TOWN OF ELLETTSVILLE

STORMWATER STANDARDS AND SPECIFICATIONS MANUAL

November 2024

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CHAPTER ONE
INTRODUCTION

This document was developed using the information contained in the Monroe County Stormwater Technical Standards Manual (STSM), prepared by Christopher B. Burke Engineering, LLC, for Monroe County Indiana. These are the standards for the design criteria and methodologies necessary for the design and construction of stormwater drainage systems infrastructure in Ellettsville, Indiana, in accordance with the requirements of the Municipal Separate Storm Sewer System General Permit (MS4) and the Construction Stormwater General Permit (CSGP).

Chapters 2 through 6 contain stormwater conveyance and detention calculations and requirements.

Chapter 7 contains information on erosion control requirements and other pollution prevention measures for active construction sites.

Chapters 8 through 9 cover calculations required to properly size and design stormwater quality features that will treat runoff long-term following construction completion. This includes both Conventional and Low Impact Development (LID) approaches. The site designer is encouraged to review the LID discussion in Chapter 8 prior to the site design to take advantage of runoff reduction recognitions provided towards water quantity calculations if LID practices are utilized as part of the site design.

Chapter 10 contains standards regarding lot developments, including grading and building pad elevations, acceptable outlet and adjoining property impact requirements. Chapter 11 contains river corridor, bluffs, and floodplain protection standards. Chapter 12 covers standards associated with proposed new or improvements to existing dams or levees as well as proposed developments downstream of existing dams. Chapter 13 contains stormwater standards associated with proposed solar farms.

Appendix A contains references for these documents and a partial listing of those that support the findings. Appendix B contains the list of Monroe County Critical Watersheds. Additional Best Management Practices (BMPs) for erosion control measures during the construction phase (beyond that published by IDEM) are contained in Appendix C. Appendix D contains non-structural and structural post-construction BMP Fact Sheets as well as Recommended Plant Lists, Recommended Materials, Soil Infiltration Testing Protocol, BMP Maintenance Checklists, and a Maintenance Agreement for post-construction BMPs.

A comprehensive glossary of abbreviations and definitions is provided.

CHAPTER TWO
METHODOLOGY FOR DETERMINATION OF RUNOFF RATES

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

(A) Sites Less than or Equal to 5 Acres in Size, With a Contributing Drainage Area Less than or Equal to 25 Acres and No Depressional Storage

A computer model, such as TR-55 (NRCS), TR-20 (NRCS), HEC-HMS (USACE), and HEC-1 (USACE), that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies may be used along with a 24-hour duration NRCS Type 2 storm. 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 Rational Method may also be used, but only for the analyses of culvert capacity and/or sewer systems. 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 Tables 2-1 and 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.

The time of concentration (t_c) methodology to be used for all stormwater management projects within Monroe County shall be as outlined in the 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 by Storm Recurrence Interval

Type of Surface	< 4% AEP	4% AEP	2% AEP	1% AEP
Hard Surfaces				
Asphalt	0.82	0.90	1.00	1.00
Gravel	0.85	0.94	1.00	1.00
Concrete	0.85	0.94	1.00	1.00
Roof	0.85	0.94	1.00	1.00
Lawns (Sandy)				
Flat (0-2% Slope)	0.07	0.08	0.09	0.12
Rolling (2-7% Slope)	0.12	0.13	0.16	0.20
Steep (Greater than 7% Slope)	0.17	0.19	0.22	0.28
Lawns (Clay)				
Flat (0-2% Slope)	0.16	0.18	0.21	0.26
Rolling (2-7% Slope)	0.21	0.23	0.28	0.35
Steep (Greater than 7% Slope)	0.30	0.33	0.40	0.50

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

Table 2-2: Rural Runoff Coefficients by Storm Recurrence Interval

Type of Surface	< 4% AEP	4% AEP	2% AEP	1% AEP
Woodland (Sandy)				
Flat (0-2% Slope)	0.10	0.11	0.13	0.17
Rolling (2-7% Slope)	0.25	0.28	0.33	0.41
Steep (Greater than 7% Slope)	0.30	0.33	0.40	0.50
Woodland (Clay)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.35	0.39	0.46	0.58
Steep (Greater than 7% Slope)	0.50	0.55	0.66	0.83
Pasture (Sandy)				
Flat (0-2% Slope)	0.10	0.11	0.13	0.17
Rolling (2-7% Slope)	0.16	0.18	0.21	0.26
Steep (Greater than 7% Slope)	0.22	0.24	0.29	0.36
Pasture (Clay)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.36	0.40	0.48	0.59
Steep (Greater than 7% Slope)	0.42	0.46	0.55	0.69
Cultivated (Sandy)				
Flat (0-2% Slope)	0.30	0.33	0.40	0.50
Rolling (2-7% Slope)	0.40	0.44	0.53	0.66
Steep (Greater than 7% Slope)	0.52	0.57	0.69	0.86
Cultivated (Clay)				
Flat (0-2% Slope)	0.50	0.55	0.66	0.83
Rolling (2-7% Slope)	0.60	0.66	0.79	0.99
Steep (Greater than 7% Slope)	0.72	0.79	0.95	1.00

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

Table 2-3: Runoff Coefficients by Land Use Typical Inlet Times, and Storm Recurrence Interval

Land Use	Runoff Coefficients "C" by Storm Recurrence												Inlet Time (minutes)[4]
	Flat[1]				Rolling[2]				Steep[3]				
	< 4% AEP	*4% AEP*	*2% AEP*	*1% AEP*	*< 4% AEP*	*4% AEP*	*2% AEP*	*1% AEP*	*< 4% AEP*	*4% AEP*	*2% AEP*	*1% AEP*	
Commercial *(CBD)*	0.75	0.83	0.99	1.00	0.83	0.91	1.00	1.00	0.91	1.00	1.00	1.00	5
Multi-family Residential	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	5 - 10
Industrial	0.63	0.69	0.83	1.00	0.70	0.77	0.92	1.00	0.77	0.85	1.00	1.00	
Garden Apartments	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	
Churches	0.54	0.59	0.71	0.89	0.60	0.66	0.79	0.99	0.66	0.73	0.87	1.00	
Schools	0.31	0.34	0.41	0.51	0.35	0.39	0.46	0.58	0.39	0.43	0.51	0.64	10 - 15
Semi-Detached Residential	0.45	0.50	0.59	0.74	0.50	0.55	0.66	0.83	0.55	0.61	0.73	0.91	
Detached Residential	0.40	0.44	0.53	0.66	0.45	0.50	0.59	0.74	0.50	0.55	0.66	0.83	
Quarter Acre Lots	0.36	0.40	0.48	0.59	0.40	0.44	0.53	0.66	0.44	0.48	0.58	0.73	
Half Acre Lots	0.31	0.34	0.41	0.51	0.35	0.39	0.46	0.58	0.39	0.43	0.51	0.64	
Parkland	0.18	0.20	0.24	0.30	0.20	0.22	0.26	0.33	0.22	0.24	0.29	0.36	Computed

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

1. Flat terrain involves slopes of 0-2%.
2. Rolling terrain involves slopes of 2-7%.
3. Steep terrain involves slopes greater than 7%.
4. The inlet times shown are for preliminary estimate purposes only. Unless the basin and inlet times are justified using TR-55 methodologies, the default T_c of 5 minutes shall be used regardless of land use.

(B) Sites Greater Than 5 Acres in Size or Contributing Drainage Area Greater than 25 Acres or With Significant Depressional Storage

The runoff rate for these 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. For 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).

Rainfall depth for various durations and frequencies shall be taken from Table 2-5 or the latest rainfall data provided by NOAA.

The 24-hour NRCS Type 2 synthetic design Rainfall Distribution shall be utilized for runoff calculations. The NRCS Type 2 distribution ordinates are found in Table 2-6. For analysis of the entire watershed (not just the development site) and/or for flood insurance study purposes, the Atlas 14 10% all cases observed rainfall distributions for 6-hr, 12-hr, and 24-hr rainfall durations may be used as an alternative to utilizing the NRCS Type 2 rainfall distribution. However, this will require a critical duration analysis to determine which one of the three stated durations will produce the highest peak discharge and/or the highest 100-year pond elevation. The Atlas 14 10% all cases temporal rainfall distributions for the 6-hr, 12hr, and 24-hr durations are provided in Table 2-7.

Examples of computer models that can generate such hydrographs include TR-55 (NRCS), TR-20 (NRCS), and HEC-HMS (USACE). These programs may be downloaded free of charge from the associated agencies' web sites. Other models may be acceptable on a case-by-case basis.

Table 2-4: Rainfall Intensities for Various Return Periods and Storm Durations[1]

Duration	Intensity (inches/hour)					
	50% AEP	*20% AEP*	*10% AEP*	*4%*	*2% AEP*	*1% AEP*
5 min	5.04	6.43	7.37	8.57	9.47	10.4
10 min	3.94	5	5.69	6.55	7.18	7.8
15 min	3.21	4.1	4.67	5.4	5.92	6.46
30 min	2.15	2.8	3.24	3.81	4.23	4.67
1 hr	1.32	1.76	2.06	2.47	2.79	3.12
2 hr	0.77	1.03	1.22	1.48	1.68	1.91
3 hr	0.547	0.736	0.873	1.06	1.22	1.38
6 hr	0.331	0.445	0.529	0.647	0.744	0.849
12 hr	0.194	0.258	0.304	0.367	0.417	0.472
24 hr	0.118	0.156	0.183	0.22	0.25	0.282

Source: NOAA, National Weather Service, "Precipitation-Frequency Atlas of the United States", NOAA Atlas 14, Volume 2, Version 3, rev 2006, for Bloomington, Indiana.

1. Values for intermediate durations can be logarithmically interpolated. All rainfall intensities are based on Annual Maximum series.

Table 2-5: Rainfall Depths for Various Return Periods

Duration	Depth (Inches)[1]						
	100% AEP	*50% AEP*	*20% AEP*	*10% AEP*	*4% AEP*	*2% AEP*	*1% AEP*
6 hr	1.78	2.16	2.73	3.20	3.89	4.47	5.11
12 hr	2.11	2.55	3.18	3.70	4.44	5.05	5.70
24 hr	2.55	3.07	3.82	4.44	5.31	6.04	6.80
48 hr	3.02	3.62	4.47	5.17	6.15	6.95	7.80

Source: NOAA, National Weather Service, "Precipitation-Frequency Atlas of the United States", NOAA Atlas 14, Volume 2, Version 2, rev 2006, for Bloomington, Indiana.

1. All rainfall depths are based on partial duration series.

Table 2-6: NRCS Type II Rainfall Distribution Ordinates

Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth	Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth	Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth	Cumulative Storm Time (hr)	Cumulative Percent of Storm Depth
0.00	0	6.25	8.5	12.50	73.5	18.75	93.4
0.25	0.2	6.50	9.0	12.75	75.8	19.00	93.8
0.50	0.5	6.75	9.5	13.00	77.6	19.25	94.2
0.75	0.8	7.00	10.0	13.25	79.1	19.50	94.6
1.00	1.1	7.25	10.5	13.50	80.4	19.75	95.0
1.25	1.4	7.50	11.0	13.75	81.5	20.00	95.3
1.50	1.7	7.75	11.5	14.00	82.5	20.25	95.6
1.75	2.0	8.00	12.0	14.25	83.4	20.50	95.9
2.00	2.3	8.25	12.6	14.50	84.2	20.75	96.2
2.25	2.6	8.50	13.3	14.75	84.9	21.00	96.5
2.50	2.9	8.75	14	15.00	85.6	21.25	96.8
2.75	3.2	9.00	14.7	15.25	86.3	21.50	97.1
3.00	3.5	9.25	15.5	15.50	86.9	21.75	97.4
3.25	3.8	9.50	16.3	15.75	87.5	22.00	97.7
3.50	4.1	9.75	17.2	16.00	88.1	22.25	98.0
3.75	4.4	10.00	18.1	16.25	88.7	22.50	98.3
4.00	4.8	10.25	19.1	16.50	89.3	22.75	98.6
4.25	5.2	10.50	20.3	16.75	89.8	23.00	98.9
4.50	5.6	10.75	21.8	17.00	90.3	23.25	99.2
4.75	6.0	11.00	23.6	17.25	90.8	23.50	99.5
5.00	6.4	11.25	25.7	17.50	91.3	23.75	99.8
5.25	6.8	11.50	28.3	17.75	91.8	24.00	100
5.50	7.2	11.75	38.7	18.00	92.2		
5.75	7.6	12.00	66.3	18.25	92.6		
6.00	8.0	12.25	70.7	18.50	93.0		

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

NOTE: For use only when SCS Type II rainfall distribution is not a default option in the computer program.

