turnover), additional water quality requirements may be imposed by City of Valparaiso in addition to those included in water quality criteria in order to remove potential pollutant loadings from entering either groundwater or surface water systems. These pre-treatment options are included in **Table 8-2** and **Table 8-3**.

**Table 8-2.** Pre-Treatment options for Stormwater Hot Spots

<b>Stormwater Hot Spots</b>	<b>Minimum Pre-Treatment Options</b>
Vehicle Maintenance and Repair Facilities	A, E, F, G
Vehicle Fueling Stations	A, D, G
Drive-through Restaurants, Pharmacies, Convenience Stores	B, C, D, I, K
Outdoor Chemical Mixing or Handling	G, H
Outdoor Storage of Liquids	G
Commercial Nursery Operations	I, J, L
Other Uses or Activities Designated by Appropriate Authority	As Required

**Table 8-3.** Minimum Pre-Treatment options

<b>Minimum Pre-Treatment Options</b>
--------------------------------------

A	Oil/Water Separators / Hydrodynamic Separators
B	Sediment Traps/Catch Basin Sumps
C	Trash/Debris Collectors in Catch Basins
D	Water Quality Inserts for Inlets (inspected and cleaned after every significant rainfall event)
E	Use of Drip Pans and/or Dry Sweep Material under Vehicles/Equipment
F	Use of Absorbent Devices to Reduce Liquid Releases
G	Spill Prevention and Response Program
H	Diversion of Stormwater away from Potential Contamination Areas
I	Vegetated Swales/Filter Strips
J	Constructed Wetlands
K	Stormwater Filters (Sand, Peat, Compost, etc.)
L	Stormwater Collection and Reuse (especially for irrigation)
M	BMPs that are a part of a Stormwater Pollution Prevention Plan (SWPPP) under a NPDES Permit

## **G. CONSTRUCTION SEQUENCING CONSIDERATIONS**

BMPs noted in this chapter refer to post-construction BMPs, which continue to treat stormwater after construction has been completed and the site has been stabilized. 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.

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.

## **H. INSPECTION AND MAINTENANCE REQUIREMENTS**

Subsequent to successful installation of Post-construction BMPs, they need to be inspected and maintained regularly in accordance with the Operation and Maintenance Manual required to be prepared for each BMP. An operations and maintenance (O&M) manual for all MS4-owned or private infrastructure, including but not limited to pipes, ponds, ditches, and BMPs (when required), shall be submitted for the final plan approval and permit process. The manual will become a maintenance guide for the drainage infrastructure once development is complete. The final O&M manual will be provided to the City of

Valparaiso in both hard copy and digital formats. The O&M manual will include the following:

1. Name, address, business phone number, home phone number, email address, cellular phone number, pager number of owner;
2. Site drawings (8½” by 11” or 11” by 17”), showing both plan and cross-section views, showing the infrastructure and applicable features, including dimensions, easements, outlet works, forebays, signage, etc., as well as an overall site map of the development showing all structures;
3. Guidance on owner-required periodic inspections;
4. Requirement of owner to perform maintenance specified by City of Valparaiso inspection, if any;
5. Guidance on routine maintenance, including mowing, litter removal, woody growth removal, signage, etc.;
6. Guidance on remedial maintenance; such as inlet replacement, outlet works maintenance, etc.;
7. Guidance on sediment and trash removal, both narrative and graphical, describing when sediment removal should occur in order to ensure that BMPs and other infrastructure remain effective as water quality and/or quantity control devices;
8. A statement that the City of Valparaiso’s representatives have the right to enter the property to inspect the infrastructure;
9. A tabular schedule showing inspection and maintenance requirements; and
10. Identification of the property owner as the party responsible for all maintenance, including cost.
11. Identification of the Homeowners Association, if applicable, for eventual transfer of BMP ownership and maintenance responsibilities.

Inspection checklists for various types of BMPs are provided in the appendices provided in the Indiana Office of Community and Rural Affairs (OCRA) Green Infrastructure Curriculum and Training web resources (<https://www.in.gov/ocra/additional-resources/other-resources/>).

Installation and maintenance of appropriate signage of all green infrastructure BMP sites shall also be encouraged both to alert the maintenance crew and to educate the public.



# Chapter Nine

## METHODOLOGY FOR DETERMINATION OF REQUIRED SIZING OF BMPs

### A. INTRODUCTION

Structural Water Quality BMPs are divided into two major classifications: retention/detention BMPs and flow-through BMPs. Retention/detention BMPs impound (pond) the runoff to be treated, while flow-through BMPs treat the runoff through some form of filtration process. This Chapter describes the acceptable methods for calculating Water Quality Volume for retention/detention BMPs, and water quality treatment flow rate for flow-through BMPs.

### B. RETENTION/DETENTION BMP SIZING

Water Quality Detention/Retention BMPs must be designed to store the water quality volume for treatment. The water quality volume,  $WQ_v$ , 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 ( $R_v$ ) multiplied by the site area, or:

$$WQ_v = (P) (R_v) (A) / 12$$

where:

$WQ_v$  = water quality volume (acre-feet)

$P$  = 1 inch of rainfall

$R_v$  = volumetric runoff coefficient

$A$  = area in acres

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

$$R_v = 0.05 + 0.009(I)$$

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:

$$R_v (\text{subarea A}) = 0.05 + 0.009(80) = 0.77$$

$$R_v (\text{subarea B}) = 0.05 + 0.009(75) = 0.73$$

$$R_v (\text{subarea C}) = 0.05 + 0.009(77) = 0.74$$

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

$$WQ_v (\text{subarea A}) = (1'')(R_v)(A)/12 = 0.77(7.5)/12 = 0.48 \text{ acre-feet}$$

$$WQ_v (\text{subarea B}) = 0.73(4.3)/12 = 0.26 \text{ acre-feet}$$

$$WQ_v (\text{subarea C}) = 0.74(6.0)/12 = 0.37 \text{ acre-feet}$$

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 runoff for upstream areas draining to the site), the designer would have the option of bypassing 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.

## C. FLOW THROUGH BMP SIZING

Flow through BMPs are designed to treat runoff at a calculated water quality treatment flow rate through the system. Examples of flow through BMPs include catch basin inserts, sand filters, and grassed channels. Another flow through BMP is a manufactured treatment device such as a hydrodynamic separator, manufactured infiltration chambers, or other similar type of device discussed in the Indiana Office of Community & Rule Affairs (OCRA) Green Infrastructure Curriculum and Training BMP Fact Sheets (<https://www.in.gov/ocra/files/Appendix-C-BMP-Fact-Sheets.pdf>).

### 1. Requirements for Manufactured Treatment Devices

Stormwater Manufactured Treatment Devices (MTD), also known as Hydrodynamic separators are proprietary, and usually include a pollutant-water separation component. The MTD should be sized to treat flows up to, and

including, the Water Quality Treatment Rate (Qwq) calculated for each project site outlet. To be acceptable, the MTD should meet the following criteria:

- The MTD must be offline and located upstream of detention facilities (if any).
- The MTD must provide complete and unobstructed access to the entire bottom of the system from grade level, if applicable, for ease of maintenance.
- The MTD, or the treatment train (if applicable) that includes the MTD as one of its components, must have the ability to capture or skim pollutants including but not limited to: floating oils / immiscible materials.
- The MTD, or the treatment train (if applicable) that includes the MTD as one of its components, must have the ability to capture both floating and suspended solid material (trash, organic material, etc.) and other pollutants.
- The MTD shall be a manufactured system currently certified by the New Jersey Department of Environmental Protection (NJDEP). A list of NJDEP-MTDs certified for 50% and 80% TSS removal are provided in a table located at <http://www.nj.gov/dep/stormwater/treatment.html>.

To obtain the maximum flow rate for various models of a MTD that is listed in the NJDEP-certified list, the latest verification report from NJCAT Verification Database must be used. A link to the database is provided right above the NJDEP-certified list table.

In summary, the following steps should be used to determine whether a proposed MTD unit is NJDEP-certified and to determine the accepted maximum flow rate for that unit.

**Step 1:** Determine if the MTD is NJDEP-certified for 50% treatment rate (when the MTD will be used in a treatment train) or 80% treatment rate (when the MTD will be used alone):

- a) Go to <http://www.nj.gov/dep/stormwater/treatment.html>
- b) Look up the name of the MTD in the first column of the table
- c) Look up the Certified TSS Removal Rate of that MTD in the fourth column

**Step 2:** Determine the maximum accepted flow rate:

- a) Click the link “Certification” in the second column of the NJDEP-certified list table referenced in Step 1. In some cases, a table of MTD model versus the NJDEP-certified maximum flow rate is included in the certification letter. In that case, skip to sub-step “g)” (below). If not continue to the sub-step “b)” (below)

- b) Click the “Click here” link above the NJDEP-certified list table to access NJCAT Verification Database
- c) Find the name of the MTD manufacturer of interest in first column
- d) Find the latest entry (one with the latest verification date shown in third column) for that particular MTD
- e) Click the report download link in the fourth column
- f) Find the Table in the report (typically towards the end of the report) that lists various MTD model sizes along with the NJDEP 50% (or 80%, if appropriate) TSS Maximum Treatment Flow Rate
- g) The selected model should have a maximum flow rate that is equal to or larger than the site’s required treatment flow rate as determined in Section C.2 of this Chapter.

Note that the NJDEP-certified manufactured system treatment rates for units not equipped with special filters reflect a standard certified 50% TSS reduction at the listed certified treatment flow rate. Therefore, to achieve the 80% TSS removal requirement, either a treatment train with a conventional listed in **Table 8-1** (except for another MTD or a sand filter) must be used or a filtration system must be used instead in accordance with the NJDEP methodology. The treatment train shall not include more than one MTD.

Also, note that multiple inlet or units in series configurations are not accepted unless the NJCAT certification and NJDEP verification is specifically done for such an arrangement.