Table 2-7: Atlas 14 10% All Cases Rainfall Distribution Ordinates

Cumulative Percent of Storm Duration	Cumulative Percent of Storm Depth		
	6-hr Duration	*12-hr Duration*	*24-hr Duration*
0	0	0	0
8.3	24.6	29.4	34.6
16.7	46.8	56.8	60.8
25.0	66.5	77.0	77.9
33.3	83.1	89.2	88.8
41.7	92.4	95.6	95.2
50.0	96.6	98.5	98.4
58.3	98.8	99.6	99.6
66.7	99.7	99.9	99.9
75.0	100	100	100
83.3	100	100	100
91.7	100	100	100
100	100	100	100

Source: NOAA, National Weather Service, "Precipitation-Frequency Atlas of the United States", NOAA Atlas 14, Volume 2, Version 2, rev 2006.

(C) Sites with Drainage Areas Greater than or Equal to One Square Mile

For the design of any major stormwater drainage system, as defined in Chapter 761-10, 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 STORAGE VOLUMES

(A) 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 a computer model (preferred), such as TR-20 (NRCS), HEC-HMS (USACE), and HEC-1 (USACE), that can generate hydrographs based on the NRCS TR-55 time of concentration and curve number calculation methodologies along with the duration storm that produces the highest peak storage volume and pond elevation. The Rational Method may also be used based on the runoff from the 10% and 1% AEP storms.

For 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 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 1% AEP allowable release rate (Q_u) to each outlet based on methodologies provided in Chapter 6 of these technical standards.
3. Determine composite runoff coefficient "Ca" based on developed conditions and a 1% AEP event from Tables 2-1 through 2-3.
4. Determine 1% AEP rainfall intensity "Id" for various storm durations "ta" up through 24 hours for the developed area using Table 2-4.
5. Determine developed inflow rates "Qd" for various storm durations "td", measured in hours:

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

6. Compute a storage rate "$S(t_d)$" for various storm durations "ta" up through 24 hours:

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

7. Compute required storage volume "S_R" in acre-feet for each storm duration "t_d":

$$S_R = S(t_d)(t_d/12)$$

This assumes a triangular hydrograph of duration ($2t_d$) hours with a peak flow of $S(t_d)$ at ta hours.

8. Select the largest storage volume computed in Step 7 for any storm duration "ta" for detention basin design.
9. Repeat Steps 2 – 8 of this process for the post-developed 10% AEP storm.

(B) 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 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. Examples of computer models that can generate such hydrographs include TR-55 (NRCS), TR-20 (NRCS), and HEC-HMS (USACE). Other models may be acceptable on a case-by-case basis.

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

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 methodologies provided in Chapter 6 of these Technical Standards document.

(C) Design Storm & Allowable Release Rates for Development Sites within a Designated Drainage Area Serviced by a Regional Detention Facility

Development sites within Designated Drainage Areas making use of regional detention ponds are typically not required to provide on-site detention. As a result, the requirements of Chapter 6 of these Stormwater Technical Standards do not apply to development sites where no on-site detention is planned.

Where a regional detention facility is servicing or is planned to service a sub-watershed area, and that sub-watershed has been declared a Designated Drainage Area to raise the necessary Infrastructure Development Fees in lieu of providing on-site detention, the following method shall be used to determine the size of storage space that would have been required on-site.

The 24-hour NRCS Type II Rainfall Distribution shall be utilized to determine the required storage volume. The stormwater model should not include an on-site detention facility. The outflow hydrograph at the downstream-most point in the site's stormwater drainage system shall be compared to the allowable release rate for the Designated Drainage Area to determine the required storage volume. The allowable release rate for a Designated Drainage Area shall be defined by the resolution forming the Designated Drainage Area.

The storage volume shall be determined by calculating the volume of outflow from the site that exceeds the given allowable release rate. For example, if a 50-acre site is located in a Designated Drainage Area that has an allowable post-development 1% AEP release rate of 0.25 cfs/acre, the required storage volume for the site would be equal to the volume of water represented by the cross-hatched area in Figure 3-1.

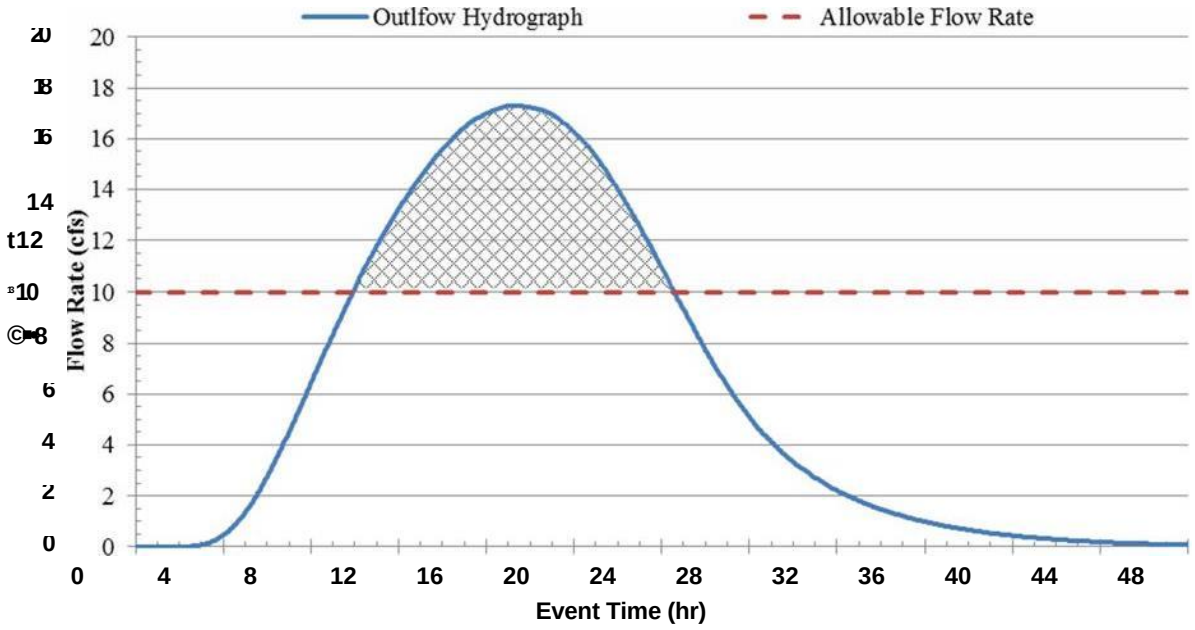

Figure 3-1: Example of a Required Storage Volume Determination

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% AEP event for on-site stormwater runoff, as well as the anticipated 10% AEP event for tributary off-site stormwater runoff based on the future developed condition (using Table 6-1 of these 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 Stormwater Drainage System Overflow Design must be completed in accordance with Section M of this chapter to ensure the safe routing of floodwaters 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 10% AEP storm calculated based on methodology described in Chapter 2. Additional discharges to storm sewer systems allowed in Section L of this Chapter 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 4% AEP, 2% AEP, and 1% AEP 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 1% AEP storm when, in the opinion of the design engineer or the MS4 Coordinator, 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 1% AEP storm at a minimum.

(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 1% AEP storm.

(5) Facilities functioning as a major stormwater drainage system must also meet IDNR design standards in addition to the Ellettsville standards. In case of discrepancy, the most restrictive requirements shall apply.

(B) Backwater Method for Pipe System Analysis

A hydraulic analysis using the backwater analysis method will be required for all existing or proposed storm drains. The backwater analysis method provides an 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 calculations. Total head losses may be determined as follows:

Total head loss = frictional loss + manhole loss + velocity head loss + junction loss

Computer modeling programs such as HYDRA, ILLUDRAIN, and STORMCAD are available for analysis of storm drains under these conditions. Use of any alternative computer model must first be accepted by the MS4 Coordinator or their designee. Allowable "n" values and full-flow maximum permissible velocities for storm sewer materials are listed in Table 4-1.

(C) Minimum Size for Culverts and Storm Sewers

The minimum diameter for all roadway culverts shall be 15 inches. Driveway culverts shall be a minimum of 12 inches in diameter. Driveway culverts larger than 15 inches in diameter shall have INDOT safety metal end sections. The minimum diameter of all storm sewers shall be 12 inches. 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 MS4 Coordinator.

Table 4-10: Typical Values of Manning's "n"

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

Source of manning "n" values: HERPICC Stormwater Drainage Manual, July 1995.

1. New earth (uniform, sodded, clay soil).
2. Existing earth (fairly uniform, with some weeds).

(D) Pipe Cover, Grade and Slope

Pipe grade shall be such that, in general, a minimum of 2 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. 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.

(E) Separation from Sanitary Sewers

A minimum of 1.5 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 and 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 22 inches or a rectangular opening of no less than 22 inches by 22 inches. Steps shall be provided in structures deeper than 4 feet, with the first step at the depth of 2 feet and the following steps spaced every 1 foot until the bottom is reached. When grade adjustments of manholes and inlets 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

Size of Pipe (in)	Maximum Distance (ft)
12 through 42	400
48 and larger	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 the message: "Dump No Waste – Drains To Stream" or similar.

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

Table 4-3: Manhole and Inlet Inside Sizing

Depth of Structure Opening	Minimum Diameter (in)	Minimum Square
Less than 5 feet	36	36" x 36"
5 feet or more	48	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 500 feet. An overflow 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 is as follows:

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

(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. 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 the Monroe County Stormwater Construction Specifications. The specifications for the construction of storm sewers and sub-drains, including backfill requirements, shall be the most stringent of those set forth in the latest edition of the INDOT's Standard Specifications, the Town of Ellettsville Manual for Construction within or Adjacent to Public Right-of-Ways, and the Ellettsville Stormwater Construction Specifications. Additionally, ductile iron pipe shall be laid in accordance with American Water Works Association (AWWA) C-600 and clay pipe shall be laid in accordance with either American Society of Testing Materials (ASTM) C-12 or the appropriate American Association of State Highway and Transportation Officials (AASHTO) specifications. Dips/sags on newly installed storm systems will not be allowed. Also, infiltration from cracks, missing pieces, and joints will not be allowed. Variations from these standards must be justified and receive written acceptance from the MS4 Coordinator.

(J) Materials

Storm sewer manholes and inlets shall be constructed of cast in place concrete or pre-cast reinforced concrete. Material and construction shall conform to the latest edition of the Indiana Department of Transportation (INDOT) "Standard Specifications" Sections 702 and 720.

Pipe and fittings used in storm sewer construction shall be extra-strength ductile iron pipe (AWWA C-151), poly vinyl chloride pipe (AASHTO M252), polyethylene pipe (AASHTO M252 or AASHTO M294), or concrete pipe (AASHTO M170). 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 MS4 Coordinator. 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 or Asphalt Coated Metal Pipe (ACMP).**

(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 the Storm Sewer System

All new connections to the storm sewer system require MS4 Coordinator approval.

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. Monroe County requires that each lot is equipped with a minimum 8-inch sub-surface drain that would connect to the storm sewer system (not to pavement underdrains).

1. **Sump pumps** installed to receive and discharge groundwater or other stormwater shall be connected to a sub-surface drain provided by the developer. Sump pumps installed to receive 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 connected to the sub-surface drain provided by the developer.

3. All **roof downspouts**, roof drains, or roof drainage piping of residential developments shall discharge onto a grass surface that is no closer than 25 feet to the right-of-way of any street and shall not be directly connected to the storm drainage system. Downspouts and roof drains shall not be directed to slopes over ten percent unless a flow diversion treatment, adequate to prevent erosion, is employed at the outlet. Variation from this requirement may be requested and granted by the MS4 Coordinator in special circumstances. Commercial, industrial, and institutional buildings that have their own private storm sewers may direct such drains directly to their systems. No downspouts or roof drains shall be connected to the public sanitary sewers.

4. **Garage and Basement floor drains** shall not be connected to the storm sewer system.

5. **Swimming Pool drains** shall not be connected to the storm sewer system.

In addition, none of the above-mentioned drains shall be connected to any road sub-drain/street underdrains, unless requested as a variance and specifically authorized by the MS4 Coordinator. Sub-drains shall be installed on all new developments by the developer.

(M) Drainage System Overflow Design

Overflow path/ponding areas throughout the development resulting from a 1% AEP 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 1% AEP storm 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 (see MCC Chapter 761-6). 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 1% AEP 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 1% AEP 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 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 using the methods in Chapter 6. Channels should be modeled according to modeling techniques discussed in Chapter 5. The calculations for determining the 1% AEP storm overflow path/ponding elevations may be based on hand calculation methods utilizing normal depth calculations and storage routing techniques or performed by computer models. Examples of computer models that either individually or in combination with other models can handle the required computations include TR-20 and HEC-HMS, combined with HEC-RAS. Other models may be acceptable on a case-by-case basis.

As an alternative to performing the calculations noted above, the default values in Table 4-4 may be used. The values in this table were calculated based on a set of conservative assumptions regarding typical dimensions and slopes of an overflow path.

Table 4-4: Minimum Building Adjacent Grade with Respect to Overflow Path Invert Elevations

Drainage Area (acres)	Minimum Building Adjacent Grade Above Overflow Path Invert (ft)[1]	Minimum Building Adjacent Grade Above Overflow Path Invert, if Overflow Path is in the Stret (ft)[1]
Up to 5	2.50	1.50
6-10	3.00	1.50
11-15	3.25	1.75
16-20	3.50	1.75
21-30	4.00	2.00
30-50	4.25	2.00

1. 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.

Regardless of the methodology used, the MS4 Coordinator and the Drainage Board can 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 is provided with 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 MS4 Coordinator 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.

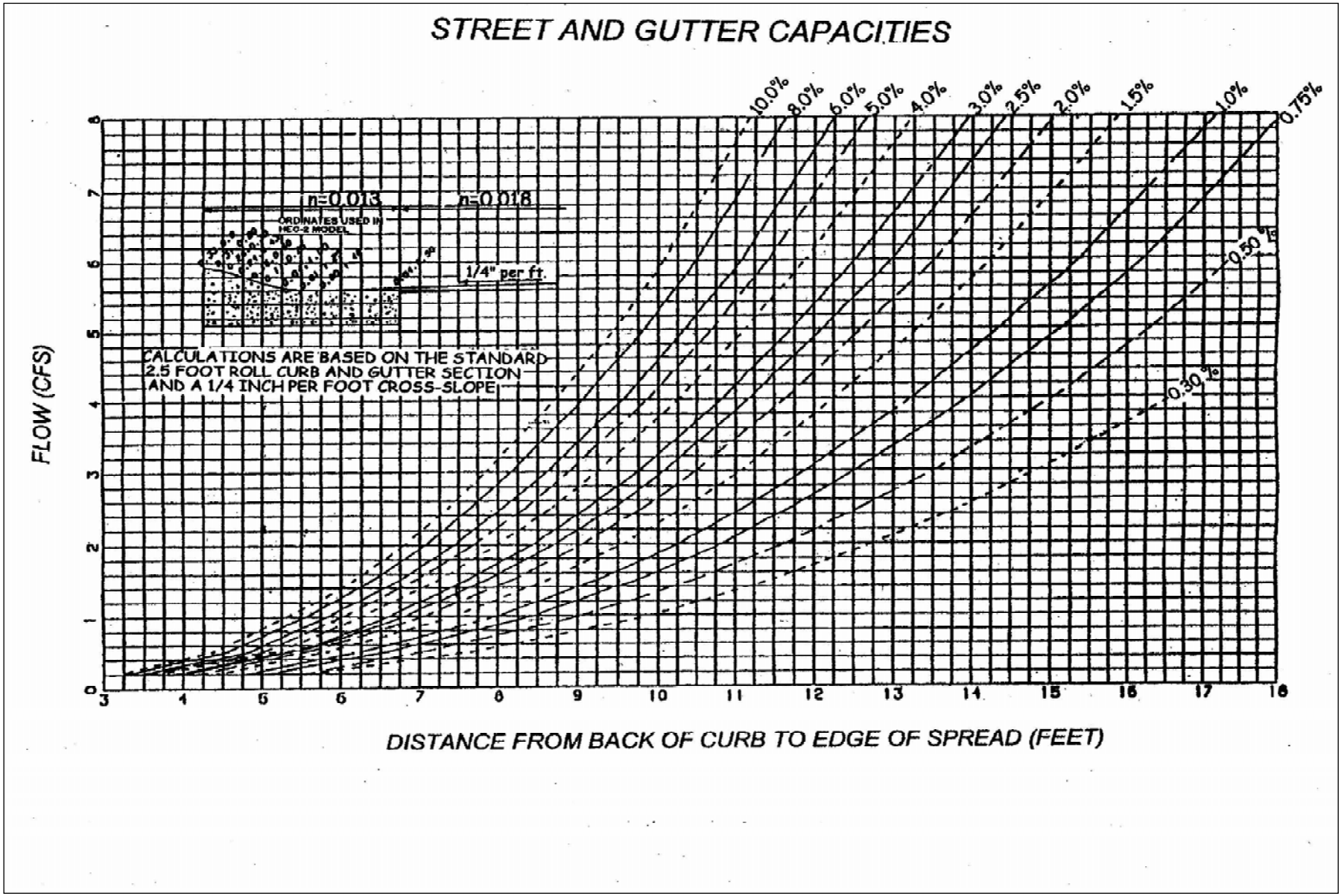

Figure 4-1: Street and Gutter Capacities.

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% AEP on-site stormwater runoff, as well as the anticipated 10% AEP tributary off-site stormwater runoff based on the future developed condition (using Table 6-1). 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. The stormwater drainage system overflow design must be completed in accordance with Section M of Chapter 4 to ensure the safe routing of floodwaters 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 10% AEP 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 2% AEP storm within the drainage easement.

(3) Channel facilities functioning as a major drainage system, as defined in Chapter 761-10, must also meet IDNR design standards in addition to the Monroe County standards. In case of discrepancy, the most restrictive requirements shall apply.

(4) The 10% AEP 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 and shall not convey flow from more than 3 lots.

(5) Regardless of minimum design frequencies stated above, the performance of all parts of drainage system shall be checked for the 1% AEP flow conditions to ensure that all buildings are properly located outside the 1% AEP flood boundary and that flow paths are confined to designated areas with sufficient easement.

(6) Lowest Adjacent Grades of all new structures along an open channel must be a minimum of 2 feet above the estimated 1% AEP flood elevation along the open channel.

(7) Riparian buffer zones encompassing the 1% AEP floodplain shall be provided for all waterways (new or existing within the development site area) with a drainage area greater than ten (10) acres. The buffer zones shall be at least twenty (20) feet in width.

(B) Manning's Equation

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

$$A = Q/V$$

A = Waterway area of channel in square feet
Q = Discharge in cubic feet per second (cfs)
V = Steady-State channel velocity, as defined by Manning' Equation

(C) Backwater Method for Drainage System Analysis

The determination of 1% AEP water surface elevation along channels and swales shall be based on accepted methodology and computer programs designed for this purpose. Computer programs HEC-RAS, HEC-2, and

ICPR are preferred programs for conducting such backwater analysis. The use of other computer models must be accepted in advance by the MS4 Coordinator.

(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 MS4 Coordinator 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 1% AEP channel flow for developed conditions either entirely or in combination with a defined overflow channel, with no reduction of velocity.

(5) Runoff from ridge top developments shall either be carried via a designed stabilized channel to a natural stabilized (rock bottom) channel or shall sheet flow from the site (preferred).

(E) Side Slopes

(1) Earthen channel and swale side slopes shall be no steeper than 3 horizontal to 1 vertical (3:1). Flatter slopes may be required to prevent erosion and for ease of maintenance.

(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 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.

(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.

Table 5-1: Maximum Permissible Velocities in Vegetal-Lined Channels[1]

Cover	Channel Slope Range (Percent)[3]	Permissible Velocity[2]	
		Erosion Resistant Soils (ft/s)[4]	*Easily Eroded Soils (ft/s)*[4]
Bermuda Grass	0-5 5-10 Over 10	8 7 6	6 5 4
Bahia Buffalo Grass Kentucky Bluegrass Smooth Brome Blue Grama	0-5 5-10 Over 10	7 6 5	5 4 3
Grass Mixture Reed Canary Grass	0-5[3] 5-10	5 4	4 3
Lespedeza Sericea Yellow Bluestem Redtop Alfalfa Red Fescue	0-5 5-10[4]	3.4	2.5
Common Lespedeza[5] Sudangrass[5]	0-5[6]	3.5	2.5

1. From Soil Conservation Service, SCSTP61, "Handbook of Channel Design for Soil and Water Conservation"
2. Use velocities exceeding 5 feet per second only where good channel ground covers and proper maintenance can be obtained.
3. Do not use on slopes steeper than 10 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
4. Do not use on slopes steeper than 5 percent except for vegetated side slopes in combination with a stone, concrete, or highly resistant vegetative center section.
5. Annuals: use on mild slopes or as temporary protection until permanent covers are established.
6. Use on slopes steeper than 5 percent is not recommended.

(G) Drainage of Swales

All swales shall meet the following requirements and the specifications of the MS4 Coordinator or their designee:

(1) Minimum swale flow line slopes are 1%. Swales with longitudinal slopes that are flatter than 1% shall consist of 6-inch-thick rebar-reinforced concrete. The front and back slopes of swales shall not be steeper than a 4 (horizontal) to 1 (vertical) slope.

(2) Maximum swale flow line slopes are 7%.

(3) Minimum swale width shall be 6 feet.
(4) 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.
(5) Unless designed to act as a stormwater quality BMP, 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 Monroe County Stormwater Construction Specifications. 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. Cleanout risers are to be installed at the high point as well as end of run.
(6) Further guidance regarding this subject may be found in the latest edition of the Indiana Drainage Handbook (DNR: Water: 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.

(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) Straw, Coconut Mattings, or other accepted material (only until grass is established).
Other lining materials must be accepted in writing by the MS4 Coordinator. Materials shall comply with the latest edition of the INDOT Standard Specifications.

CHAPTER SIX
STORMWATER DETENTION DESIGN STANDARDS FOR PEAK FLOW CONTROL

Basins shall be constructed to retain and/or temporarily detain the stormwater runoff that exceeds the maximum peak release rate authorized by the Stormwater Technical Standards Manual. 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% AEP or 1% AEP storm as explained below in Section B. Also, basins shall be constructed to provide adequate capacity to allow for sediment accumulation and to permit the pond to function for reasonable periods between cleanings.

In addition to the requirement for peak flow control through retention and/or detention, the Stormwater Management Ordinance and Technical Standards require the developer to address Water Quality Control requirements discussed in Chapter 8. The proper way to accommodate the water quality, channel protection, and peak flow rate control of a site is to first consider addressing the water quality and channel protection volume requirements through conventional or LID approaches (as described in Chapter 8) and then determine the size and dimensions of the required retention or detention storage for peak flow rate control.

Chapter 8 provides several BMPs and options to address the channel protection volume and water quality requirements. However, in many cases, providing some level of extended detention may become necessary to meet those requirements. While such extended detention is best provided in a separate facility, many developers choose to combine the needed extended detention feature with the detention pond needed for peak runoff rate control of the site into one facility.

A combined facility must accommodate the channel protection volume, water quality volume, and design storm detention to meet allowable release rate requirements while also meeting channel protection or water quality detention time requirements. These requirements can be challenging to meet, especially with additional considerations needed for bypassing runoff from off-site areas. The following are suggested calculation sequences for designing a detention pond for peak flow control only, and for combining extended detention with peak flow control. However, every site is different and depending on the site conditions and the layout of the pond, there may be other ways to design the pond such that all the objectives of this Manual are met.

The following shall govern the design of any improvement with respect to the retention or detention of stormwater runoff for peak flow control.

(A) Detention Design for Peak Flow Control with and without Extended Detention

To design a detention pond for peak flow control only:

(1) Determine the main outlet's control elevation.
(2) Route the on-site 10% AEP and 1% AEP inflow hydrographs through the pond (by temporarily ignoring off-site flows) and size the main outlet to limit peak outflows to the allowable release rates. If an orifice will be used to limit the outflow, use the actual orifice size needed to meet the release rate requirements (even if the orifice is less than 4"). The resulting maximum water surface elevation is the top of peak flow control storage for on-site flows. If no off-site flows are routed through the detention facility, then this will be the pond's 1% AEP elevation and the emergency spillway invert elevation.
(3) Off-site flows that are bypassed (no detention) through the site detention pond should be routed through a separate outlet (such as a drop inlet structure) with its control elevation set at the on-site 1% AEP pond elevation determined in Step 2. The 1% AEP pond elevation is determined by routing the on-site and off-site 1% AEP inflow hydrographs through the pond. Ideally, a separate emergency spillway should be provided with an invert elevation set at the combined (on-site and off-site) 1% AEP ponding elevation. A

less desirable option would be to route the off-site flows through the emergency spillway with the invert elevation set at the on-site 1% AEP ponding elevation as determined in Step 2. However, since this would result in water flowing over the emergency spillway more frequently, this option may require additional erosion control measures based on the estimated frequency of use. Additional discussion on managing off-site runoff on project sites draining to sinkholes is provided in this Chapter.