## 2. Calculating the Required Treatment Flow Rate (Qwq)

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:

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

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)

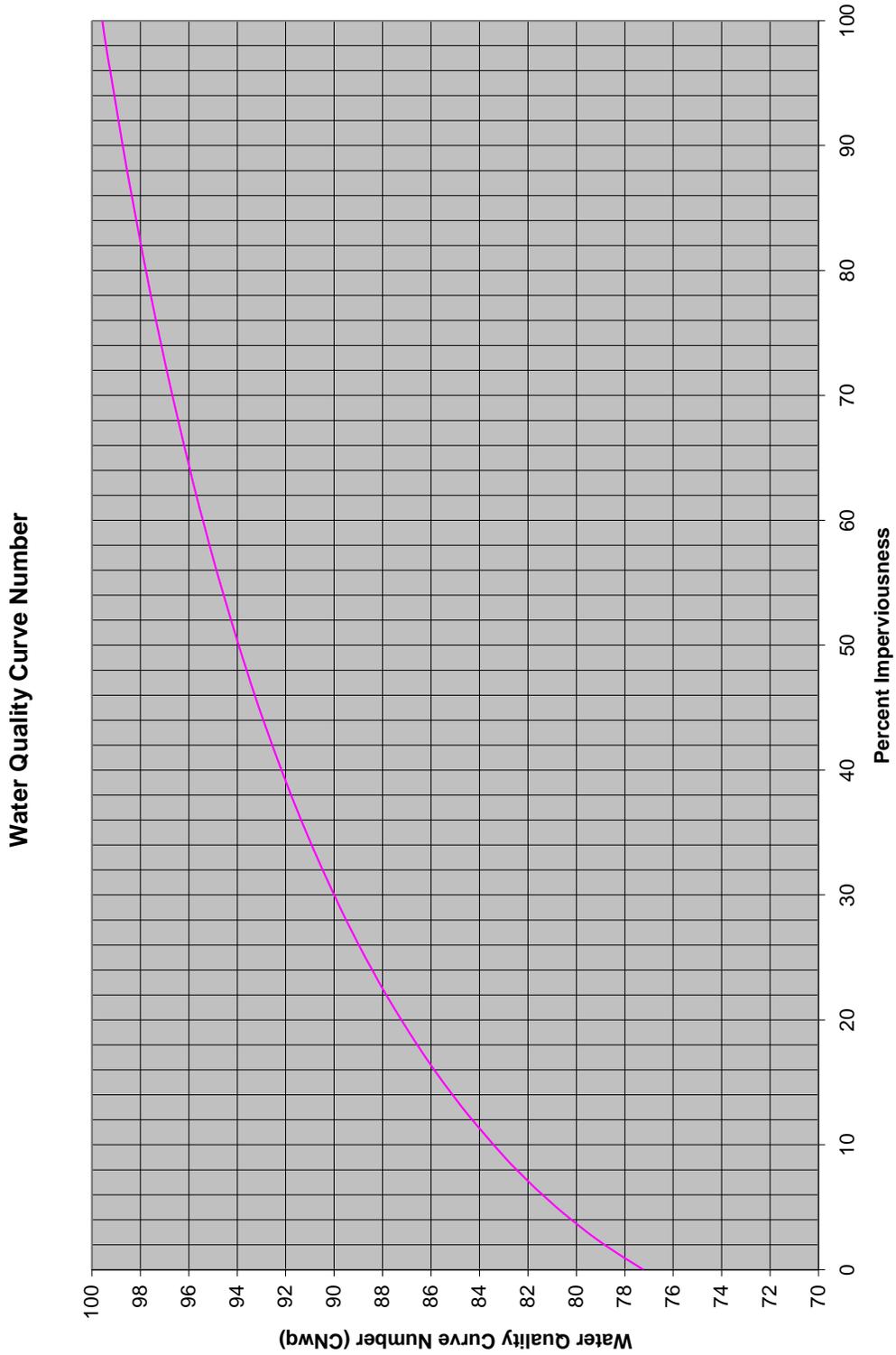
Due to the complexity of the above equation, the water quality curve number is represented as a function of percent imperviousness in **Figure 9-1**.

The water quality curve number,  $CN_{wq}$ , is then used in conjunction with the standard calculated time-of-concentration,  $t_c$ , 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 flow rate,  $Q_{wq}$ , can then be calculated.

## REFERENCES

1. Maryland Stormwater Design Manual, Volume II, Appendix D.10, 2000
2. Pitt, R., 1994, Small Storm Hydrology. University of Alabama - Birmingham. Unpublished manuscript. Presented at design of stormwater quality management practices. Madison, WI, May 17-19 1994.
3. Schueler, T.R. and R.A. Claytor, 1996, Design of Stormwater Filter Systems. Center for Watershed Protection, Silver Spring, MD.
4. United States Department of Agriculture (USDA), 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division. Technical Release 55 (TR-55).

**Figure 9-1**  
**Curve Number Calculation for Water Quality Storm Event**





# Chapter Ten

## LOT/BUILDING GRADING AND DRAINAGE STANDARDS

### A. GRADING AND BUILDING PAD ELEVATIONS

#### *Minimum Federal and State Requirements*

For all structures located in the Special Flood Hazards Area (SFHA) as shown on the FEMA maps and/or that mapped by the IDNR based on Best Available Data, the Lowest Floor elevation, including basement, shall be at or above the flood protection grade (FPG) and therefore have a minimum of 2 feet of freeboard above the 100-year flood elevation. Additional requirements for buildings within SFHA are contained in the *City of Valparaiso* Floodplain Management Ordinance.

#### *Additional Local Requirements*

FPG for all buildings located within or adjacent to SFHA shall be shown on the secondary plat.

For all structures located outside SFHA or an IDNR designated floodplains that are subject to flooding from a detention/retention pond, the lowest adjacent grade (LAG) of all residential, commercial, or industrial buildings shall have a minimum of 2 feet of freeboard above the 100-year flood elevation or the emergency overflow weir elevation, whichever is higher.

For all structures located outside SFHA or an IDNR designated floodplains that are subject to flooding from a stream or an open ditch or other waterway (an area along a stream with no floodplain designation or an area adjacent to a designated floodplain with ground elevation below 100-year flood elevation plus 2 feet), the LAG of all residential, commercial, or industrial buildings shall have a minimum of 2 feet of freeboard above the 100-year flood elevation of that open ditch or waterway.

For all structures fronting a flooding source other than a swale or an emergency flood route, the floor of any basements or crawl spaces (if provided) shall be a minimum of 1 foot above the normal pool level (if pond) or the (if a stream or an open ditch). In addition, 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.

For all structures adjacent to an emergency flood route (also referred to as overflow path/ponding areas), the minimum adjacent grade of the portion of the structure (the

ground elevation next to the building after construction is completed that sits adjacent to the emergency flood route or may be subject to flooding by the emergency flood route) shall be a minimum of 1 foot above the estimated 100-year elevation of the emergency flood route assuming that all stormwater inlets and pipes are fully clogged, with no discharge into the storm sewer system. The building adjacent grade requirements (including default elevations above the overflow route bottom) for buildings adjacent to overflow path/ponding areas are further discussed in Chapters 4 of this Manual.

For all structures adjacent to a road, the building's lowest entry elevation that is adjacent to and facing a road shall be a minimum of 1.5 feet above the road elevation (elevation of the top of the curb at the center of the lot) so that the road drainage is not directed against the building.

There shall be a positive slope drainage away from the building with maximum yard slopes that 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 1 foot above finished grade around the building.

In addition to any other provisions in the Ordinance or these Standards, no buildings shall be placed within 25 feet from the top of the bank of any existing or proposed stream, drain, or watercourse, regardless of the contributing drainage area or the bank height.

## **B. LOT DRAINAGE**

All lots shall be laid out so as to provide drainage away from all buildings, and individual lot drainage shall be coordinated with the general stormwater drainage pattern for the subdivision. Drainage shall be designed so as to avoid the concentration of stormwater runoff from a lot onto adjacent lots. Each lot owner shall maintain the lot grade, as it relates to stormwater drainage, in compliance with the approved construction plans.

No part of the lot area of any lot may contain land that is utilized as retention or detention facility or drainage pond, contains a watercourse, or is within a floodway. Where a watercourse separates the buildable area of the lot from the street by which it has access, provisions shall be made for the installation of a culvert or other appropriate structure, as approved by the City Engineer or designee. If a subdivision contains an existing or to be developed waterbody, watercourse, or portion thereof, appropriate documentary assurances acceptable to the City Engineer shall be provided for the maintenance of such waterbody or watercourse.

It shall be the property owners' responsibility to maintain the natural features on their lots and to take preventive measures against any and all erosion and/or deterioration of natural or manmade features on their lots.

## **C. ACCEPTANCE OUTLET AND ADJOINING PROPERTY IMPACTS POLICIES**

Design and construction of the stormwater facility shall provide for the discharge of the

stormwater runoff from off-site land areas as well as the stormwater from the area being developed (on-site land areas) to an acceptable outlet(s) (as determined by the City Engineer) having capacity to receive upstream (off-site) and on-site drainage. A Roadside Ditch is generally not considered an adequate outlet. The flow path from the development outfall(s) to a regulated drain, a City of Valparaiso storm drain, or natural watercourse (as determined or approved by the City Engineer) 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. In addition, no activities conducted as part of the development shall be allowed to obstruct the free flow of flood water from an upstream property.

Where the outfall from the stormwater drainage system of any development flows through real estate owned by others prior to reaching an acceptable outlet, 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.

If an adequate outlet is not located on site, then off-site drainage improvements 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 City Engineer.

**APPENDIX A**

**ABBREVIATIONS AND DEFINITIONS**

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**ABBREVIATIONS**

<b>BF E</b>	Base Flood Elevation
<b>BMP</b>	Best Management Practice
<b>CFS</b>	Cubic Feet Per Second
<b>CLOMR</b>	Conditional Letter of Map Revision (from FEMA)
<b>CLOMR-F</b>	Conditional Letter of Map Revision Based on Fill (from FEMA)
<b>CN</b>	Curve Number
<b>COE/USACE</b>	United States Army Corps of Engineers
<b>CSMP</b>	Comprehensive Stormwater Management Program
<b>CSO</b>	Combined Sewer Overflow
<b>CWA</b>	Clean Water Act
<b>ERM</b>	Elevation Reference Mark
<b>E&amp;SC</b>	Erosion and Sediment Control
<b>EPA</b>	Environmental Protection Agency
<b>ETJ</b>	Extraterritorial Jurisdiction
<b>FBFM</b>	Flood Boundary and Floodway Map
<b>FEMA</b>	Federal Emergency Management Agency
<b>FHBM</b>	Flood Hazard Boundary Map
<b>FIRM</b>	Flood Insurance Rate Map
<b>FIS</b>	Flood Insurance Study
<b>FPG</b>	Flood Protection Grade
<b>FPS</b>	Feet Per Second
<b>GIS</b>	Geographical Information System
<b>GPS</b>	Global Positioning System
<b>HGL</b>	Hydraulic Grade Line

<b>HHW</b>	Household Hazardous Waste
<b>HUC</b>	Hydrologic Unit Code
<b>IDEM</b>	Indiana Department of Environmental Management
<b>IDNR</b>	Indiana Department of Natural Resources
<b>INDOT</b>	Indiana Department of Transportation.
<b>LAG</b>	Lowest Adjacent Grade
<b>LOMA</b>	Letter of Map Amendment (from FEMA)
<b>LOMR</b>	Letter of Map Revision (from FEMA)
<b>LOMR-F</b>	Letter of Map Revision Based on Fill (from FEMA)
<b>MCM</b>	Minimum Control Measure
<b>MS4</b>	Municipal Separate Storm Sewer System
<b>NAVD</b>	North American Vertical Datum of 1988
<b>NFIP</b>	National Flood Insurance Program
<b>NGVD 1929</b>	National Geodetic Vertical Datum of 1929
<b>NRCS</b>	USDA-Natural Resources Conservation Service
<b>NPDES</b>	National Pollutant Discharge Elimination System
<b>NPS</b>	Non-point source
<b>POTW</b>	Publicly Owned Treatment Works
<b>SFHA</b>	Special Flood Hazard Area
<b>SWCD</b>	Soil and Water Conservation District
<b>SWPPP</b>	Stormwater Pollution Prevention Plan
<b>SWQMP</b>	Stormwater Quality Management Plan
<b>Tc</b>	Time of Concentration
<b>TMDL</b>	Total Maximum Daily Load
<b>USCS</b>	Unified Soil Classification System
<b>USDA</b>	United States Department of Agriculture
<b>USFWS</b>	United States Fish and Wildlife Service

## **DEFINITIONS**

**Acre-Foot (AF).** A measure of water volume equal to the inundation of a flat one-acre area to a depth of one foot (43,560 cubic feet).

**Administering authority.** The designated unit of government given the authority to issue permits.

**Agricultural land disturbing activity.** Tillage, planting, cultivation, or harvesting operations for the production of agricultural or nursery vegetative crops. The term also includes pasture renovation and establishment, the construction of agricultural conservation practices, and the installation and maintenance of agricultural drainage tile. For purposes of this rule, the term does not include land disturbing activities for the construction of agricultural related facilities, such as barns, buildings to house livestock, roads associated with infrastructure, agricultural waste lagoons and facilities, lakes and ponds, wetlands; and other infrastructure.

**Agricultural land use conservation practices.** Use of land for the production of animal or plant life, including forestry, pasturing or yarding of livestock, and planting, growing, cultivating, and harvesting crops for human or livestock consumption. Practices that are constructed on agricultural land for the purposes of controlling soil erosion and sedimentation. These practices include grass waterways, sediment basins, terraces, and grade stabilization structures.

**Amortization Period.** The length of time used to repay a debt or mortgage or to depreciate an initial cost.

**Antecedent Runoff Condition.** The index of runoff potential before a storm event. The index, developed by the Soil Conservation Service (SCS), is an attempt to account for the variation of the SCS runoff curve number (CN) from storm to storm.

**Backflow Preventer.** Device that allows liquids to flow in only one direction in a pipe. Backflow preventers are used on sewer pipes to prevent a reverse flow during flooding situations.

**Backwater.** The rise in water surface elevation caused by some obstruction such as a narrow bridge opening, buildings or fill material that limits the area through which the water shall flow.

**Base Flood Elevation.** The water surface elevation corresponding to a flood having a one percent probability of being equaled or exceeded in a given year.

**Base Flood.** See "Regulatory Flood".

**Base Flow.** Stream discharge derived from groundwater sources as differentiated from surface runoff. Sometimes considered to include flows from regulated lakes or reservoirs.

**Basement.** A building story that is all or partly underground but having at least one-half of its height below the average level of the adjoining ground. A basement shall not be counted as a story for the purpose of height regulations.

**Benchmark.** A marked point of known elevation from which other elevations may be established.

**Best Management Practices.** Design, construction, and maintenance practices and criteria for stormwater facilities that minimize the impact of stormwater runoff rates and volumes, prevent erosion, and capture pollutants.

**Buffer Strip.** An existing, variable width strip of vegetated land intended to protect water quality and habitat.

**Building.** See “Structure”.

**Capacity of a Storm Drainage Facility.** The maximum flow that can be conveyed or stored by a storm drainage facility without causing damage to public or private property.

**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.

**Centerline of Channel.** The thalweg of a channel.

**Channel Improvement.** Alteration, maintenance, or reconstruction of the channel area for the purpose of improving the channel capacity or overall drainage efficiency. The noted "improvement" does not necessarily imply water quality or habitat improvement within the channel or its adjacent area.

**Channel Modification.** Alteration of a channel by changing the physical dimensions or materials of its bed or banks. Channel modification includes damming, rip-rapping or other armoring, widening, deepening, straightening, relocating, lining, and significant removal of bottom or woody vegetation. Channel modification does not include the clearing of dead or dying vegetation, debris, or trash from the channel. Channelization is a severe form of channel modification typically involving relocation of the existing channel (e.g., straightening).

**Channel Stabilization.** Protecting the sides and bed of a channel from erosion by controlling flow velocities and flow directions using jetties, drops, or other structures and/or by fining the channel with vegetation, riprap, concrete, or other suitable lining material.

**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.

**Class V injection well.** A type of well, which typically has a depth greater than its largest surface dimension, emplaces fluids into the subsurface, and does not meet the definitions of Class I through Class IV wells as defined under 40 CFR 146.5. While the term includes the specific examples described in 40 CFR 144.81, septic systems that serve more than one (1) single-family dwelling or provide service for non-domestic waste, dug wells, bored wells, improved sinkholes, french drains, infiltration sumps, and infiltration galleries, it does not include surface impoundments, trenches, or ditches that are wider than they are deep.

**Closed Conduit.** A pipe, tube, or tile used for transmitting water.

**Combined Sewer Overflow.** A system designed and used to receive and transport combined sewage so that during dry periods the wastewater is carried to a treatment facility. During storm events, the excess water is discharged directly into a river, stream, or lake without treatment.

**Compensatory Storage.** An artificial volume of storage within a floodplain used to balance the loss of natural flood storage capacity when artificial fill or substructures are placed within the floodplain.

**Compost.** Organic residue (or a mixture of organic residue and soil) that has undergone biological decomposition until it has become relatively stable humus.

**Comprehensive Stormwater Management Program.** A comprehensive stormwater program for effective management of stormwater quantity and quality throughout the community.

**Constructed Wetland.** A manmade shallow pool that creates growing conditions suitable for wetland vegetation and is designed to maximize pollutant removal.

**Construction activity.** Land disturbing activities, and land disturbing activities associated with the construction of infrastructure and structures. This term does not include routine ditch or road 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 stormwater 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.

**Contiguous.** Adjoining or in actual contact with.

**Contour Line.** Line on a map which represents a contour or points of equal elevation.

**Contour.** An imaginary line on the surface of the earth connecting points of the same elevation.

**Contractor or subcontractor.** An 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.

**Control Structure.** A structure designed to control the rate of flow that passes through the structure, given a specific upstream and downstream water surface elevation.

**Conveyance.** Any structural method for transferring stormwater between at least two points. The term includes piping, ditches, swales, curbs, gutters, catch basins, channels, storm drains, and roadways.

**Convolution.** The process of translating precipitation excess into a runoff hydrograph.

**Crawl Space.** Low space below first floor of a house where there has not been excavation deep enough for a basement, usually less than seven (7) feet in depth, but where there is access for pipes, ducts, utilities and similar equipment.

**Critical Duration Analysis.** The process of testing different rainfall durations to find that “critical duration”, which produces the highest peak runoff or the highest storage volume.

**Cross-Section.** A graph or plot of ground elevation across a stream valley or a portion of it, usually along a line perpendicular to the stream or direction of flow.

**Crown of Pipe.** The elevation of top of pipe.

**Cubic Feet Per Second (CFS).** Used to describe the amount of flow passing a given point in a stream channel. One cubic foot per second is equivalent to approximately 7.5 gallons per second.

**Culvert.** A closed conduit used for the conveyance of surface drainage water under a roadway, railroad, canal or other impediment.

**Curve Number (CN).** The Soil Conservation Service index that represents the combined hydrologic effect of soil, land use, land cover, hydrologic condition and antecedent runoff condition.

**Dam.** A barrier to confine or impound water for storage or diversion, to prevent gully erosion, or to retain soil, sediment, or other debris.

**Damage.** Measurable rise in flood heights on buildings currently subject to flooding, flooding of buildings currently not subject to flooding and increases in volume or velocity to the point where the rate of land lost to erosion and scour is substantially increased.

**Datum.** Any level surface to which elevations are referred, usually Mean Sea Level.

**Dechlorinated swimming pool discharge.** Chlorinated water that has either sat idle for seven (7) days following chlorination prior to discharge to the MS4 conveyance, or, by analysis, does not contain detectable concentrations (less than five-hundredths (0.05) milligram per liter) of chlorinated residual.

**Depressional Storage Areas.** 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.

**Detention Basin.** A facility constructed or modified to restrict the flow of stormwater to a prescribed maximum rate, and to detain concurrently the excess waters that accumulate behind the outlet.

**Detention Facility.** A facility designed to detain a specified amount of stormwater runoff assuming a specified release rate. The volumes are often referred to in units of acre-feet.

**Detention Storage.** The temporary detaining of storage of stormwater in storage facilities, on rooftops, in streets, parking lots, school yards, parks, open spaces or other areas under

predetermined and controlled conditions, with the rate of release regulated by appropriately installed devices.

**Detention Time.** The theoretical time required to displace the contents of a tank or unit at a given rate of discharge (volume divided by rate of discharge).

**Detention.** Managing stormwater runoff by temporary holding and controlled release.

**Detritus.** Dead or decaying organic matter; generally contributed to stormwater as fallen leaves and sticks or as dead aquatic organisms.

**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.

**Development.** Any man-made change to improved or unimproved real estate including but not limited to:

1. Construction, reconstruction, or placement of a building or any addition to a building;
2. Construction of flood control structures such as levees, dikes, dams or channel improvements;
3. Construction or reconstruction of bridges or culverts;
4. Installing a manufactured home on a site, preparing a site for a manufactured home, or installing a recreational vehicle on a site for more than hundred eight (180) days;
5. Installing utilities, erection of walls, construction of roads, or similar projects;
6. Mining, dredging, filling, grading, excavation, or drilling operations;
7. Storage of materials; or
8. Any other activity that might change the direction, height, or velocity of flood or surface waters.

“Development” does not include activities such as the maintenance of existing buildings and facilities such as painting, re-roofing, resurfacing roads, or gardening, plowing and similar agricultural practices that do not involve filling, grading, excavation, or the construction of permanent buildings.

**Direct Release.** A method of stormwater management where runoff from a part or the entire development is released directly to the receiving stream without providing detention.

**Discharge.** Usually the rate of water flow. A volume of fluid passing a point per unit time commonly expressed as cubic feet per second, cubic meters per second, gallons per minute, or millions of gallons per day.

**Disposal.** The discharge, deposit, injection, spilling, leaking, or placing of any solid waste or hazardous waste into or on any land or water so that the solid waste or hazardous waste, or any

constituent of the waste, may enter the environment, be emitted into the air, or be discharged into any waters, including

**Ditch.** A man-made, open drainageway in or into which excess surface water or groundwater drained from land, stormwater runoff, or floodwaters flow either continuously or intermittently.

**Drain.** A buried slotted or perforated pipe or other conduit (subsurface drain) or a ditch (open drain) for carrying off surplus groundwater or surface water.

**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.

**Drainage Classification (soil).** As a natural condition of the soil, drainage refers to both the frequency and duration of periods when the soil is free of saturation. Soil drainage conditions are defined as:

- *Well-drained*--Excess water drains away rapidly, and no mottling occurs within 36 in. of the surface.
- *Moderately well drained*--Water is removed from the soil somewhat slowly resulting in small but significant periods of wetness, and mottling occurs between 18 and 36 in.
- *Poorly drained*--Water is removed so slowly that it is wet for a large part of the time, and mottling occurs between 0 and 8 in.
- *Somewhat poorly drained*--Water is removed from the soil slowly enough to keep it wet for significant periods but not all of the time, and mottling occurs between 8 to 18 in.
- *Very poorly drained*--Water is removed so slowly that the water table remains at or near the surface for the greater part of the time; there may also be periods of surface ponding; the soil has a black to gray surface layer with mottles up to the surface.

**Drainage.** The removal of excess surface water or groundwater from land by means of ditches or subsurface drains. Also see “Natural Drainage”.

**Drop Manhole.** Manhole having a vertical drop pipe connecting the inlet pipe to the outlet pipe. The vertical drop pipe shall be located immediately outside the manhole.

**Dry Well.** A type of infiltration practice that allows stormwater runoff to flow directly into the ground via a bored or otherwise excavated opening in the ground surface. Also see “Class V Injection Well”.

**Dry-Bottom Detention Basin.** A basin designed to be completely dewatered after having provided its planned detention of runoff during a storm event.

**Duration.** The time period of a rainfall event.

**Earth Embankment.** A man-made deposit of soil, rock, or other material often used to form an impoundment.

**Elevation Certificate.** A form published by the Federal Emergency Management Agency that is used to certify the 100-year or base flood elevation and the lowest elevation of usable space to which a building has been constructed.

**Elevation Reference Mark (ERM).** Elevation benchmark tied to the National Geodetic Vertical Datum of 1929 and identified during the preparation of a Flood Insurance Study prepared for the Federal Emergency Management Agency.