To design a detention pond for peak flow control with extended detention:

(1) Calculate the extended detention storage volume as needed to address the requirements noted in Chapter 8. In addition, there may be no need to provide extended detention depending on the approach used to address water quality and channel protection volume requirements.
(2) Determine the outlet control elevation. This will be the bottom of the extended detention storage volume, and the permanent pool elevation if a wet-bottom pond is used.
(3) Design the pond to provide the extended detention storage volume determined in Step 1, and assuming no outflow through the pond outlet. The top of this storage volume will be the invert elevation of the main outlet.
(4) Route the on-site 10% AEP and 1% AEP inflow hydrographs through the pond (with the initial elevation at normal pool, i.e., the bottom of extended detention space) and size the main outlet to limit peak outflows to the allowable release rates. If an orifice will need to be used to limit the outflow, use the actual orifice size needed to meet the release rate requirements (even if the orifice is less than 4"). The resulting maximum water surface elevation is the top of peak flow control storage for on-site flows. If no off-site flows are routed through the detention facility, then this will be the pond's 1% AEP elevation and the emergency spillway invert elevation.
(5) Off-site flows that are bypassed (no detention) through the site detention pond (rather than bypassed around the pond), should be routed through a separate outlet (such as a drop inlet structure) with its control elevation set at the on-site 100-year pond elevation determined in Step 2. The 100-year pond elevation is determined by routing the on-site and off-site 100-year inflow hydrographs through the pond. Ideally, a separate emergency spillway should be provided with an invert elevation set at the combined (on-site and off-site) 100-year ponding elevation. A less desirable option would be to route the off-site flows through the emergency spillway with the invert elevation set at the on-site 100-year ponding elevation as determined in Step 2. However, since this would result in water flowing over the emergency spillway more frequently, this option may require additional erosion control measures based on the estimated frequency of use. Additional discussion on managing off-site runoff is contained in Section B.3 of this chapter.
(6) Determine the size and design the retention/extended detention storage drain in a manner to meet the extended detention minimum and maximum emptying time requirements discussed in Chapter 8, using both on-site and, if applicable, off-site runoff. If an orifice is required to control the flow of the extended detention drain, the minimum orifice size shall be 4 inches. However, depending on the proposed clog-free design and the proposed maintenance schedule of the extended detention storage drain structures, a smaller orifice than 4 inches may be allowed on a case-by-case basis.
(7) To make sure that the addition of the release through the drain will not cause the on-site only allowable release rate to be exceeded, reroute the on-site 10-year and 100-year inflow hydrographs through the pond (with the initial elevation at normal pool, i.e., the bottom of extended detention space), this time allowing water to also leave through the extended detention storage drain as the pond fills up. If the total peak outflow discharge exceeds the on-site only allowable release rate, the size of the main outlet orifice may need to be reduced or the storage volume increased.

In some instances, such as relatively small development sites less than 10 acres or sites with highly restrictive site-specific maximum allowable release rates, when the required outlet orifice size and/or the required size of the extended detention drain will be small, the calculated drain time may extend beyond the maximum required 48-hour emptying time. The situation can often be addressed by enlarging the pond volume or reconfiguring the pond's shape. When the situation cannot be resolved in a reasonable manner despite those attempts, the MS4 Coordinator or their designee may, on a case-by-case basis, allow deviation from the

required orifice size, maximum allowable release, or emptying time after considering reasonable options and examining the potential impacts on downstream or upstream areas. Economic factors shall not be considered for this determination.

(B) 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, 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.

(C) 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 10% AEP storm events and 0.9 cfs per acre of developed area for 1% AEP storm events.

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) Peak Rate Calculations

In addition to the general release rates per acre of development. Calculations must demonstrate the following:

Post-developed peak rate	Must not exceed	Pre-developed peak rate
2 year frequency storm		2 year frequency storm
10 year frequency storm		10 year frequency storm
100 year frequency storm		100 year frequency storm

(3) Downstream Restrictions and Critical Watershed Limitations

Control devices shall limit the discharge on project sites in Critical Watersheds (see list in **Appendix B**) to a rate such that the post-developed release rate from the site is no greater than 0.25 cfs per acre of development for 10% AEP storm events and 0.45 cfs per acre of developed area for 1% AEP storm events.

The MS4 Coordinator may assign different release rates for Critical Watersheds (see list in **Appendix B**) or for certain watersheds if more detailed data becomes available as a result of comprehensive watershed studies conducted and/or formally approved and adopted by the MS4 Coordinator. The applicant shall confirm the applicable release rates with the MS4 Coordinator or their designee prior to initiating the design calculations to determine whether a basin-specific rate has been established for the watershed of their interest or whether the site is located within a Critical Watershed. A map of areas with specific release rates and critical watersheds is provided on the Monroe County website.

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 MS4 Coordinator, 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 MS4 Coordinator 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 MS4 Coordinator 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.

(1) 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 only outlet is a weir at an elevation that stormwater can currently overflow the depressional storage area. Similar to any depressional area, if the depressional storage is a sinkhole, assume the sinkhole is plugged and no discharge shall be used for the sink outlet.

Post-developed release rate for sites with depressional storage shall be the 50% AEP pre-developed peak runoff rate for the post-developed 10% AEP storm and 10% AEP pre-developed peak runoff rate for the post-developed 1% AEP storm. In no case shall the calculated site-specific release rates be larger than general release rates provided above.

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: a calculation of the appropriate composite runoff curve number and the time of concentration. Stage-storage data for the depressional area should be obtained from the site topography. The overflow outlet should be clearly marked, and any calculations performed to create a stage-discharge rating curve must be included with the drainage plan submittal.

For determining the post-developed peak runoff rates, the depressional storage must be assumed to be filled unless the MS4 Coordinator can be assured, through dedicated easement, that the noted storage will be preserved in perpetuity.

(2) Site-Specific Release Rates for Sites Draining to Sinkholes

For proposed developments that drain to sinkholes, a more restrictive release rate and additional storage on site will be required. The release rate must be such that the drawdown time from the end of a 1% AEP, 48-hour storm is no less than two days (as determined by routing this hydrograph through the pond).

(3) Management of Off-site Runoff

Runoff from all upstream tributary areas (off-site land areas) may be bypassed around the retention/detention 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. Further discussion on routing off-site areas through on-site detention ponds is provided in the beginning of this Chapter.

The efficiency of the retention/detention 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

in controlling on-site runoff where the ratio of off-site area to an on-site area is larger than 5:1.

(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% AEP and 1% AEP events, pre-developed 2-year flow rates in cfs as well as pre- and post-developed flow rates for 2-, 10%, and 1% AEP events. The worksheet provided as Table 6-1 should be filled for each final site outlet.

(D) General Design Requirements for Detention Basins

(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. When conditions exist such that the detention basin emptying requirement and the allowable release rate from the project site cannot both be met, the applicant shall develop a detention basin design that is as close as possible to meeting both requirements, with the design fully supported in the stormwater drainage technical report. In most cases, when conditions exist as described above, priority should be given to matching the allowable release rate.

(2) The 100-year elevation of stormwater retention/detention facilities shall be separated by not less than twenty-five (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 two (2) feet above the 100-year pond elevation or two (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 one (1) foot above the normal water level of any wet-bottom pond or the 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) Detention facilities shall be separated from parking lots and roadways by an appropriately-selected and designed method of safety barrier, such as guard rails, bollards, or other physical barriers capable of preventing the passage of a vehicle into the pond.

(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 with a maximum opening of six (6) inches shall be provided for any pipe or opening end sections 12 inches in diameter or larger. Storm pipes outletting into ponds shall not be submerged.

(7) Use of fences around all retention/detention ponds is encouraged to assure safety. Unless specifically required by the MS4 Coordinator, 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 maintenance and attention for proper operation. For maintenance purposes, the outlet from the pond shall be a minimum of 0.5 foot above the normal water level of the receiving water body. Detention pond outlets shall be at least ten (10) feet from the downstream property line unless the outlet is directly connected to a subsurface culvert or storm sewer.

Table 6-1: Worksheet for summarizing modeling results.

Site outlet no.		Pre-development					Post-development				
		D.A. (ac)	*Depres Storage (Y/N)*	*50% AEP*	*10% AEP*	*1% AEP*	*D.A. (ac)*	*Depres Storage (Y/N)*	*50% AEP*	*10% AEP*	*1% AEP*
1	Default Unit Discharge Allowable Release Rate (cfs/acre)									0.5	0.9
	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)							N			

(9) Emergency overflow facilities such as a weir or spillway shall be provided for the release of flood waters or in emergency conditions should the normal discharge devices become totally or partially inoperative.
   (a) The overflow facility shall be of such design that its operation is automatic and does not require manual attention.
   (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 two (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 and function in conformance to its design.

(12) No residential lots or any part thereof, unless approved by the Plan Commission, shall be used for any part of a detention basin assumed full to the 1% AEP water surface elevation or the emergency overflow weir elevation, whichever is higher. Detention basins shall be placed within a common area either platted or legally described and recorded as a perpetual stormwater easement (see MCC Chapter 761-6). These common areas or easements shall be designed to encompass the basin at its full capacity (either at the 1% AEP water surface elevation or the emergency overflow weir elevation, whichever is higher). A minimum of twenty (20) feet horizontally from the top of bank of the facility, or the 1% AEP pool if no defined top of bank is present, shall be dedicated as permanent stormwater easement if the above-noted boundary of the common area does not extend that far. In addition, an exclusive easement to assure access to the pond from an adjacent public street/road right-of-way shall be required. No above-ground utilities or other obstruction that may hinder access shall be allowed within this exclusive access easement. Larger ponds may require more than one access easement.

(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), and longitudinal and transverse grades to perimeter drainage facility. Unless designed as a retention facility, a 6-inch underdrain with a minimum of eighteen (18) inches of cover shall be provided within all dry-bottom ponds. No part of the pond bottom shall be more than ten (10) feet from an underdrain.

(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 stable.

(F) 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. In addition, 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. For these facilities, the following 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 pond's 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 twelve (12) inches above the permanent water level and a safety ledge ten (10) feet in width is required and shall be installed approximately six (6) inches below the permanent water level.

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

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

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

(4) Prior to final acceptance of construction and release of bonds, danger signs warning of deep water, possible flood conditions during storm periods, or other dangers, shall be installed at an interval of four-hundred (400) feet around the perimeter of wet-bottom facilities without a vegetated safety ledge, riparian buffer, or a security fence. Maintenance of the warning signs shall be the responsibility of the owner or the homeowners' association.

(5) If a retaining wall is used below the normal pool of a wet detention pond, the wall shall have either steps or a ladder incorporated into the construction at the center of the wall span.

(6) 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.

(7) Parks, playgrounds, and athletic fields shall be separated from all stormwater detention or retention facilities by no less than one-hundred (100) feet, measured from the 1% AEP pool of the pond. Trails and sidewalks shall be separated from all stormwater detention facilities by no less than twenty-five (25) feet, measured from the 1% AEP pool of the pond.

(8) Periodic maintenance is required in lakes to control weeds and larval growth. The facility shall 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.

(9) For maintenance purposes, the outlet of storm sewers entering the pond shall be a minimum of 0.5 foot above the normal pool level.

(10) 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 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: Example of a typical diffuser aeration system.

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

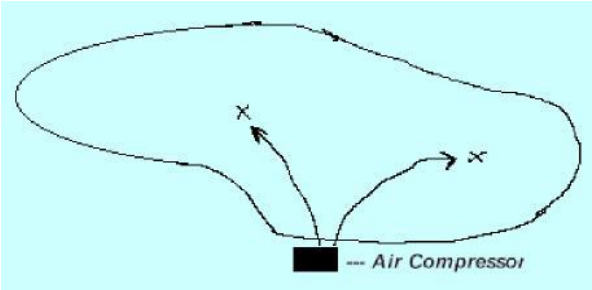

Figure 6-2: Example configuration for multiple aeration units.

(b) 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 for post-construction BMPs noted in Chapter 8 of these Technical Standards.

(c) 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.

(11) If the facility will be located near an airport, a minimum horizontal separation distance between the airport property and the pond shall be provided in accordance with 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.

(G) Detention Facilities in Floodplains

No detention facilities are allowed within FEMA regulatory floodplains.

(H) Joint Development of Control Systems

Stormwater control systems may be planned and constructed jointly by two or more developers as long as compliance with this Ordinance is maintained. A legally binding maintenance agreement, to be approved by the MS4 Coordinator, shall be adopted by all parties involved in these systems.

(I) 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 MS4 Coordinator.

(J) IDNR Requirements

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

(K) 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.

(L) Maintenance

The routine maintenance of stormwater detention and retention facilities (i.e. trash pickup, aeration, weed control, sediment removal, etc.) is the responsibility of the Homeowners' Association or the owner/entity designated in the executed O&M Manual and/or the BMP Maintenance Agreement.