**Emergency Spillway.** Usually a vegetated earth channel used to safely convey flood discharges around an impoundment structure.

**Energy Dissipater.** A device to reduce the energy of flowing water.

**Environment.** The sum total of all the external conditions that may act upon a living organism or community to influence its development or existence.

**Erosion and sediment control measure.** A practice, or a combination of practices, to control erosion and resulting sedimentation. and/or off-site damages.

**Erosion and sediment control system.** 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.

**Erosion control plan.** A written description and site plan of pertinent information concerning erosion control measures designed to meet the requirements of this Ordinance.

**Erosion.** The wearing away of the land surface by water, wind, ice, gravity, or other geological agents. The following terms are used to describe different types of water erosion:

- *Accelerated erosion*--Erosion much more rapid than normal or geologic erosion, primarily as a result of the activities of man.
- *Channel erosion* --An erosion process whereby the volume and velocity of flow wears away the bed and/or banks of a well-defined channel.
- *Gully erosion* --An erosion process whereby runoff water accumulates in narrow channels and, over relatively short periods, removes the soil to considerable depths, ranging from 1-2 ft. to as much as 75-100 ft.
- *Rill erosion*--An erosion process in which numerous small channels only several inches deep are formed; occurs mainly on recently disturbed and exposed soils (see "Rill").
- *Splash erosion*--The spattering of small soil particles caused by the impact of raindrops on wet soils; the loosened and spattered particles may or may not be subsequently removed by surface runoff.
- *Sheet erosion*--The gradual removal of a fairly uniform layer of soil from the land surface by runoff water.

**Extraterritorial Jurisdiction (ETJ).** Areas located outside the corporate limits of a community over which the community has statutory development authority.

**Farm or Field Tile.** A pipe installed in an agricultural area to allow subsurface drainage of farmland for the purpose of agricultural production.

**FEMA.** The Federal Emergency Management Agency.

**Filter Strip.** Usually a long, relatively narrow area (usually, 20-75 feet wide) of undisturbed or planted vegetation used near disturbed or impervious surfaces to filter stormwater pollutants for the protection of watercourses, reservoirs, or adjacent properties.

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

**Floatable.** Any solid waste that will float on the surface of the water.

**Flood (or Flood Waters).** A general and temporary condition of partial or complete inundation of normally dry land areas from the overflow, the unusual and rapid accumulation, or the runoff of surface waters from any source.

**Flood Boundary and Floodway Map (FBFM).** A map prepared by the Federal Emergency Management Agency that depicts the FEMA designated floodways within a community. This map also includes delineation of the 100-year and 500-year floodplain boundaries and the location of the Flood Insurance Study cross-sections.

**Flood Crest.** The maximum stage or elevation reached or expected to be reached by the waters of a specific flood at a given time.

**Flood Duration.** The length of time a stream is above flood stage or overflowing its banks.

**Flood Easement.** Easement granted to identify areas inundated by the 100-year flood and prohibit or severely restrict development activities.

**Flood Elevation.** The elevation at all locations delineating the maximum level of high waters for a flood of given return period.

**Flood Fighting.** Actions taken immediately before or during a flood to protect human life and to reduce flood damages such as evacuation, emergency sandbagging and diking.

**Flood Forecasting.** The process of predicting the occurrence, magnitude and duration of an imminent flood through meteorological and hydrological observations and analysis.

**Flood Frequency.** A statistical expression of the average time period between floods equaling or exceeding a given magnitude. For example, a 100-year flood has a magnitude expected to be equaled or exceeded on the average of once every hundred years; such a flood has a one-percent chance of being equaled or exceeded in any given year. Often used interchangeably with "recurrence interval".

**Flood Hazard Area.** Any floodplain, floodway, floodway fringe, or any combination thereof which is subject to inundation by the regulatory flood; or any flood plain as delineated by Zone X on a Flood Hazard Boundary Map.

**Flood Hazard Boundary Map (FHBM).** A map prepared by the Federal Emergency Management Agency that depicts Special Flood Hazard Areas as a Zone A within a community. There are no study text, base flood elevations, or floodways associated with this map.

**Flood Insurance Rate Map (FIRM).** A map prepared by the Federal Emergency Management Agency that depicts Special Flood Hazard Areas within a community. This map also includes the 100-year or Base Flood Elevation at various locations along the watercourses. More recent versions of the FIRM may also show the FEMA designated floodway boundaries and the location of the Flood Insurance Study cross-sections.

**Flood Insurance Study (FIS).** A study prepared by the Federal Emergency Management Agency to assist a community participating in the National Flood Insurance Program in its application of the program regulations. The study consists of a text which contains community background information with respect to flooding, a floodway data table, summary of flood discharges, flood profiles, a Flood Insurance Rate Map, and a Flood Boundary and Floodway Map.

**Flood Profile.** A graph showing the relationship of water surface elevation to a specific location, the latter generally expressed as distance above the mouth of a stream of water flowing in a channel. It is generally drawn to show surface elevation for the crest or a specific magnitude of flooding, but may be prepared for conditions at any given time or stage.

**Flood Protection Grade (FPG).** The elevation of the regulatory or 100-year flood plus two (2) feet at any given location in the Special Flood Hazard Area or 100-year floodplain.

**Flood Protection Grade.** The elevation of the lowest floor of a building, including the basement, which shall be two feet above the elevation of the regulatory flood.

**Flood Resistant Construction (Flood Proofing).** Additions, changes or adjustments to structures or property that are designed to reduce or eliminate the potential for flood damage.

**Flood Storage Areas.** Depressions, basins, or other areas that normally stand empty or partially empty, but fill with rainfall runoff during storms to hold the runoff and reduce downstream flow rates. The volumes are often referred to in units or acre-feet.

**Floodplain Management.** The operation of a program of corrective and preventive measures for reducing flood damage, including but not limited to flood control projects, floodplain land use regulations, flood proofing of buildings, and emergency preparedness plans.

**Floodplain Regulations.** General term applied to the full range of codes, ordinances and other regulations relating to the use of land and construction within floodplain limits. The term encompasses zoning ordinances, subdivision regulations, building and housing codes, encroachment laws and open area (space) regulations.

**Floodplain.** The channel proper and the areas adjoining the channel which have been or hereafter may be covered by the regulatory or 100-year flood. Any normally dry land area that is susceptible to being inundated by water from any natural source. The floodplain includes both the floodway and the floodway fringe districts.

**Floodway Fringe.** That portion of the flood plain lying outside the floodway, which is inundated by the regulatory flood.

**Floodway.** The channel of a river or stream and those portions of the floodplains adjoining the channel which are reasonably required to efficiently carry and discharge the peak flow of the regulatory flood of any river or stream.

**Footing Drain.** A drain pipe installed around the exterior of a basement wall foundation to relieve water pressure caused by high groundwater elevation.

**Forebay (or Sediment Forebay).** A small pond placed in front of a larger retention/detention structure such as a wet pond, dry pond, or wetland to intercept and concentrate a majority of sediment that is coming into the system before it reaches the larger structure.

**Freeboard.** An increment of height added to the base flood elevation to provide a factor of safety for uncertainties in calculations, unknown local conditions, wave actions and unpredictable effects such as those caused by ice or debris jams. (See “Flood Protection Grade”).

**French Drain.** A drainage trench backfilled with a coarse, water-transmitting material; may contain a perforated pipe.

**Gabion.** An erosion control structure consisting of a wire cage or cages filled with rocks.

**Garbage.** All putrescible animal solid, vegetable solid, and semisolid wastes resulting from the processing, handling, preparation, cooking, serving, or consumption of food or food materials.

**Geographical Information System.** A computer system capable of assembling, storing, manipulation, and displaying geographically referenced information. This technology can be used for resource management and development planning.

**Geotextile Fabric.** A woven or non-woven, water-permeable synthetic material used to trap sediment particles, prevent the clogging of aggregates with fine grained soil particles, or as a separator under road aggregate.

**Geotextile Liner.** A synthetic, impermeable fabric used to seal impoundments against leaks.

**Global Positioning System.** A system that provides specially coded satellite signals that is processed by a receiver, which determines position, velocity, and time. The system is funded and controlled by the U.S. Department of Defense.

**Grade.** (1) The inclination or slope of a channel, canal, conduit, etc., or natural ground surface usually expressed in terms of the percentage the vertical rise (or fall) bears to the corresponding horizontal distance. (2) The finished surface of a canal bed, roadbed, top of embankment, or bottom of excavation; any surface prepared to a design elevation for the support of construction,

such as paving or the laying of a conduit. (3) To finish the surface of a canal bed, roadbed, top of embankment, or bottom of excavation, or other land area to a smooth, even condition.

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

**Grass.** A member of the botanical family Graminae, characterized by blade-like leaves that originate as a sheath wrapped around the stem.

**Grassed Swale.** A type of vegetative practice used to filter stormwater runoff via a vegetated, shallow-channel conveyance.

**Grassed Waterway.** A natural or constructed waterway, usually broad and shallow, covered with erosion-resistant grasses and used to conduct surface water from an area.

**Green Space.** Open space maintained in a natural, undisturbed, or re-vegetated condition.

**Ground Cover (horticulture).** Low-growing, spreading plants useful for low-maintenance landscape areas.

**Groundwater Recharge.** The infiltration of water into the earth. It may increase the total amount of water stored underground or only replenish supplies depleted through pumping or natural discharge.

**Groundwater.** Accumulation of underground water, natural or artificial. The term does not include

**Habitat.** The environment in which the life needs of a plant or animal are supplied.

**Hard Surface.** See “Impervious Surface.”

**High Water.** Maximum designed permitted, or regulated water level for an impoundment.

**Hotspot.** An area where the land use or activities are considered to generate runoff with concentrations of pollutants in excess of those typically found in stormwater.

**Household Hazardous Waste.** Solid waste generated by households that is ignitable, toxic, reactive, corrosive, or otherwise poses a threat to human health or the environment.

**Hydraulic Grade Line (HGL).** For Channel flow, the HGL is equal to the water surface whereas for pressure flow it is the piezometric surface.

**Hydraulics.** A branch of science that deals with the practical application of the mechanics of water movement. A typical hydraulic study is undertaken to calculate water surface elevations.

**Hydrodynamic Loads.** Forces imposed on structures by floodwaters due to the impact of moving water on the upstream side of the structure, drag along its sides, and eddies or negative pressures on its downstream side.

**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.

**Hydrologic Unit Code.** A numeric United States Geologic Survey code that corresponds to a watershed area. Each area also has a text description associated with the numeric code.

**Hydrology.** The science of the behavior of water in the atmosphere, on the surface of the earth, and underground. A typical hydrologic study is undertaken to compute flow rates associated with specified flood events.

**Hydrometeorologic.** Water-related meteorological data such as rainfall or runoff.

**Hydrostatic Loads.** Those loads or pressures resulting from the static mass of water at any point of floodwater contact with a structure. They are equal in all direction and always act perpendicular to the surface on which they are applied. Hydrostatic loads can act vertically on structural members such as floors, decks and roofs, and can act laterally on upright structural members such as walls, piers, and foundations.

**IDNR.** Indiana Department of Natural Resources.

**Illicit Discharge.** Any discharge to a conveyance that is not composed entirely of stormwater except naturally occurring floatables, such as leaves or tree limbs.

**Impact Areas.** Areas defined or mapped that are unlikely to be easily drained because of one or more factors including but not limited to any of the following: soil type, topography, land where there is not adequate outlet, a floodway or floodplain, land within 75 feet of each bank of any regulated drain or within 75 feet from the centerline of any regulated tile ditch.