CHAPTER SEVEN
CONSTRUCTION SITE 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 stormwater pollution resulting from construction activities as well as solid and hazardous wastes. Practices and measures included herein assure that the transport of pollutants such as sediment, construction debris, or chemicals from a site is minimized and not 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 construction site for many reasons, including the loss of surface vegetation and compaction of the soil structure, which results 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.

Stormwater concerns associated with construction site erosion include: transport of pollutants attached to sediment; increased turbidity (more suspended/dissolved solids and reduced light) in receiving waters; and recreational use impairment. The deposited sediment may be toxic 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 washout, paints, solvents, and hydrocarbons from refueling operations, and many other undesirable substances. Poor control and handling of construction materials can pose an acute (short-term) or chronic (long-term) risk of death to aquatic life, wildlife, and the public.

(B) Erosion and Sediment Control Requirements

(1) General and Implementation Requirements

The implementation requirements apply to all land-disturbing activities and shall be considered in the preparation of a SWPPP and/or site plan within the Ellettsville MS4 area.

(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 in the IDEM Stormwater 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 Stormwater 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, 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 Stormwater 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 Stormwater 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. Wastes 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 shall document this process, and provide to the City upon request. 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 stormwater pollution prevention plan (SWPPP). If use of a polymer is not in the SWPPP and is selected at a later date, notification to IDEM and the *Town of Ellettsville* 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.

(2) 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.

(C) Stabilization 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) 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

- 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.
- 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 for individual lots (less than or greater than one (1) acre) within a larger common plan of development or sale, is achieved when the operator:

- Completes final stabilization considering weather and season;
- Initiates permanent seeing with appropriately crimped or tackified mulch cover, erosion control blanket or sod; or
- Installs appropriate and/or ensures functional erosion and sediment control measures are in place in the individual lot. Upon transfer of ownership to the homeowner, the homeowner is responsible for maintaining the erosion and sediment control measures until final stabilization has occurred.

(3) Final stabilization for single-family residences ponds, multi-lot projects, or strip developments where land disturbance is less than one (1) acre and not part of a larger common plan of development or sale is achieved by the operator when:

- All land-disturbing activities have been completed, temporary BMPs have been removed, permanent BMPs have been cleaned, and a uniform perennial vegetative cover with a density of 70% has been established on all unpaved areas and areas not covered by a permanent structure or equivalent permanent stabilization measures have been employed. This does not include final landscaping.
- Final stabilization for construction projects on land used for agricultural purposes is achieved when:
  a) Stabilization is completed per (3) above as land disturbance progresses;
  b) Land is returned to its preconstruction agricultural use is temporarily or permanently seeded upon completing land disturbance activities; and
  c) Disturbed areas, not previously used for agricultural production, such as filter strips, are being returned to their preconstruction agricultural use.

(C) Common Stormwater Pollution Control Practices

All erosion control and stormwater pollution prevention measures required for compliance with the Ellettsville Unified Development Ordinance shall meet the design criteria, standards, and specifications similar to or the same as those outlined in the "Indiana Drainage Handbook" and the "Indiana Storm Water Quality Manual" (ISWQM), or other comparable and reputable references. Table 7-1 lists common and effective practices for preventing stormwater pollution from construction sites. Details of each practice can be found in the Indiana Drainage Handbook, ISWQM, or in Appendix C. These practices should be used to protect ***every*** potential pollution pathway to stormwater conveyances.

(D) Individual Lot Erosion and Sediment 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.

The standard individual lot plan includes perimeter silt fence, stabilized construction entrance, curb inlet protection, yard 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.

Construction sequence on individual lots and parcels 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 of the tree.
(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 yard inlet protection for all yard inlets on the property (also called drop inlets).
(5) Install curb inlet protection, on both sides of the road, for all inlets along property frontage and the along the frontage of adjacent lots.
(6) Install gravel construction entrance that extends from the street to the building pad.
(7) Perform primary grading operations.
(8) Remove topsoil and store on site in a stabilized stockpile for reuse, if possible. Contain erosion from any soil stockpiles with silt fence around the base.
(9) Establish temporary seeding and straw mulch on disturbed areas.
(10) Construct the home and install utilities
(11) Install downspout extenders once the roof and gutters have been constructed. Extenders should outlet to a stabilized area.
(12) Re-seed any areas disturbed by construction and utilities installation with temporary seed mix within 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.

Table 7-1: Common Stormwater Pollution Control Practices for Land Disturbing Activities

Practice	BMP Description	Applicability	Standard[1]
1	Site Assessment	All sites	ISWQM
2	Development of a Construction Sequence Schedule	All sites	ISWQM
3	Tree Preservation and Protection	All sites with existing trees	ISWQM
4	Temporary Construction Ingress/Egress Pad	All sites	ISWQM
5	Wheel Wash	Some sites. Wash water must be treated.	CN - 101
6	Concrete Washout	All sites	ISWQM
7	Topsoil Salvage and Utilization	All sites	ISWQM
8	Silt Fence	Small drainage areas	ISWQM
9	Surface Roughening	Sites with slopes that are stabilized with vegetation	ISWQM
10	Temporary Seeding	Areas of bare soil where additional work is not scheduled to be performed	ISWQM
11	Mulching	Temporary surface stabilization	ISWQM
12	Erosion Control Blanket (Surface)	Temporary surface stabilization, anchor for mulch	ISWQM
13	Temporary Diversion	Up-slope and down-slope sides of construction site, above disturbed slopes within site	ISWQM
14	Rock Check Dam	2 acres maximum contributing drainage area	ISWQM
15	Temporary Slope Drain	Sites with cut or fill slopes	ISWQM
16	Yard Inlet Protection	1 acre maximum contributing drainage area	ISWQM
17	Curb Inlet Protection	1 acre maximum contributing drainage area	ISWQM
18	Temporary Sediment Trap	5 acres maximum contributing drainage area	ISWQM
19	Temporary Dry Sediment Basin	30 acres maximum contributing drainage area	ISWQM
20	Dewatering Structures	Sites requiring dewatering	CN-102
21	Dust Control	All sites	ISWQM
22	Spill Prevention and Control	All sites	CN - 103
23	Solid Waste Management	All sites	CN - 104
24	Hazardous Waste Management	All sites	CN - 105

1. See ISWQM (IDEM: Stormwater Permitting: Indiana Stormwater Quality Manual) and other IDEM resources, unless otherwise noted.

CHAPTER EIGHT
POST-CONSTRUCTION STORMWATER QUALITY MANAGEMENT STANDARDS

The requirements of the Ordinance and this Technical Standards Manual with regards to channel protection and water quality treatment can be satisfied through a variety of methods that can be broadly categorized under a general approach:

This Chapter establishes the minimum standards for the selection and design of post-construction water quality treatment and channel protection 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 channel protection volume (CPv), water quality volume (WQv), and for flow-through BMPs the water quality discharge rate (Qwq), as appropriate. The methodology for calculating the CPv, WQv, and Qwq values is provided in Chapter 9.

(A) Post-Construction BMP Performance Criteria

Channel protection is typically achieved by matching the post-construction runoff volume and rate to the pre-conversion (prior to any historical land conversion by man) condition for all runoff events up to the bankfull flow. The bankfull flow in most Indiana streams correlates with the 1.5- to 2-year flood event flow. However, due to difficulties in determining the pre-conversion conditions, the net control of runoff resulting from a 1-year, 24-hour storm in proposed conditions (rather than the alternative method of determining increase in 2-year, 24-hour storm over pre-conversion conditions) is established as the standard for channel protection.

An established minimum standard for the measurement of the effectiveness of the control of post-construction stormwater runoff quality will be based on removal of floatables in stormwater runoff and treatment, to the maximum extent practicable, of all major pollutants of concern expected for the proposed land use and/or those identified in the Storm Water Pollution Prevention Plan (SWPPP) for the site (including, if applicable, those pollutants found to be the cause of the receiving stream to be listed in IDEM 303(d) list) for the first inch of rainfall at the site. The above-noted "maximum extent practicable" criterion is subject to a minimum of 80% removal of Total Suspended Solids (TSS). These requirements are adopted as the basis of the stormwater quality management program for all areas of the jurisdiction.

For the purpose of these Standards, the control of channel protection volume and post-construction stormwater runoff quality is assumed satisfactory when the appropriate number of pre-approved structural BMPs, tiered in accordance to the total site disturbed area as shown below, are designed, installed, and operated in accordance with fact sheets provided in Appendix D.

Total Property/Development Area	Post-Construction BMP Requirement*
0 to less than 1 acre	No Water Quality BMP
At least 1 acre to less than 3 acres	At least 1 Water Quality BMP
At least 3 acres	2 Water Quality BMPs in series
At least 10 acres	CPv plus at least 1 Water Quality BMP**

* These BMPs are in addition to any pre-treatment that may be required for hot spots.

** If the Channel Protection Volume is provided in the form of retention (no surface outflow) that is pretreated for sedimentation by a settling basin (see Infiltration Basin Fact Sheet), then no additional water quality BMPs are required.

As noted above, unless the Channel Protection Volume or Water Quality Volume can be fully retained and infiltrated, a combination of at least two BMPs in series (each sized to handle water quality volume) is required for sites with a disturbed area of at least 3 acres (for sites larger than 10 acres, one should be sized to handle Channel Protection volume), with the first BMP acting as a pretreatment measure to reduce pollutant concentrations within the downstream, or secondary, BMP. A dual BMP provision provides a failsafe benefit should adverse conditions result in clogging or other potential BMP impairments. Only one of the required BMPs in series can be a manufactured Water Quality Device.

(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

Some pollutants accumulate on impervious surfaces, which are then subject to being washed into watercourses during storm events. It is for this reason that fish kills often occur during rain events, especially when it rains for the first time after a dry 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 or 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) Conventional Approach Procedures

The following procedures shall be followed according to the Conventional approach:

(1) Step 1: Provide BMPs to address Channel Protection Volume

In a conventional approach, the receiving channel is protected through retaining (when possible) or the extended detention (if infiltration methods are considered ineffective/ inappropriate for the site) of the 1-year, 24-hour storm event on entire site (disturbed and undisturbed) tributary to each outlet. The methodology for calculating the Channel Protection Volume (CPv) is according to that discussed in Chapter 9 of this Standards Manual. Both retention or wet/dry extended detention may be used so long as only 10% of the maximum stored volume is left in the basin after 36 hours from maximum storage time (or 48 hours from the start of storm) and no more than 40% of the maximum stored volume is released within the first 12 hours. To ensure that adequate retention/detention volume is available within the facility over the years, the facility should be designed for long-term sediment accumulation. If long-term sediment accumulation cannot be adequately provided for in the pond, or if the pond is intended to provide sediment control during the construction phase of the project, forebays near inlets can be included to help manage sediment accumulation. Forebays do not require a hard maintenance surface and shall not be visibly disconnected from the pond by rip rap or other berm structures.

Since, by design, 90% of the original volume will be available within 48 hours of start of each storm event (assumed to be about 36 hours from when the Channel Protection pool is full), the volume in the pond associated with the channel protection (CPv) may be assumed empty for the purpose of peak flow retention/detention analysis discussed in Chapter 6. In addition, the volume provided for channel protection would also count as one BMP towards the water quality requirements, provided that the facility meets the design criteria in the fact sheet and additional pre-treatment and/or wetland fringe can be provided to assure the performance criteria noted in Section B of this Chapter are met.

(2) Step 2: Provide BMPS to address Water Quality Management

When the channel protection volume is controlled with BMPs that also meet the stormwater quality performance criteria in Section B (including both the required type and also the number of BMP in series), often no additional calculation or BMP implementation is necessary. If the channel protection volume is not controlled through practices that also meet the stormwater quality performance criteria in Section B, additional BMPs will be required. Monroe County has designated a number of pre-approved structural BMP methods (listed in **Table 8-1** for Conventional Approach and Tables 8-4 through 8-6 for LID Approach) to be used alone or in combination to achieve the stormwater quality performance criteria noted in Section B of this Chapter for runoff generated from up to first inch of rainfall on the entire site (disturbed and undisturbed) tributary to each outlet. Details regarding the applicability and design of these pre-approved BMPs, including the effectiveness of these BMPs in treating pollutants of concern

(including, if applicable, those pollutants found to be the cause of the receiving stream to be listed in IDEM 303(d) list), are contained within fact sheets presented in **Appendix D**. Additional information on recommended plant lists and recommended materials used for construction of stormwater BMPs are also provided in **Appendix D**.

Innovative BMPs, including but not limited to, BMPs not previously accepted by Ellettsville must be certified by a Professional Engineer licensed in State of Indiana and approved through Monroe County. ASTM standard methods must be followed when verifying performance of new measures. New BMPs, individually or in combination, must meet the performance criteria noted in Section B of this Chapter, including the capture and removal of floatables. All innovative BMPs must have a low to medium maintenance requirement to be considered by Ellettsville. Testing to establish the pollutant removal rate must be conducted by an independent testing facility, not the BMP manufacturer. The accepted design flow rate for a Water Quality Device shall be the flow value at which the claimed removal rate for TSS is equaled or exceeded based on the unit's efficiency curve (flow rate versus removal rate graph).