**Impaired Waters.** Waters that do not or are not expected to meet applicable water quality standards, as included on IDEM's CWA Section 303(d) List of Impaired Waters.

**Impervious surface.** Surfaces, such as pavement and rooftops, which prevent the infiltration of stormwater into the soil.

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

**Individual lot operator.** A contractor or subcontractor working on an individual lot.

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

**INDOT.** Indiana Department of Transportation. Generally used here to refer to specifications contained in the publication "INDOT Standard Specifications."

**Infiltration practices.** Any structural BMP designed to facilitate the percolation of run-off through the soil to ground water. Examples include infiltration basins or trenches, bioinfiltration basins, permeable pavement, and underground infiltration systems.

**Infiltration.** Passage or movement of water into the soil.

**Infiltration Swales.** A depressed earthen area that is designed to promote infiltration.

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

**Integrated Management Practice.** Low-impact development microscale and distributed management techniques used to maintain predevelopment site hydrology. Integrated management practices shall include bioretention facilities, filter/buffer strips, grassed swales, rain barrels, cisterns, infiltration trenches and amended soils as specified in the low-impact development design manuals.

**Intermittent Stream.** An intermittent stream has flowing water during certain times of the year, when groundwater provides water for stream flow. During dry periods, intermittent streams may not have flowing water. Runoff from rainfall is a supplemental source of water for stream flow.

**Invert.** The inside bottom of a culvert or other conduit.

**Junction Chamber.** A converging section of conduit, usually large enough for a person to enter, used to facilitate the flow from one or more conduits into a main conduit.

**Land Development or Land Development Project.** A man-made change to the land surface that potentially changes its runoff characteristics.

**Land City Engineer.** A person licensed under the laws of the State of Indiana to practice land surveying.

**Land-disturbing Activity.** Any man-made 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.

**Lateral Storm Sewer.** A drain that has inlets connected to it but has no other storm drain connected.

**Life Cycle Cost.** Cost based on the total cost incurred over the system life including research, development, testing, production, construction, operation, and maintenance. Costs are normally determined on present worth or equivalent annual cost basis.

**Linear Development Project.** A land development project that is linear in nature such as, but not limited to, (i) the construction of electric and telephone utility lines and natural gas pipelines; (ii) construction of tracks, rights-of-way, bridges, communication facilities and other related structures of a railroad company; and (iii) highway construction projects.

**Low Entry Elevation.** The elevation in a structure where overbank flooding can enter the structure.

**Lowest Adjacent Grade.** The elevation of the lowest grade adjacent (abutting) 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).

**Lowest Floor.** Refers to the lowest of the following:

1. The top of the basement floor;
2. The top of the garage floor, if the garage is the lowest level of the building;
3. The top of the first floor of buildings constructed on a slab or of buildings elevated on pilings or constructed on a crawl space with permanent openings; or
4. The top of the floor level of any enclosure below an elevated building where the walls of the enclosure provide any resistance to the flow of flood waters unless:
  - a) The walls are designed to automatically equalize the hydrostatic flood forces on the walls by allowing for the entry and exit of flood waters, by providing a minimum of two opening (in addition to doorways and windows) having a total area of one (1) square foot for every two (2) square feet of enclosed area subject to flooding. The bottom of all such openings shall be no higher than one (1) foot above grade.
  - b) Such enclosed space shall be usable only for the parking of vehicles or building access.

**Low Impact Development.** A hydrologically functional site design with pollution-prevention measures to reduce impacts and compensate for development impacts on hydrology and water quality.

**Low Impact Development Design Manuals.** Low-Impact Development Design Strategies: An Integrated Design Approach Manual and the Low-Impact Development Hydrologic Analysis Manual as incorporated by reference in this chapter.

**Maintenance Agreement.** A legally binding agreement between the landowner of a stormwater management structure and City of Valparaiso outlining each party's responsibility towards the operation, maintenance and general upkeep of said structure.

**Maintenance Plan.** A component of the stormwater management design plan describing the stormwater management structures at the land development project and identifying maintenance items that will be performed by the landowner to ensure proper functioning of said structures.

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

**Manhole.** Storm drain structure through which a person may enter to gain access to an underground storm drain or enclosed structure.

**Manning Roughness Coefficient or Manning's "n" Value.** A dimensionless coefficient ("n") used in the Manning's equation to account for channel wall frictional losses in steady uniform flow.

**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.

**Minimum Control Measure.** Minimum measures required by the NPDES Phase II program. The six (6) MCMs are: Public education and outreach, Public participation and involvement, Illicit discharge detection and elimination, Construction site runoff control, Post-construction runoff control, and Pollution prevention and good housekeeping.

**Minor Drainage Systems.** Drainage system carrying runoff from an area of less than one square mile.

**Minor Subdivision.** See “Subdivision, Minor”.

**Mulch.** A natural or artificial layer of plant residue or other materials covering the land surface which conserves moisture, holds soil in place, aids in establishing plant cover, and minimizes temperature fluctuations.

**Multi-Family.** Any structure which contains three or more dwelling units. A dwelling unit is any structure, or part of a structure, which is constructed to a house a family.

**Municipal Separate Storm Sewer Systems.** An MS4 meets all the following criteria: (1) is a conveyance or system of conveyances owned or operated by a State, county, city, town, or other public entity that discharges into waters of the U.S.; (2) is designed or used for collecting or conveying stormwater; (3) is not a combined sewer; and, (4) is not part of a Publicly Owned Treatment Works (POTW).

**Municipal, state, federal, or institutional refueling area.** An operating gasoline or diesel fueling area whose primary function is to provide fuel to either municipal, state, federal, or institutional equipment or vehicles.

**Mutual Drain.** A drain that: (1) Is located on two or more tracts of land that are under different ownership; (2) was established by the mutual consent of all the owners; and (3) was not established under or made subject to any drainage statute.

**National Flood Insurance Program (NFIP).** The NFIP is a Federal program enabling property owners to purchase flood insurance. The Federal Emergency Management Agency administers the NFIP in communities throughout the United States. The NFIP is based on an agreement between local communities and the Federal government which states that if a community will implement floodplain management measures to reduce future flood risks to new construction and substantially improved structures in flood hazard areas, the Federal government will make flood insurance available within the community as a financial protection against flood losses that do occur.

**National Geodetic Vertical Datum of 1929.** The nationwide, Federal Elevation datum used to reference topographic elevations to a known value.

**National Pollution Discharge Elimination System (NPDES).** A permit developed by the U.S. EPA through the Clean Water Act. In Indiana, the permitting process has been delegated to IDEM. This permit covers aspects of municipal stormwater quality.

**Natural Drainage.** The flow patterns of stormwater run-off over the land in its pre-development state.

**Nonagricultural land use.** Commercial use of land for the manufacturing and wholesale or retail sale of goods or services, residential or institutional use of land intended primarily to shelter people, highway use of land including lanes, alleys, and streets, and other land uses not included in agricultural land use.

**Nonpoint Source Pollution.** Pollution that enters a water body from diffuse origins on the watershed and does not result from discernable, confined, or discrete conveyances.

**Nonstructural Stormwater Practice.** A stormwater runoff treatment technique which uses natural measures to reduce pollutant levels, does not require extensive construction efforts and/or promotes pollution reduction by eliminating the pollutant source.

**Normal Depth.** Depth of flow in an open conduit during uniform flow for the given conditions.

**North American Vertical Datum of 1988 (NAVD 1988).** The nationwide, Federal Elevation datum used to reference topographic elevations to a known value.

**Nutrient(s).** (1) A substance necessary for the growth and reproduction of organisms. (2) In water, those substances (chiefly nitrates and phosphates) that promote growth of algae and bacteria.

**Off-site.** Everything not located at or within a particular site.

**Off-site Land Areas.** Those areas that by virtue of existing topography naturally shed surface water onto or through the developing property.

**Off-site Stormwater Management Facility.** A stormwater management facility located outside the subject property boundary described in the stormwater management design plan for the land development activity.

**100-Year Frequency Flood.** See “Regulatory Flood”.

**On-Site.** Located within the controlled or urbanized area where runoff originates.

**On-site Stormwater Management Facility.** A stormwater management facility located within the subject property boundary described in the stormwater management design plan for the land development activity.

**Open Drain.** A natural watercourse or constructed open channel that conveys drainage water.

**Open Space.** Any land area devoid of any disturbed or impervious surfaces created by industrial, commercial, residential, agricultural, or other manmade activities.

**Orifice.** A device which controls the rate of flow from a detention basin.

**Outfall scouring.** The deterioration of a streambed or lakebed from an outfall discharge to an extent that the excessive settling of solid material results and suitable aquatic habitat is diminished.

**Outfall.** The point, location, or structure where a pipe or open drain discharges to a receiving body of water.

**Outlet.** The point of water disposal from a stream, river, lake, tidewater, or artificial drain.

**Overcompensation.** The extra water quantity or quality control provided at one site discharge point in order to allow another discharge point(s) to go uncontrolled.

**Overland Flow.** Consists of sheet flow, shallow concentrated flow and channel flow.

**Peak Discharge (or Peak Flow).** The maximum instantaneous flow from a given storm condition at a specific location.

**Percolation.** The movement of water through soil.

**Perennial Stream.** A stream that maintains water in its channel throughout the year.

**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.

**Permeability (soil).** The quality of a soil that enables water or air to move through it. Usually expressed in inches per hour or inches per day.

**Person.** Any firm, association, organization, partnership, trust, company, or corporation, as well as an individual.

**Pervious.** Allowing movement of water.

**Pesticides.** Chemical compounds used for the control of undesirable plants, animals, or insects. The term includes insecticides, herbicides, algicides, rodenticides, nematocides, fungicides, and growth regulators.

**pH.** A numerical measure of hydrogen ion activity, the neutral point being 7.0. All pH values below 7.0 are acid, and all above 7.0 are alkaline.

**Phasing of construction.** 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.

**Phosphorus (available).** Inorganic phosphorus that is readily available for plant growth.

**Piping.** The formation of "pipes" by underground erosion. Water in the soil carries the fine soil particles away, and a series of eroded tubes or tunnels develop. These openings will grow progressively larger and can cause a dam failure.

**Planimetric Data.** Horizontal measurements involving distances or dimensions on a diagram, map, Plat of Survey or topographic map. Normally in units of feet.

**Plat of Survey.** A scaled diagram showing boundaries of a tract of land or subdivision. This may constitute a legal description of the land and be used in lieu of a written description.

**Point Source.** Any discernible, confined, and discrete conveyance including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, or container from which pollutants are or maybe discharged (P.L. 92-500, Section 502[14]).

**Pollutant of concern.** Any pollutant that has been documented via analytical data as a cause of impairment in any waterbody.

**Porosity.** The volume of pore space in soil or rock.

**Porous pavement.** Also called permeable pavement. A type of infiltration practice to improve the quality and reduce the quantity of stormwater run-off via the use of manmade, pervious pavement which allows run-off to percolate through the pavement and into underlying soils.

**Post-Development.** The conditions that reasonably may be expected or anticipated to exist after completion of the land development activity on a specific site or tract of land.

**Pre-Development.** The land condition that exists at the time that plans for the land development are submitted to the locality. Where phased development or plan approval occurs (preliminary grading, roads, and utilities, etc.), the existing land use at the time the first item is submitted shall establish predevelopment conditions.

**Pre-Treatment.** The techniques employed in a stormwater management plan to provide storage or filtering to help trap coarse materials before they enter the stormwater BMP. Pretreatment is required on some BMPs to help avoid costly maintenance.

**Private Drain.** A drain that: (1) Is located on land owned by one person or by two or more persons jointly; and (2) was not established under or made subject to any drainage statute.

**Professional Engineer.** A person licensed under the laws of the State of Indiana to practice professional engineering.

**Program Administrator.** The City Administrator or his designee.

**Programmatic Indicator.** Any data collected by an MS4 entity that is used to indicate implementation of one (1) or more minimum control measures.

**Project site owner.** The person required to submit a stormwater permit application, and required to comply with the terms of this ordinance, including a developer or a 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.

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

**Probable Maximum Flood.** The most severe flood that may be expected from a combination of the most critical meteorological and hydrological conditions that are reasonably possible in the drainage basin. It is used in designing high-risk flood protection works and siting of structures and facilities that shall be subject to almost no risk of flooding. The probable maximum flood is usually much larger than the 100-year flood.

**Publicly Owned Treatment Works (POTW).** A municipal operation that breaks down and removes contaminants in the wastewater prior to discharging to a stream through primary and/or secondary treatment systems.

**Qualified professional.** An individual who is trained and experienced in stormwater treatment techniques and related fields as may be demonstrated by state registration, professional certification, experience, or completion of coursework that enable the individual to make sound, professional judgments regarding stormwater control or treatment and monitoring, pollutant fate and transport, and drainage planning.

**Radius of Curvature.** Length of radius of a circle used to define a curve.

**Rain garden.** A vegetative practice used to alter impervious surfaces, such as roofs, into pervious surfaces for absorption and treatment of rainfall.

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

**Reach.** Any length of river, channel or storm drain.

**Receiving Stream or Receiving Water.** The body of water into which runoff or effluent is discharged. The term does not include private drains, unnamed conveyances, retention and detention basins, or constructed wetlands used as treatment.

**Recharge.** Replenishment of groundwater reservoirs by infiltration and transmission from the outcrop of an aquifer or from permeable soils.

**Recurrence Interval.** A statistical expression of the average time between floods equaling or exceeding a given magnitude.

**Redevelopment.** Alterations of a property that change a site or building in such a way that there is disturbances of one (1) acre or more of land. The term does not include such activities as exterior remodeling.

**Regional Stormwater Management Facility (Regional Facility).** A facility or series of facilities designed to control stormwater runoff from a specific watershed and for one or more developments.

**Regulated Area.** The following areas within City of Valparaiso:

1. All territory of the County except for a territory of a municipality located within the County unless the municipality has entered into an agreement to adopt the City of Valparaiso Stormwater Management Ordinance.
2. All areas, within a municipality, that directly drain to a Regulated Drain.

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

**Regulatory or 100-Year Flood.** The discharge or elevation associated with the 100-year flood as calculated by a method and procedure which is acceptable to and approved by the Indiana

Department of Natural Resources and the Federal Emergency Management Agency. The "regulatory flood" is also known as the "base flood".

**Regulatory Floodway.** See "Floodway".

**Release Rate.** The amount of stormwater release from a stormwater control facility per unit of time.

**Reservoir.** A natural or artificially created pond, lake or other space used for storage, regulation or control of water. May be either permanent or temporary. The term is also used in the hydrologic modeling of storage facilities.

**Retail gasoline outlet.** An operating gasoline or diesel fueling facility whose primary function is the resale of fuels. The term applies to facilities that create five thousand (5,000) or more square feet of impervious surfaces, or generate an average daily traffic count of one hundred (100) vehicles per one thousand (1,000) square feet of land area.

**Retention basin.** A type of storage practice, that has no positive outlet, used to retain stormwater run-off for an indefinite amount of time. Runoff from this type of basin is removed only by infiltration through a porous bottom or by evaporation.

**Retention.** The storage of stormwater to prevent it from leaving the development site. May be temporary or permanent.

**Retention Facility.** A facility designed to completely retain a specified amount of stormwater runoff without release except by means of evaporation, infiltration or pumping. The volumes are often referred to in units of acre-feet.

**Return Period.** The average interval of time within which a given rainfall event will be equaled or exceeded once. A flood having a return period of 100 years has a one percent probability of being equaled or exceeded in any one year.

**Revetment.** Facing of stone or other material, either permanent or temporary, placed along the edge of a stream to stabilize the bank and protect it from the erosive action of the stream. Also see "Revetment Riprap".

**Right-of-Way for a County Drain.** The statutory right of way as defined by Indiana Code for a regulated drain.

**Riparian habitat.** A land area adjacent to a waterbody that supports animal and plant life associated with that waterbody.

**Riparian zone.** Of, on, or pertaining to the banks of a stream, river, or pond.

**Riprap.** Broken rock, cobble, or boulders placed on earth surfaces, such as the face of a dam or the bank of a stream, for protection against the action of water (waves). Revetment riprap is material graded such that: (1) no individual piece weighs more than 120 lbs. and (2) 90-100% will pass through a 12-inch sieve, 20-60% through a 6-inch sieve, and not more than 10% through a 12-inch sieve.

**River Restoration.** Restoring the channel of a stream or ditch to its perceived original, non-obstructed capacity by means of clearing & snagging, obstruction removal, and inexpensive streambank protection measures. The term "restoration", as noted, does not necessarily imply restoration or improvement of water quality or habitat within the channel or its adjacent area.

**Riverine.** Relating to, formed by, or resembling a stream (including creeks and rivers).

**Runoff Coefficient.** A decimal fraction relating the amount of rain which appears as runoff and reaches the storm drain system to the total amount of rain falling. A coefficient of 0.5 implies that 50 percent of the rain falling on a given surface appears as stormwater runoff.

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

**Sand.** (1) Soil particles between 0.05 and 2.0 mm in diameter. (2) A soil textural class inclusive of all soils that are at least 70% sand and 15% or less clay.

**Sanitary Backup.** The condition where a sanitary sewer reaches capacity and surcharges into the lowest area.

**Scour.** The clearing and digging action of flowing water.

**Sediment.** 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 earth's surface.

**Sediment Forebay.** See "Forebay".

**Sedimentation.** The process that deposits soils, debris and other unconsolidated materials either on the ground surfaces or in bodies of water or watercourses.

**Seepage.** The passage of water or other fluid through a porous medium, such as the passage of water through an earth embankment or masonry wall.

**Sensitive Water.** A water body in need of priority protection or remediation based on its:

providing habitat for threatened or endangered species,

usage as a public water supply intake,

relevant community value,

usage for full body contact recreation,

exceptional use classification as found in 327 IAC 2-1-11(b), outstanding state resource water classification as found in 327 IAC 2-1-2(3) and 327 IAC 2-1.5-19(b).

**Setback.** The distance a structure must be located from property lines or other structures.

**Settling Basin.** An enlargement in the channel of a stream to permit the settling of debris carried in suspension.

**Silt Fence.** A fence constructed of wood or steel supports and either natural (e.g. burlap) or synthetic fabric stretched across area of non-concentrated flow during site development to trap and retain on-site sediment due to rainfall runoff.

**Silt.** (1) Soil fraction consisting of particles between 0.002 and 0.05 mm in diameter. (2) A soil textural class indicating more than 80% silt.

**Siphon.** A closed conduit or portion of which lies above the hydraulic grade line, resulting in a pressure less than atmospheric and requiring a vacuum within the conduit to start flow. A siphon utilizes atmospheric pressure to effect or increase the flow of water through a conduit. An inverted siphon is used to carry stormwater flow under an obstruction such as a sanitary sewer.

**Site.** The entire area included in the legal description of the land on which land disturbing activity is to be performed.

**Slope.** Degree of deviation of a surface from the horizontal, measured as a numerical ratio or percent. Expressed as a ratio, the first number is commonly the horizontal distance (run) and the second is the vertical distance (rise)--e.g., 2:1. However, the preferred method for designation of slopes is to clearly identify the horizontal (H) and vertical (V) components (length (L) and Width (W) components for horizontal angles). Also note that according to international standards (Metric), the slopes are presented as the vertical or width component shown on the numerator--e.g., 1V:2H. Slope expressions in this Ordinance follow the common presentation of slopes--e.g., 2:1 with the metric presentation shown in parenthesis--e.g., (1V:2H). Slopes can also be expressed in "percents". Slopes given in percents are always expressed as  $(100 * V/H)$  --e.g., a 2:1 (1V:2H) slope is a 50% slope.

**Soil and Water Conservation District.** A public organization created under state law as a special-purpose district to develop and carry out a program of soil, water, and related resource conservation, use, and development within its boundaries. A subdivision of state government with a local governing body, established under IC 14-32.

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

**Solid Waste.** Any garbage, refuse, debris, or other discarded material.

**Special Flood Hazard Area.** An area that is inundated during the 100-Year flood.

**Spill.** The unexpected, unintended, abnormal, or unapproved dumping, leakage, drainage, seepage, discharge, or other loss of petroleum, hazardous substances, extremely hazardous substances, or objectionable substances. The term does not include releases to impervious surfaces when the substance does not migrate off the surface or penetrate the surface and enter the soil.

**Spillway.** A waterway in or about a hydraulic structure, for the escape of excess water.

**Standard Project Flood.** A term used by the U.S. Army Corps of Engineers to designate a flood that may be expected from the most severe combination of meteorological and hydrological conditions that are considered reasonable characteristics of the geographical area in

which the drainage basin is located, excluding extremely rare combinations. The peak flow for a standard project flood is generally 40 – 60 percent of the probable maximum flood for the same location.

**Stilling Basin.** A basin used to slow water down or dissipate its energy.

**Storage practices.** Any structural BMP intended to store or detain stormwater and slowly release it to receiving waters or drainage systems. The term includes detention and retention basins.

**Storm drain signing.** Any marking procedure that identifies a storm sewer inlet as draining directly to a receiving waterbody so as to avoid dumping pollutants. The procedures can include painted or cast messages and adhesive decals.

**Storm Duration.** The length of time that water may be stored in any stormwater control facility, computed from the time water first begins to be stored.

**Storm Event.** An estimate of the expected amount of precipitation within a given period of time. For example, a 10-yr. frequency, 24-hr. duration storm event is a storm that has a 10% probability of occurring in any one year. Precipitation is measured over a 24-hr. period.

**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 stormwater, while excluding sewage and industrial wastes. Also called a storm drain.

**Stormwater.** Water resulting from rain, melting or melted snow, hail, or sleet.

**Stormwater Drainage System.** All means, natural or man-made, used for conducting stormwater 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.

**Stormwater Management Extended Detention Basin (Extended Detention Basin).** A stormwater management facility that temporarily impounds runoff and discharges it through a hydraulic outlet structure over a specified period of time to a downstream conveyance system for the purpose of water quality enhancement or stream channel erosion control. Since an extended detention facility impounds runoff only temporarily, it is normally dry during non-rainfall periods.

**Stormwater Management Facility.** A device that controls stormwater runoff and changes the characteristics of that runoff including, but not limited to, the quantity and quality, the period of release, or the velocity of flow.

**Stormwater Management Filtering System.** A stormwater treatment practice that utilizes an artificial media [medium] to filter out pollutants. Filtering systems shall include bioretention facilities and sand filters, as specified in the Valparaiso Stormwater Technical Standards Manual.

**Stormwater Management Infiltration Facility.** A stormwater management facility that temporarily impounds runoff and discharges it via infiltration through the surrounding soil. Infiltration facilities shall include infiltration basins, infiltration trenches, permeable pavement, bioinfiltration basin, tree box/tree trench and underground infiltration systems as specified in the Valparaiso Stormwater Technical Standards Manual.