A single BMP measure may not be adequate to achieve the water quality requirements (as noted above) 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:

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

Where: E_{series} = Removal Efficiency of the BMP series combined (in decimal form)
E_1, E_2, E_3,... = Removal Efficiency of Units 1, 2, 3, ..., respectively (in decimal form)

Table 8-1: Pre-Approved Post-Construction BMPs for Conventional Approach

BMP[A]	Typical % Removal Efficiency for TSS[B]	Easement Requirements
Bioretention	90[C]	25 feet wide along the perimeter
Constructed Wetland	67[C]	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[C]	25 feet wide along the perimeter
Infiltration Trench	90[C]	25 feet wide along the perimeter
Constructed (Sand) Filter	70[C]	25 feet wide along the perimeter
Water Quality Device	VARIES[D]	20 feet wide strip from access easement to chamber's access shaft

Vegetated Filter Strip	78[C]	25 feet wide along the length on the pavement side
Vegetated Swale	81[C]	25 feet wide along the top of bank on one side
Wet Ponds/Retention 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 Appendix D.
B. Removal rates shown are based on typical results. Unless otherwise shown, data extracted by CBBEL 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. Further details on acceptable Water Quality Devices and their treatment rates are provided in Chapter 9.

(D) SPECIAL PROVISIONS FOR "HOT SPOT" LAND USES

For all those projects involving land uses considered to be high pollutant producers or "hot spots" (see Table 8-9 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 Monroe County 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 requirements are included in Table 8-9 and Table 8-10.

Table 8-9: Pretreatment Options for Stormwater Hot Spots

Stormwater Hot Spots	Minimum Pretreatment Options
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	M, As Required

Table 8-10: Minimum Stormwater Pretreatment Options

Label	Description
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

Runoff/water used in a car wash operation must be connected to the sanitary sewer and shall not be allowed to discharge as stormwater. Commercial car wash operations shall not be allowed in areas not serviced by sanitary sewers.

(H) 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.

(I) 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 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 County in both hard copy and digital formats. The O&M manual maintenance agreement along with a site map showing the BMP locations shall be recorded with the final plat or property deed. The O&M manual will include the following:

(1) Name, address, business phone number, cell phone number, email address;
(2) Site drawings ($8^1/_2$" 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 County 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 County'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.

Inspection checklists for various types of BMPs are provided in **Appendix D5**. A sample Stormwater Management Maintenance Agreement is provided in **Appendix D6**. The formal Stormwater Management Maintenance agreement submitted to the Town of Ellettsville will need to be customized, signed, notarized, and recorded so that it can be a part of the property's deed.

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

Since the proper perpetual maintenance of post-construction BMPs, especially the green infrastructure, is so crucial to proper operation of such BMPs, in addition to the maintenance agreement discussed above, the developer is required to establish a permanent maintenance escrow account and subsequently transfer it to the future property owner's association or similar entity to cover the cost of annual maintenance of the post-construction BMPs in perpetuity.

The established escrow account can be spent solely for sediment removal, structural, biological or vegetative replacement or removal, invasive species or weed management, mulching, major repair, or reconstruction of the stormwater management measures and devices of the particular site plan or subdivision. If stormwater management facilities are not performing adequately or as intended or are not properly maintained, the Town, in its sole discretion, may remedy the situation, and in such instances the Town shall be fully reimbursed from the escrow account. Escrowed funds may be spent by the association for sediment removal, structural, biological or vegetative replacement or removal, invasive species or weed spraying and/or removal/trimming, mulching, major repair, and reconstruction of the stormwater management facilities; provided that, the Town shall first consent to the expenditure. The list of eligible expenses excludes routine mowing, landscaping, pruning, and other similar activities that have traditionally and continue to be expected of the entity controlling the land to fund.

Initially, the developer's contribution shall fund the escrow account. Prior to plat recordation or issuance of construction plan approval/permits, whichever shall first occur, the developer shall pay into the escrow account an amount equal to fifteen (15) per cent of the estimated initial construction cost of the stormwater control facilities. This amount shall remain in the escrow account and shall be transferred to the future property owner's association or similar entity after the developer receives the NOT for the project. The establishment and dedication of the above referenced maintenance escrow account is in addition to the 3-year maintenance bond/assurance required by the Resolution following the issuance of a "verified" NOT.

Once the NOT is granted for the project and the maintenance of the site has been turned over to the property owner/property owner's association or similar entity, the subsequent required annual funding of the escrow account shall be the responsibility of the property owner association. A portion of the annual assessments of the property owner's association shall include an allocation into the escrow account. Any funds drawn down from the escrow account shall be replaced in accordance with the schedule of anticipated work used to create the budget. The property owner's association or similar entity shall report the balance and financial activities of the escrow account to the Town on an annual basis in the manner acceptable to the Town.

(J) REFERENCES

Southeast Michigan Council of Governments (SEMCOG), Low Impact Development Manual for Michigan: A Design Guide for Implementers and Reviewers, Detroit, Michigan, 2008.

CHAPTER NINE
METHODOLOGY FOR DETERMINATION OF REQUIRED SIZING OF BMPS

This Chapter describes the acceptable methods for calculating Channel Protection Volume, Water Quality Volume, and Flow-Through BMP Flow Rate associated with Conventional Stormwater Management Approach (acceptable methods associated with the LID Stormwater Management Approach are discussed in Chapter 8).
Channel Protection is achieved through retention or extended detention of runoff volume for 1-year, 24-hour storm event.

Structural Water Quality treatment is achieved by treating the first one (1) inch of rainfall, either through retention/detention BMPs or by Flow-through BMPs. Detention/Retention BMPs impound (pond) the runoff to be treated, while flow-through BMPs treat the runoff through some form of filtration process.

(A) Retention and Detention BMP Sizing

(1) Channel Protection Volume

Channel Protection Detention/Retention BMPs must be designed to store the channel protection volume. The channel protection volume, CPv, is the storage needed to retain or detain the runoff to the receiving stream from the 1-year, 24-hour rainfall.

The methodology for calculating the Channel Protection Volume (CPv) for each of site's final outlets using computer models or manual calculation is as follows:

(a) Computer Model: Use acceptable computer models (listed in Chapter 2) to determine the total runoff volume for the site contributing to each site's outlet, utilizing 1-year, 24-hour rainfall depth with Soil Conservation Service (SCS) type 2 storm distribution, drainage area, and the composite CN calculated for the site, according to the Soil Conservation Service (SCS) CN loss method along with SCS unitless hydrograph methodology.

(b) Manual Calculation: If calculating manually, use the following formula:

$$CPv\ (ft^3) = Qv \times 1/12 \times A$$

Where

A = total post-construction site area contributory to each outlet (ft^2)
Qv = Runoff Depth (in) = $(P - 0.2S)^2/(P + 0.8S)$
P = 1-Year, 24 Hr Rainfall (in)
S = (1000/CN) – 10

(2) Water Quality Volume

Water Quality Detention BMPs must be designed to store the water quality volume for treatment. The water quality volume, WQv, is the storage needed to capture and treat the runoff from the first one (1) inch of rainfall. The water quality volume is equivalent to one (1) inch of rainfall multiplied by the volumetric runoff coefficient (Rv) multiplied by the site area.

A calculation methodology similar to that described for the channel protection volume may be utilized, except that the rainfall depth (P) will be equal to 1 inch, instead of the 1-year, 24-hour depth.

Alternatively, a simpler methodology may be used for calculation of WQv as follows:

$$WQv = (P)\ (Rv)\ (A) / 12$$

where:

WQv = water quality volume for each site's outlet (acre-feet)
P = 1 inch
Rv = volumetric runoff coefficient

A = area in acres

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

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

Where:

I is the percent impervious cover

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

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

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

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

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

WQv (subarea A) = (1")(Rv)(A)/12 = 0.77(7.5)/12 = 0.47 acre-feet
WQv (subarea B) = 0.73(4.3)/12 = 0.26 acre-feet
WQv (subarea C) = 0.74(6.0)/12 = 0.37 acre-feet

This example assumed no off-site sources of discharge through the water quality BMPs. If there were significant sources of off-site runoff (sometimes called run-on 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 on-site channel protection volume plus the water quality volume for the off-site sources.

(B) 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/hydrodynamic separator or other similar type of device discussed in the Water Quality Devices Fact Sheet (Appendix D1).

(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 must meet the following criteria:

(a) The MTD must be offline and located upstream of detention facilities (if any).
(b) The MTD must provide complete and unobstructed access to the entire bottom of the system from grade level for ease of maintenance.

(c) 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.

(d) 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.

(e) The MTD must be provided with a well-defined access roadway located in common areas and contained in an easement.

(f) 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 above the NJDEP-certified list table.

(2) NJDEP Certification and Manufactured System Treatment Rates

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.

(a) 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):

(i) Go to http://www.nj.gov/dep/stormwater/treatment.html

(ii) Look up the name of the MTD in the first column of the table (see below a screen capture of a portion of the table at the time of this writing)

(iii) Look up the Certified TSS Removal Rate of that MTD in the fourth column

The table below includes the listing of MTDs that are NJCAT verified and NJDEP certified under the updated procedures and protocols dated January 25, 2013.

Click here to link to NJCAT Verification Database

Stormwater Management Manufactured Treatment Devices Certified by NJDEP	MTD Laboratory Test Certifications	Superseded Certifications	Certified TSS Removal Rate	Maintenance Plan
Aqua-Swirl By AquaShield. Inc.	Certification	Superseded	50%	Plan
BayFilter by BaySaver Technologies, LLC	Certification		80%	Plan
Continuous Deflective Separator (CDS) Unit by CONTECH Stormwater Solutions, Inc.	Certification	Superseded	50%	Plan
Downstream Defender by Hydro International, Inc.	Certification	Superseded	50%	Plan
Dual Vortex Separator by Oldcastle Stormwater Solutions	Certificaton		50%	Plan
Filterra Bioretention System by Contech	Certification	Superseded	80%	Plan

(b) **Step 2:** Determine the maximum accepted flow rate:

(i) Click the link "Certification" in the second column of the NJDEP-certified list table (above). 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 (vii) below. If not, continue to the sub-step (ii) below.

(ii) Click the "Click here" link above the NJDEP-certified list table to access NJCAT Verification Database.

(iii) Find the name of the MTD manufacturer of interest in first column (see below a screen capture of a portion of the table at the time of this writing).

(iv) Find the latest entry (one with the latest verification date shown in third column) for that particular MTD.

(v) Click the report download link in the fourth column.

(vi) 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 (see below a screen capture of a portion of the table for a sample MTD).

(vii) The selected model should have a maximum flow rate that is equal or larger than the site's required treatment flow rate as determined in this Chapter.

[redacted] Model	Manhole Diameter (ft)	NJDEP 50% TSS Maximum Treatment Flow Rate (cfs)	Treatment Area (ft^2)	Hydraulic Loading Rate (gpm/ft^2)	50% Max Sediment Storage Volume (ft^3)	Required Sediment Removal Interval[1] (Months)
4-ft	4-ft	1.12	12.6	40.0	9.45	60
6-ft	6-ft	2.52	28.3	40.0	28.35	80
8-ft	8-ft	4.49	50.3	40.0	62.78	99
10-ft	10-ft	7.00	78.5	40.0	117.45	119

(c) 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 BMP 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 NJDEP methodology. The treatment train shall not include more than one MTD.

(d) Multiple inlet or units in series configurations are not accepted unless the NJCAT certification and NJDEP verification is specifically done for such an arrangement.