**Stormwater Management Open Channel System.** A vegetated open channel designed to remove pollutants from stormwater runoff by filtration through grass and infiltration into the soil.

**Stormwater Management Wetland.** An area intentionally designed and created to emulate the water quality improvement function of wetlands for the primary purpose of removing pollutants from stormwater.

**Stormwater Pollution Prevention Plan.** A plan developed to minimize the impact of stormwater pollutants resulting from construction activities.

**Stormwater Quality Management Plan.** A comprehensive written document that addresses stormwater runoff quality.

**Stormwater Quality Measure.** A practice, or a combination of practices, to control or minimize pollutants associated with stormwater runoff.

**Stormwater runoff.** The water derived from rains falling within a tributary basin, flowing over the surface of the ground or collected in channels or conduits.

**Stream Gauging.** The quantitative determination of streamflow using gauges, current meters, weirs, or other measuring instruments at selected locations.

**Stream Length.** The length of a stream or ditch, expressed in miles, from the confluence of the stream or ditch with the receiving stream to the upstream extremity of the stream or ditch, as indicated by the solid or dashed, blue or purple line depicting the stream or ditch on the most current edition of the seven and one-half (7.2) minute topographic quadrangle map published by the United States Geological Survey, measured along the meanders of the stream or ditch as depicted on the map.

**Stream.** See “Intermittent Stream”, “Perennial Stream”, and “Receiving Stream”.

**Streambanks.** The usual boundaries (not the flood boundaries) of a stream channel. Right and left banks are named facing downstream.

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

**Structure.** Refers to a structure that is principally above ground and is enclosed by walls and a roof. The term includes but is not limited to, a gas or liquid storage tank, a manufactured home or a prefabricated building, and recreational vehicles to be installed on a site for more than 180 days.

**Structural Engineer.** A person licensed under the laws of the State of Indiana to engage in the designing or supervising of construction, enlargement or alteration of structures or any part thereof.

**Structural Floodplain.** Management Measures. Those physical or engineering measures employed to modify the way floods behave, (e.g., dams, dikes, levees, channel enlargements and diversions).

**Subarea/Subbasin.** Portion of a watershed divided into homogenous drainage units which can be modeled for purposes of determining runoff rates. The subareas/subbasins have distinct boundaries, as defined by the topography of the area.

**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.

**Subdivision, Minor.** The subdivision of a parent parcel into any combination of not more than three (3) contiguous or non-contiguous new residential, commercial, or industrial building sites. The parcel shall front upon an existing street which is an improved right-of-way maintained by the City or other governmental entity and not involve any new street.

**Subsoil.** The B horizons of soils with distinct profiles. In soils with weak profile development, the subsoil can be defined as the soil below which roots do not normally grow.

**Subsurface Drain.** A pervious backfield trench, usually containing stone and perforated pipe, for intercepting groundwater or seepage.

**Subwatershed.** A watershed subdivision of unspecified size that forms a convenient natural unit. Also see “Subarea”.

**Sump Failure.** A failure of the sump pump that results in inundation of crawl space or basement.

**Sump Pump.** A pump that discharges seepage from foundation footing drains.

**Surcharge.** Backup of water in a sanitary or storm sewer system in excess of the design capacity of the system.

**Surface Runoff.** Precipitation that flows onto the surfaces of roofs, streets, the ground, etc., and is not absorbed or retained by that surface but collects and runs off.

**Suspended Solids.** Solids either floating or suspended in water.

**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.).

**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.

**Thalweg.** The deepest point (or centerline) of a channel.

**Tile Drain.** Pipe made of perforated plastic, burned clay, concrete, or similar material, laid to a designed grade and depth, to collect and carry excess water from the soil.

**Tile Drainage.** Land drainage by means of a series of tile lines laid at a specified depth, grade, and spacing.

**Time of Concentration (tc).** 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.

**Topographic Map.** Graphical portrayal of the topographic features of a land area, showing both the horizontal distances between the features and their elevations above a given datum.

**Topography.** The representation of a portion of the earth's surface showing natural and man-made features of a give locality such as rivers, streams, ditches, lakes, roads, buildings and most importantly, variations in ground elevations for the terrain of the area.

**Topsoil.** (1) The dark-colored surface layer, or a horizon, of a soil; when present it ranges in depth from a fraction of an inch to 2-3 ft. (2) Equivalent to the plow layer of cultivated soils. (3) Commonly used to refer to the surface layer(s), enriched in organic matter and having textural and structural characteristics favorable for plant growth.

**Total Maximum Daily Load.** Method used to establish allowable loadings for specified pollutants in a surface water resource to meet established water quality standards.

**Toxicity.** The characteristic of being poisonous or harmful to plant or animal life. The relative degree or severity of this characteristic.

**TP-40 Rainfall.** Design storm rainfall depth data for various durations published by the National Weather Service in their Technical Paper 40 dated 1961.

**Trained individual.** An individual who is trained and experienced in the principles of stormwater quality, including erosion and sediment control as may be demonstrated by state registration, professional certification, experience, or completion of coursework that enable the individual to make judgments regarding stormwater control or treatment and monitoring.

**Transition Section.** Reaches of the stream of floodway where water flows from a narrow cross-section to a wide cross-section or vice-versa.

**Tributary.** Based on the size of the contributing drainage area, a smaller watercourse which flows into a larger watercourse.

**Turbidity.** (1) Cloudiness of a liquid, caused by suspended solids. (2) A measure of the suspended solids in a liquid.

**Underdrain.** A small diameter perforated pipe that allows the bottom of a detention basin, channel or swale to drain.

**Unified Soil Classification System.** A system of classifying soils that is based on their identification according to particle size, gradation, plasticity index, and liquid limit.

**Uniform Flow.** A state of steady flow when the mean velocity and cross-sectional area remain constant in all sections of a reach.

**Unit Hydrograph.** A unit hydrograph is the hydrograph that results from one inch of precipitation excess generated uniformly over the watershed at a uniform rate during a specified period of time.

**Urban Drain.** A drain defined as “Urban Drain” in Indiana Drainage Code.

**Urbanization.** The development, change or improvement of any parcel of land consisting of one or more lots for residential, commercial, industrial, institutional, recreational or public utility purposes.

**Vegetative practices.** Any nonstructural or structural BMP that, with optimal design and good soil conditions, utilizes various forms of vegetation to enhance pollutant removal, maintain and improve natural site hydrology, promote healthier habitats, and increase aesthetic appeal. Examples include grass swales, filter strips, buffer strips, constructed wetlands, and rain gardens.

**Vegetative Stabilization.** Protection of erodible or sediment producing areas with: permanent seeding (producing long-term vegetative cover), short-term seeding (producing temporary vegetative cover), or sodding (producing areas covered with a turf of perennial sod-forming grass).

**Water Course.** Any river, stream, creek, brook, branch, natural or man-made drainage way in or into which stormwater runoff or floodwaters flow either regularly or intermittently.

**Water Quality.** A term used to describe the chemical, physical, and biological characteristics of water, usually in respect to its suitability for a particular purpose.

**Water Resources.** The supply of groundwater and surface water in a given area.

**Water Table.** (1) The free surface of the groundwater. (2) That surface subject to atmospheric pressure under the ground, generally rising and falling with the season or from other conditions such as water withdrawal.

**Waterbody.** Any accumulation of water, surface, or underground, natural or artificial.

**Watercourse.** Any river, stream, creek, brook, branch, natural or man-made drainageway in or into which stormwater runoff or floodwaters flow either continuously or intermittently.

**Watershed Area.** All land and water within the confines of a drainage divide. Also see “Watershed”.

**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.

**Waterway.** A naturally existing or manmade open conduit or channel utilized for the conveyance of water.

**Weir.** A channel-spanning structure for measuring or regulating the flow of water.

**Wellhead protection area.** The meaning is set forth at 327 IAC 8-4.1-1(27).

**Wet-Bottom Detention Basin (Retention Basin).** A basin designed to retain a permanent pool of water after having provided its planned detention of runoff during a storm event.

**Wetlands.** Areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions.

**APPENDIX B**

**INFORMATION CHECKLIST AND  
CERTIFICATION FORM**

- B1. Stormwater Information Submission Checklist**
- B2. Certification of Completion and Compliance**

# Stormwater Information Submission Checklist

## 1. Construction Plans – General Requirements

- 1.1 Title sheet which includes location map, vicinity map, operating authority, design company name, developer name, and index of plan sheets.
- 1.2 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.
- 1.3 A reduced plat or project site map showing the parcel identification numbers, the 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.
- 1.4 An existing project site layout that must include the following information:
  - 1.4.1 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 either National Geodetic Vertical Datum of 1929 (NGVD) or 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.
    - i. 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.
    - ii. 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.
  - 1.4.2 Location, name, and normal water level of all wetlands, lakes, ponds, and water courses on or adjacent to the project site.
  - 1.4.3 Location of storm, sanitary, combined sewer, and septic tank systems and outfalls.
  - 1.4.4 The location of regulated drains, farm drains, inlets and outfalls, if any of record.
  - 1.4.5 Location of all existing cornerstones within the proposed development and a plan to protect and preserve them.

- 1.5 A grading and drainage plan, including the following information:
  - 1.5.1 Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas.
  - 1.5.2 Delineation of all proposed land disturbing activities, including off-site activities that will provide services to the project site.
  - 1.5.3 Information regarding any off-site borrow, stockpile, or disposal areas that are associated with a project site, regardless of who owns or controls those areas. Off-site disposal areas may need to have their own permits.
  - 1.5.4 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/ponding areas shown as hatched areas, along with the associated easements.
  - 1.5.5 Location, size, and dimensions of features such as permanent retention or detention facilities, including existing or manmade 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.
  - 1.5.6 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 this ordinance, and the relationship of structures, streets, and other facilities.
- 1.6 Utility plan sheet(s) showing the location of all proposed utility lines for the project
- 1.7 Storm sewer plan/profile sheet(s) showing the elevation, size, length, location of all proposed storm sewers. Existing and proposed ground grades, storm sewer structures elevations, and utility crossings also must be included.
- 1.8 A 24-inch by 36-inch plat, including the following information:
  - 1.8.1 Legal description.
  - 1.8.2 Cross reference to Rule 12.
  - 1.8.3 Regulated drain statement and table.
- 1.9 Any other information required by City of Valparaiso to thoroughly evaluate the submitted material.
2. Storm Water Drainage Technical Report
  - 2.1 A summary report, including the following information:

- 2.1.1 Description of the nature and purpose of the project.
  - 2.1.2 The significant drainage problems associated with the project.
  - 2.1.3 The analysis procedure used to evaluate these problems and to propose solutions.
  - 2.1.4 Any assumptions or special conditions associated with the use of these procedures, especially the hydrologic or hydraulic methods.
  - 2.1.5 The proposed design of the drainage control system.
  - 2.1.6 The results of the analysis of the proposed drainage control system showing that it does solve the project's drainage problems. 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.
  - 2.1.7 Proof of Errors and Omissions Insurance for the registered professional engineer or licensed surveyor showing a minimum amount of \$1,000,000 in coverage.
- 2.2 A Hydrologic/Hydraulic Analysis, consistent with the methodologies and calculation included in the technical standards, and including the following information:
- 2.2.1 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 should be addressed as well. This report should be comprehensive and detail all of the steps the engineer took during the design process.
  - 2.2.2 All hydrologic and hydraulic computations should be included in the submittal. These calculations should include, but are not limited to: runoff curve numbers and runoff coefficients, runoff calculations, stage-discharge relationships, times-of-concentration and storage volumes.
  - 2.2.3 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 will expedite the review process and is required to be submitted.
  - 2.2.4 A set of exhibits should be included showing the drainage sub-areas and a schematic detailing of how the computer models were set up.
  - 2.2.5 A conclusion which summarizes the hydraulic design and details how this design satisfies this Ordinance.
3. Stormwater Pollution Prevention Plan for Construction Sites

3.1 Construction Plan Elements (Section A in IDEM Form)

- A1 Index of the location of required plan elements in the construction plan
- A2 A vicinity map depicting the project site location in relationship to recognizable local landmarks, towns, and major roads
- A3 Narrative of the nature and purpose of the project
- A4 Latitude and longitude to the nearest fifteen (15) seconds
- A5 Legal description of the project site
- A6 11 X 17-inch plat showing building lot numbers/boundaries and road layout/names
- A7 Boundaries of the one hundred (100) year floodplains, floodway fringes, and floodways
- A8 Land use of all adjacent properties
- A9 Identification of a U.S. EPA approved or established TMDL
- A10 Name(s) of the receiving water(s)
- A11 Identification of discharges to a water on the current 303d list of impaired waters and the pollutant(s) for which it is impaired
- A12 Soil map of the predominant soil types
- A13 Identification and location of all known wetlands, lakes and water courses on or adjacent to the project site (construction plan, existing site layout)
- A14 Identification of any other state or federal water quality permits or authorizations that are required for construction activities
- A15 Identification and delineation of existing cover, including natural buffers
- A16 Existing topography at a contour interval appropriate to indicate drainage patterns
- A17 Location(s) of where run-off enters the project site
- A18 Location(s) of where run-off discharges from the project site prior to land disturbance
- A19 Location of all existing structures on the project site
- A20 Existing permanent retention or detention facilities, including manmade wetlands, designed for the purpose of stormwater management

- A21 Locations where stormwater may be directly discharged into ground water, such as abandoned wells, sinkholes, or karst features
  - A22 Size of the project area expressed in acres
  - A23 Total expected land disturbance expressed in acres
  - A24 Proposed final topography
  - A25 Locations and approximate boundaries of all disturbed areas
  - A26 Location, size, and dimensions of all stormwater drainage systems, such as culverts, storm sewers, and conveyance channels
  - A27 Locations of specific points where stormwater and non-stormwater discharges will leave the project site
  - A28 Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas
  - A29 Location of all on-site soil stockpiles and borrow areas
  - A30 Construction support activities that are expected to be part of the project
  - A31 Location of any in-stream activities that are planned for the project including, but not limited to stream crossings and pump arounds
- 3.2 Erosion and Sediment Control/Project Site Management (Section B in IDEM Form)
- B1 Description of the potential pollutant generating sources and pollutants, including all potential non-stormwater discharges
  - B2 Stable construction entrance locations and specifications
  - B3 Specifications for temporary and permanent stabilization
  - B4 Sediment control measures for concentrated flow areas
  - B5 Sediment control measures for sheet flow areas
  - B6 Run-off control measures
  - B7 Stormwater outlet protection locations and specifications
  - B8 Grade stabilization structure locations and specifications
  - B9 Dewatering applications and management methods
  - B10 Measures utilized for work within waterbodies
  - B11 Maintenance guidelines for each proposed temporary stormwater quality measure

- B12 Planned construction sequence describing the relationship between implementation of stormwater quality measures in relation to land disturbance
- B13 Provisions for erosion and sediment control on individual building lots regulated under the proposed project
- B14 Material handling, spill prevention and spill response plan meeting requirements in 327 IAC 2-6.1
- B15 Material handling and storage procedures associated with construction activity

Post-Construction Stormwater Pollution Prevention Plan

3.3 SWPPP – Post-Construction (Section C in IDEM Form)

- C1 Description of pollutants and their sources associated with the proposed land use
- C2 Description of proposed post-construction stormwater measures
- C3 Plan details for each stormwater measure
- C4 Sequence describing stormwater measure implementation
- C5 Maintenance guidelines for proposed post-construction stormwater measures
- C6 Entity that will be responsible for operation and maintenance of the post-construction stormwater measures

3.4 Post-Construction Stormwater BMP Operation and Maintenance Manual

**DEVELOPER'S CERTIFICATE OF COMPLETION AND COMPLIANCE**

Name of project: \_\_\_\_\_

Address of premises on which land alteration was accomplished: \_\_\_\_\_  
\_\_\_\_\_

Inspection Date(s): \_\_\_\_\_

IDEM CSGP Permit Number: \_\_\_\_\_ Valparaiso Site Permit Number: \_\_\_\_\_

Relative to plans prepared by: \_\_\_\_\_ on \_\_\_\_\_  
(date)

I hereby certify that:

1. I am familiar with drainage requirements applicable to such land alteration (as set forth in the Stormwater Management Ordinance of City of Valparaiso; and
2. I (or a person under my direct supervision) have personally inspected the completed work and examined the drainage permit and its conditions, as-built plans, and final drainage calculations consistent with as-built conditions performed pursuant to the above referenced drainage permit; and
3. To the best of my knowledge, information, and belief, such land alteration has been performed and completed in conformity with all such drainage requirements, except

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Signature: \_\_\_\_\_

Date: \_\_\_\_\_

Typed or Printed Name: \_\_\_\_\_

Phone: (\_\_\_\_) \_\_\_\_\_

(SEAL)

Business Address: \_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

SURVEYOR

ENGINEER

(circle one)

Indiana Registration No. \_\_\_\_\_

**APPENDIX C**

**POST-CONSTRUCTION BMP  
INSPECTION CHECKLIST**

**Bioretention**

**Constructed Wetland**

**Infiltration Trench**

**Infiltration Basin**

**Media Filtration**

**Vegetated Filter Strip**

**Vegetated Swale**

**Detention Pond**

## Bioretention Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Debris Cleanout</b>		
Bioretention and contributing areas clean of debris (litter, branches, etc.)		
No dumping of yard wastes into BMP		
<b>2. Vegetation</b>		
Plant height not less than design water depth but not greater than 6 inches		
Observed plant types consistent with accepted plans		
Plants covering greater than 85% of total BMP surface area		
Plant community appears thick and healthy		
No evidence of erosion		
<b>3. Sediment Deposits/Accumulation</b>		
No evidence of sediment buildup around check dams or energy dissipaters.		
Sumps are not more than 50% full of sediment		
Sediment is not >20% of BMP design depth.		



## Constructed Wetland Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Embankment and Emergency Spillway</b>		
Healthy vegetation with at least 85% ground cover.		
No signs of erosion on embankment.		
No animal burrows.		
Embankment is free of cracking, bulging, or sliding.		
Embankment is free of woody vegetation.		
Embankment is free of leaks or seeps		
Emergency spillway is clear of obstructions.		
<b>2. Riser and Principal Spillway</b>		
Low flow outlet free of obstruction.		
Trash rack is not blocked or damaged.		
Riser is free of excessive sediment buildup		
Outlet pipe is in good condition.		
Control valve is operational		
Outfall channels are stable and free of scouring.		



## Infiltration Trench Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Debris Cleanout</b>		
Trench surface clear of debris		
Inflow pipes clear of debris		
Overflow spillway clear of debris		
Inlet area clear of debris		
<b>2. Sediment Traps or Forebays</b>		
Obviously trapping sediment		
Greater than 50% of storage volume remaining		
<b>3. Trench</b>		
Trench dewatered between storms		
No evidence of sedimentation in trench		
Sediment accumulation doesn't yet require cleanout		
<b>4. Inlets</b>		
Good condition		
No evidence of erosion		



## Infiltration Basin Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Debris Cleanout</b>		
Basin bottom clear of debris		
Inlet clear of debris		
Outlet clear of debris		
Emergency spillway clear of debris		
<b>2. Sediment Traps or Forebays</b>		
Obviously trapping sediment		
Greater than 50% of storage volume remaining		
<b>3. Vegetation</b>		
Mowing done when needed		
No evidence of erosion		
<b>4. Dewatering</b>		
Basin dewatered between storms		
<b>5. Sediment Cleanout of Basin</b>		
No evidence of sedimentation		
Sediment accumulation does not yet require cleanout		



## Media Filtration Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Debris Cleanout</b>		
Contributing areas clean of debris		
Filtration facility clean of debris		
Inlet and outlets clear of debris		
<b>2. Oil and Grease</b>		
No evidence of filter surface clogging		
Activities in drainage area minimize oil and grease entry		
<b>3. Vegetation</b>		
Contributing drainage area stabilized		
No evidence of erosion		
Area mowed and clippings removed		
<b>4. Water Retention Where Required</b>		
Water holding chambers at normal pool		
No evidence of leakage		

**Actions to be Taken:** \_\_\_\_\_

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## Vegetated Filter Strip Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Vegetation</b>		
Observed plant types consistent with accepted plans		
Vegetation is healthy		
Plants covering greater than 85% of total BMP surface area		
Grass height not more than 6 inches		
No evidence of concentrated flows		
No evidence of erosion		
<b>2. Level Spreader</b>		
Lip of spreader showing no signs of erosion		
Sediment noted in spreader?		

**Actions to be Taken:** \_\_\_\_\_

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## Vegetated Swale Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Debris Cleanout</b>		
Contributing drainage areas free from debris		
<b>2. Vegetation</b>		
Mowing performed when needed		
No evidence of erosion		
<b>3. Check Dams or Energy Dissipaters</b>		
No evidence of flow going around structure		
No evidence of erosion at the downstream toe		
Soil permeability		
<b>4. Sediment Forebay</b>		
Sediment cleanout not needed (clean out when 50% full)		

**Actions to be Taken:** \_\_\_\_\_

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## Detention Pond Operation, Maintenance, and Management Inspection Checklist

**Project:** \_\_\_\_\_

**Location:** \_\_\_\_\_

**Date:** \_\_\_\_\_ **Time:** \_\_\_\_\_

**Inspector:** \_\_\_\_\_ **Title:** \_\_\_\_\_

**Signature:** \_\_\_\_\_

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>1. Embankment and emergency spillway</b>		
Healthy vegetation with at least 85% ground cover.		
No signs of erosion on embankment.		
No animal burrows.		
Embankment is free of cracking, bulging, or sliding.		
Embankment is free of woody vegetation.		
Embankment is free of leaks or seeps		
Emergency spillway is clear of obstructions.		
Vertical/horizontal alignment of top of dam "As-Built"		
<b>2. Riser and principal spillway</b>		
Low flow outlet free of obstruction.		
Trash rack is not blocked or damaged.		
Riser is free of excessive sediment buildup		
Outlet pipe is in good condition.		
Control valve is operational		
Outfall channels are stable and free of scouring.		

Maintenance Item	Satisfactory/ Unsatisfactory	Comments
<b>3. Permanent Pool (Wet Ponds)</b>		
No Evidence of undesirable vegetation		
No accumulation of floating or floatable debris		
No evidence of shoreline scour or erosion		
<b>4. Sediment Forebays</b>		
Sediment is being collected by forebay(s)		
Forebay is not in need of cleanout (less than 50% full)		
<b>5. Dry Pond Areas</b>		
Healthy vegetation with at least 85% ground cover.		
No undesirable woody vegetation		
Low flow channels clear of obstructions		
No evidence of sediment and/or trash accumulation		
<b>6. Condition of Outfall into Ponds</b>		
No riprap failures		
No evidence of slope erosion or scouring		
Storm drain pipes are in good condition, with no evidence of non-stormwater discharges		
Endwalls/Headwalls are in good condition		

**Actions to be Taken:**

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