(3) 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:

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

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

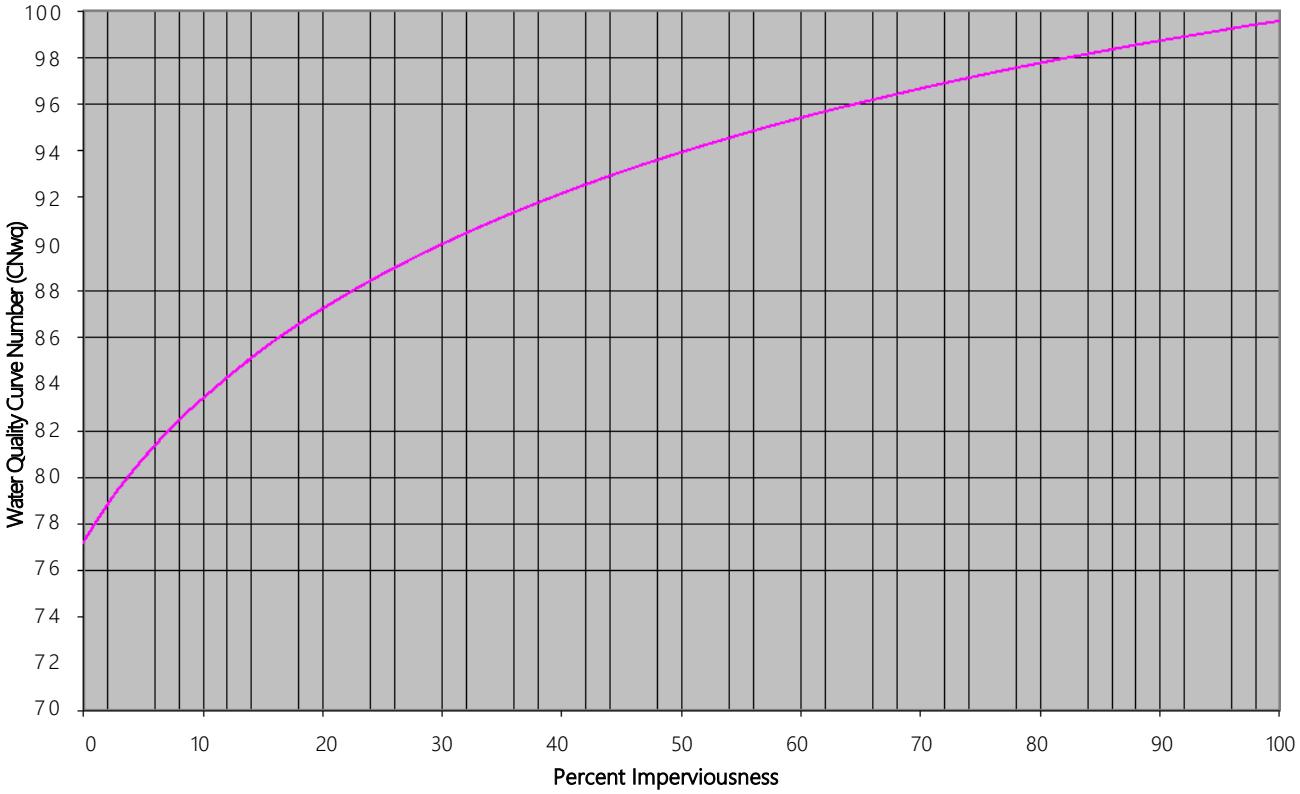

Figure 9-1: Curve Number Calculation for Water Quality Storm Event

(C) References

Maryland Stormwater Design Manual, Volume II, Appendix D.10, 2000.

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.

Schueler, T.R. and R.A. Claytor, 1996, Design of Stormwater Filter Systems. Center for Watershed Protection, Silver Spring, MD.

United States Department of Agriculture (USDA), 1986. Urban Hydrology for Small Watersheds. Soil Conservation Service, Engineering Division. Technical Release 55 (TR-55).

CHAPTER TEN
LOT DEVELOPMENT STANDARDS

(A) Grading and Building Pad Elevations

(1) For all structures located in the Special Flood Hazards Area (SFHA) as shown on the FEMA maps and/or that are mapped by the IDNR based on Best Available Data, the Lowest Floor elevation must comply with the Monroe County Floodplain Development Ordinance.

(2) For all structures located outside SFHA or an IDNR designated floodplain that are subject to flooding from a detention or 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 1% AEP flood elevation or the emergency overflow weir elevation, whichever is higher.

(3) For all structures located outside SFHA or an IDNR designated floodplains that are subject to flooding from a stream or an open ditch (an area along a stream with no floodplain designation or an area adjacent to a designated floodplain with ground elevation below the 1% AEP 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 1% AEP flood elevation.

(4) 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 2-year flood level (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 1% AEP flood elevation of an adjacent flooding source or pond.

(5) 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 1% AEP 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 Chapter 4 of these Standards.

(6) 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 2 feet above the road elevation (elevation of the gutter at the center of the lot) so that the road drainage is not directed against the building and the building is not flooded if road overflow occurs.

(7) 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. The ground adjacent to all sides of a building shall fall a minimum of six (6) inches in the first ten (10) feet from the building. Driveways which lead to garages shall fall a minimum of three (3) inches in the first ten (10) feet away from the garage. A note to this effect shall be placed on the construction plans. The MS4 Coordinator may approve alternative diversion plans upon a finding that the alternative plans will provide adequate positive drainage away from the building.

(8) Finished floor elevation or the lowest building entry elevation must be no less than six (6) inches above finished grade around the building.

(9) In addition to any other provisions in the Ordinance or these Standards, no buildings shall be placed within twenty-five (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

(1) 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.

(2) Drainage shall be designed so as to avoid the concentration of stormwater runoff from a lot onto adjacent lots.
(3) Each lot owner shall maintain the lot grade, as it relates to stormwater drainage, in compliance with the approved construction plans.
(4) No part of any residential lot may contain land that is utilized as retention or detention facility or drainage pond, contain a watercourse, or is within a floodplain (with the exception of minor subdivisions where an individual lot may contain a watercourse or be located within a floodplain).
(5) 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 MS4 Coordinator or their designee.
(6) If a subdivision contains an existing or to be developed waterbody, watercourse, or portion thereof, appropriate documentary assurances acceptable to the MS4 Coordinator shall be provided for the maintenance of such waterbody or watercourse.
(7) 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.

CHAPTER ELEVEN
RIVER CORRIDOR, BLUFFS, AND FLOODPLAIN PROTECTION STANDARDS

(A) Development Within Floodways and Fluvial Erosion Hazard Corridors

Regulatory Floodways and Fluvial Erosion Hazard (FEH) Corridors along regulated drains or any natural stream watercourse must be preserved to the extent possible to minimize flooding and erosion impacts within the stream system.

(1) Basis for Establishing Floodways

The regulatory floodway along Monroe County streams is established in the latest edition of the Monroe County Flood Damage Prevention Ordinance (Title 8).

(2) Basis for Establishing Fluvial Erosion Hazard (FEH) Corridors

The Indiana Silver Jackets Hazard Mitigation Task Force has initiated a multi-agency program to identify, study and provide mitigation planning resources for communities who would like to adopt Fluvial Erosion Hazard (FEH) avoidance strategies. The resources provided by this project enable individuals and communities to better recognize areas prone to natural stream-erosion processes and adopt strategies to avoid FEH-related risks. The FEH resources define approximate setbacks for communities to better manage river corridors. The setbacks vary based on the stream's recent migration history (actively migrating or relatively stationary).

For actively migrating and relatively stationary streams, a GIS analysis algorithm generated bankfull width values for each stream segment using regional curves that are based on drainage area within each physiographic region in Indiana. For relatively stationary streams, the analysis used these values to create buffer zones of at least one bankfull width on each side (a total corridor width of 3 times bankfull width) or 100 feet on each side of the bankfull bank, whichever is greater. For actively migrating streams, GIS generated a total corridor width of 8 times bankfull width, which was manually edited and refined to reflect the digital elevation model and stream meander evidence.

The FEH corridors were created at a map scale of approximately 1:10,000 to 1:15,000. The depicted areas were not meant to be accurate beyond providing an approximate boundary of potential stream migration. A data layer containing FEH Corridors along Indiana streams is currently hosted by IDNR-Division of Water on their mapping portal currently at: https://indnr.maps.arcgis.com/apps/webappviewer/index.html?id=43e7b307a0184c7c851b5068941e2e23. The IDNR website notes that, due to its level of detail, these data are not intended for use in project design or parcel level site analysis and that a more detailed analysis of the localized geology and fluvial mechanics is necessary for the proper evaluation of the fluvial erosion hazard.

Despite its inherent level of accuracy, the FEH corridor map created by the Indiana Silver Jackets constitutes the best available data in Monroe County and is the basis for regulating development within these corridors. A scaled version of the Monroe County FEH corridor map is available from the Monroe County GIS website. More detailed mapping than that used as part of the Indiana Silver Jackets erosion hazard mapping program may be provided by the applicant if it is based on detailed field assessment acceptable to the Drainage Board.

(3) Special Requirements FEH Corridors

For FEH corridors outside regulatory floodways, no disturbance (fill or excavation) associated with a new development or redevelopment is permitted unless such modifications are part of a stream-wide restoration plan or a watershed master plan. Any streambank stabilization effort within an FEH corridor shall require prior review by the MS4 Coordinator.

(B) Development Within or Adjacent to Bluff Zones

(1) For the purpose of these Standards, a bluff is defined as a natural topographic feature having:

(a) A slope that rises at least 25 feet and the grade of the slope averages 30 percent or greater, measured over a horizontal distance of 25 feet, from the toe of the slope to the top of the slope. Where the slope begins below the ordinary high-water level, the ordinary high water level is the toe of the slope. See **Figure 11-1**; or

(b) A natural escarpment or cliff with a slope that rises at least ten feet above the ordinary high-water level or toe of the slope, whichever is applicable, to the top of the slope, with a slope of 75 degrees or greater. See **Figure 11-2**.

Bluffs exist in many places and do not have to be along a permanent stream. They may be along rivers (but sometimes outside the floodway and FEH zones) or along headcut channels and developing ravines in Monroe County that may be tributary to various streams. To protect buildings from damage due to natural slope adjustment next to bluffs, a minimum of 40 feet of landward setback shall be required from top of the bluff as illustrated in **Figures 11-1** and **11-2**. If a floodway or FEH is also present on the site, the most landward limit shall govern.

(2) The definition of other terms shown in **Figures 11-1** and **11-2** are as follows:

(a) Bluff impact zone: A bluff and land located within 20 feet of the bluff.

(b) Bluffline: A line delineating the top of the bluff. More than one bluffline may be encountered proceeding landward from the river.

(c) Toe of Bluff: A line along the bottom of a bluff, requiring field verification, such that the slope above the line exceeds 30 percent and the slope below the line is 30 percent or less, measured over a horizontal distance of 25 feet.

(d) Top of Bluff: A line along the top of a bluff, requiring field verification, such that the slope below the line exceeds 30 percent and the slope above the line is 30 percent or less, measured over a horizontal distance of 25 feet.

(3) Where principal structures exist on the adjoining lots on both sides of a proposed building site, the minimum setback may be altered to conform to the average of the adjoining setbacks. In addition to structure setback noted above, with the exception of erosion control practices sanctioned by or approved by the Monroe County Surveyor, no land disturbance (fill or excavation) shall be allowed within a Bluff Impact Zone.

The minimum setback required in these standards is just that: a minimum, which is based on national experience. When buildings or other infrastructure is proposed near bluffs or steep slopes, the applicant may be required to seek a detailed geotechnical evaluation that may result in needing to have a larger setback or have special provisions even when the slopes are gentler than that regulated in these Standards.

(C) Floodplain Protection and No Net Loss Floodplain Storage Standards

(1) Floodplains exist adjacent to all natural and man-made streams, regardless of contributing drainage area or whether they have been previously identified or mapped. The intent of floodplain management is to protect against loss of property, protect human life, and maintain natural beneficial functions of floodplains in helping mitigate flooding and providing habitat and water quality benefits. **Therefore, filling of the land in the floodplain of a man-made channel or any natural stream or watercourse that has a defined channel and a contributing drainage area of 1 square mile or more, located within the Monroe County MS4 area, is prohibited**. **The use of the floodplain area for detention/retention ponds or lakes is also prohibited.**

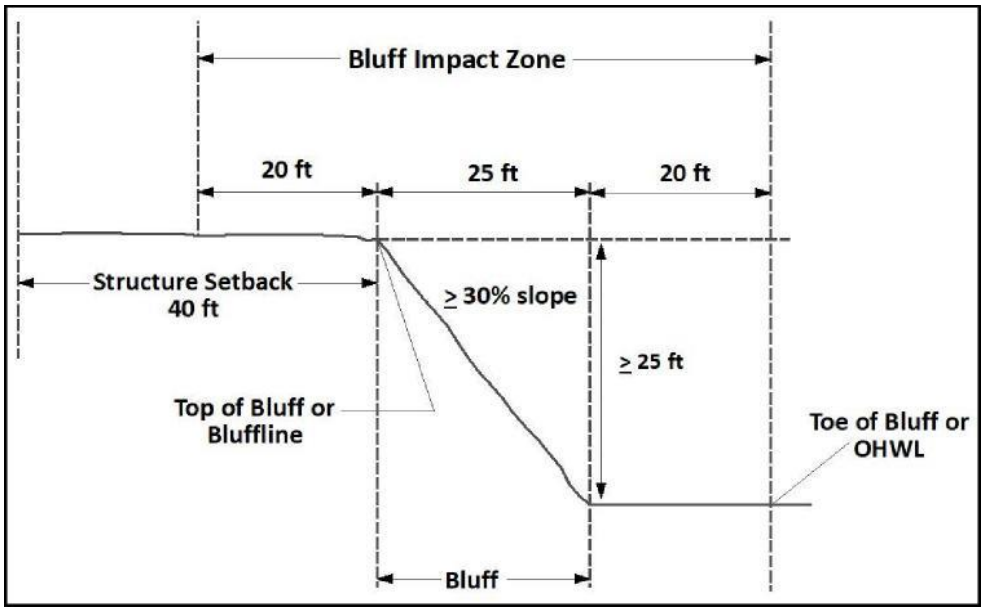

Figure 11-1: Bluff and Bluff Impact Zone

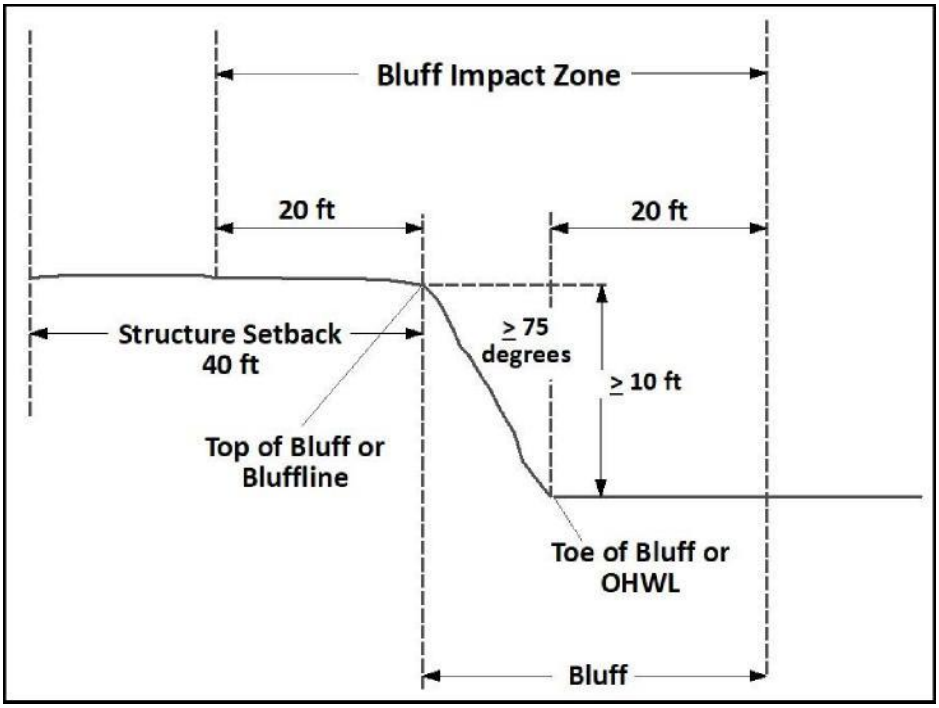

Figure 11-2: Natural Escarpment Bluff and Bluff Impact Zone

(2) Floodplain boundaries are to be determined by using the 1% AEP Base Flood Elevation (BFE) as shown on the Flood Insurance Rate Maps (FIRM) of the Federal Emergency Management Agency (FEMA), or the best available/calculated data if FIRM does not show the BFE.

(a) If, during the process of using the BFE and 1-foot topographic data, it is determined that the FIRM is incorrect, then a Letter of Map Revision (LOMR) to correct the FIRM is to be filed with FEMA. No filling of the floodplain, either the floodplain shown on the FIRM or the floodplain determined by the Floodplain Study, whichever is more conservative, will be allowed until an approved copy of the LOMR is provided to the Monroe County Planning Department.

(b) If a FIRM does not establish a 1% AEP BFE for a drain, natural stream, or natural watercourse, the 1%

AEP BFE shall be established through a site-specific Floodplain Study performed by a Professional Engineer registered in the State of Indiana.

(i) If the drainage area for the Floodplain Study reach is greater than one (1) square mile at the farthest downstream point of the study reach, then the Floodplain Study must be submitted to IDNR – Division of Water for approval and to MS4 Coordinator for review and comment. A copy of the final study, approved by IDNR-Division of Water, must be submitted to MS4 Coordinator as part of the project requiring the study to be completed. Upon acceptance of the Floodplain Study by IDNR – Division of Water, a Letter of Map Revision (LOMR) is to be filed with FEMA to incorporate the new Floodplain Study into the new FIRM panels.

(ii) If the drainage area for the Floodplain Study reach is less than one (1) square mile at the farthest downstream point of the study reach, then the Floodplain Study must be submitted to MS4 Coordinator for review and approval. The methodology for determining the BFE shall be in accordance with Chapters 2 and 3 of these Standards. If the applicant is seeking credit for existing detention or retention facilities in the watershed, such detention/retention facilities must be incorporated in the modeling using as-built conditions. MS4 Coordinator will have the option to send the Floodplain Study to a consulting engineering firm for review and comment, should the accuracy of the Floodplain Study be in question. The cost of the consulting engineering firm's time will be the responsibility of the owner of the project and will need to be consented to in a written agreement prior to any review of the Floodplain Study by the consulting engineer.

(3) Compensatory Storage Requirement

When the avoidance of floodplain disturbance is not practical due to an unavoidable use of floodplain areas, as determined by the MS4 Coordinator, compensatory excavation equivalent to the floodplain storage lost shall be required. The MS4 Coordinator or Drainage Board may alter the compensation ratio, based on extenuating circumstances, for a specific project.

(a) General Requirements

By definition, compensatory storage is the replacement of the existing floodplain and, in rare exceptions, the floodway storage lost due to fill. Compensatory storage is required when a portion of the floodplain is filled, occupied by a structure, or when (as a result of a project) a change in the channel hydraulics occurs that reduces the existing available floodplain storage. Compensatory storage must:

(i) Be provided regardless of whether the flooding source is mapped or whether flood elevations are published or not. When flood elevations are not available for a flooding source that has a drainage area one (1) square mile or greater, the applicant is to determine the 10% AEP and 1% AEP flood elevations at the site and receive approval from the IDNR and MS4 Coordinator prior to use for floodplain compensation calculations.

(ii) Equal at least 1 times the volume of flood storage lost below the 10-year and 100-year plus 2 feet flood elevations;

(iii) Be operational prior to placement of fill, structures, or other materials temporarily or permanently placed in the regulatory floodplain;

(iv) Be provided in the immediate vicinity of the flood storage lost, where practical;

(v) Be provided in such a way to mimic as close as possible the function provided by the lost floodplain storage. If the floodplain storage is to be lost outside the active flow conveyance path, then it must be compensated for outside the flow conveyance path (e.g., a flood conveyance shelf/2-stage ditch, while improving conveyance and erosion, is not an appropriate compensation for floodplain storage lost in the floodway fringe area).

(vi) Be provided in addition to the site retention/detention volume; and

(vii) Drain freely and openly to the waterway.

(b) Compensatory storage is also required to be provided incrementally such that:

(i) All floodplain storage/conveyance capacity lost within the floodway shall be compensated for within the floodway;

(ii) All floodplain storage lost within the floodway fringe shall be compensated for within the floodway fringe;
(iii) All floodplain storage lost below the existing 10% AEP flood elevation shall be compensated for below the proposed 10% AEP flood elevation; and
(iv) All floodplain storage lost above the existing 10% AEP flood elevation shall be compensated for above the proposed 10% AEP flood elevation.

(c) Compensatory storage is required for activities in the regulatory floodplain. There is no threshold to compensatory storage; any volume of fill requires compensatory storage to be provided. However, the compensatory storage requirement does not apply to the floodproofing of an existing building where the floodproofing measures such as berms or floodwalls are within 10 feet of the building, or crossing improvements, where artificially created storage is lost due to a reduction in head loss.

(4) Computing Compensatory Storage

(a) Computations must show 1:1 compensation for floodplain storage volume lost for 10% EP and 1% EP storm events, plus two (2) feet. Storage lost between the existing ground and the existing 10% EP flood elevation must be compensated for by providing 1 time the amount lost and be placed between the existing ground elevation and the proposed 10-year floodplain elevation. Storage lost between the existing 10% EP and the existing 1% EP plus 2 feet elevation must be compensated by providing 1 times the amount lost and be placed between the proposed 10% EP elevation and proposed 1% EP plus 2 feet elevation.

(b) When preparing a grading plan, thought should be given to how compensatory storage will be quantified. The most common methodology is the use of cross sections and the "average end area method." The following requirements should be followed when preparing cross sections:
(i) Prepare a detailed topographic survey tied to North American Vertical Datum of 1988 and the Monroe County Survey Control Network benchmarks.
(ii) Locate cross sections parallel to each other and perpendicular to a reference line, such as a property line or fence line. Cross sections used in a hydraulic model are always perpendicular to flood flows, and not always parallel to each other. Therefore, these are often not suitable for computing flood fringe compensatory storage volumes.
(iii) Plot cross sections at a standard engineering scale to allow the reviewer to verify areas. Horizontal scale should be a maximum of 1 in = 50 ft and vertical scale should be a maximum of 1 in =5 ft, or as approved by the MS4 Coordinator.
(iv) Show existing grades, proposed grades, existing and proposed 10% AEP flood elevations, existing and proposed 1% AEP flood elevations, normal water level, a reference line, and floodway limits on the cross sections on the plans.
(v) Locate cross sections no more than 150 feet apart, with a minimum of three cross sections per cut/fill area, or as necessary to accurately quantify cuts and fills.
(vi) Locate cross sections to pick up critical features such as berms, ditches, and existing and proposed structures.
(vii) Each cross section should be numbered or lettered and referenced on the plans.
This information is then utilized to compute the areas of cut and fill. A sample grading plan, a typical cross section, and associated compensatory storage calculations for the 10% AEP flood are provided on Figures 11-3, Figure 11-4, and Table 11-1, respectively.

(c) Volume of Fill between cross sections are calculated by finding the average fill cross sectional area and multiplying it by the distance between the two cross sections. For example, the fill volume between cross sections A and B is calculated as follows:

Average Fill Area = (Fill Area "A" + Fill Area "B")/2 = (0 ft^2 +100 ft^2)/2 = 50 ft^2
Volume of Fill = (Average Fill Area) × (Distance) = (50 ft^2) × (150 ft) = 7,500 ft^3

Once the total volume of fill placed, for this example, between the 0-and 10-yr flood elevations is determined, the total required compensatory storage can be calculated and compared against the total compensatory storage volume provided by the design as shown in the table. For this example:

Required Compensatory Storage = (1) × (Total Volume of Fill) = (1) × (36,250 ft^3) = 36,250 ft^3

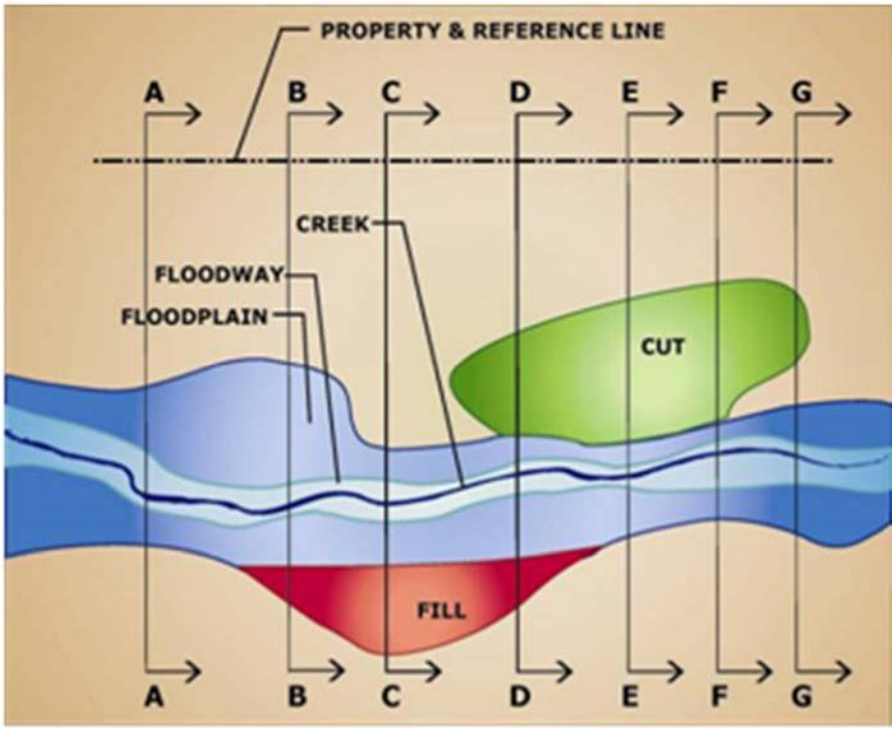

Figure 11-3: Example Compensatory Storage Conceptual Plan (not to scale and topography not shown for clarity).

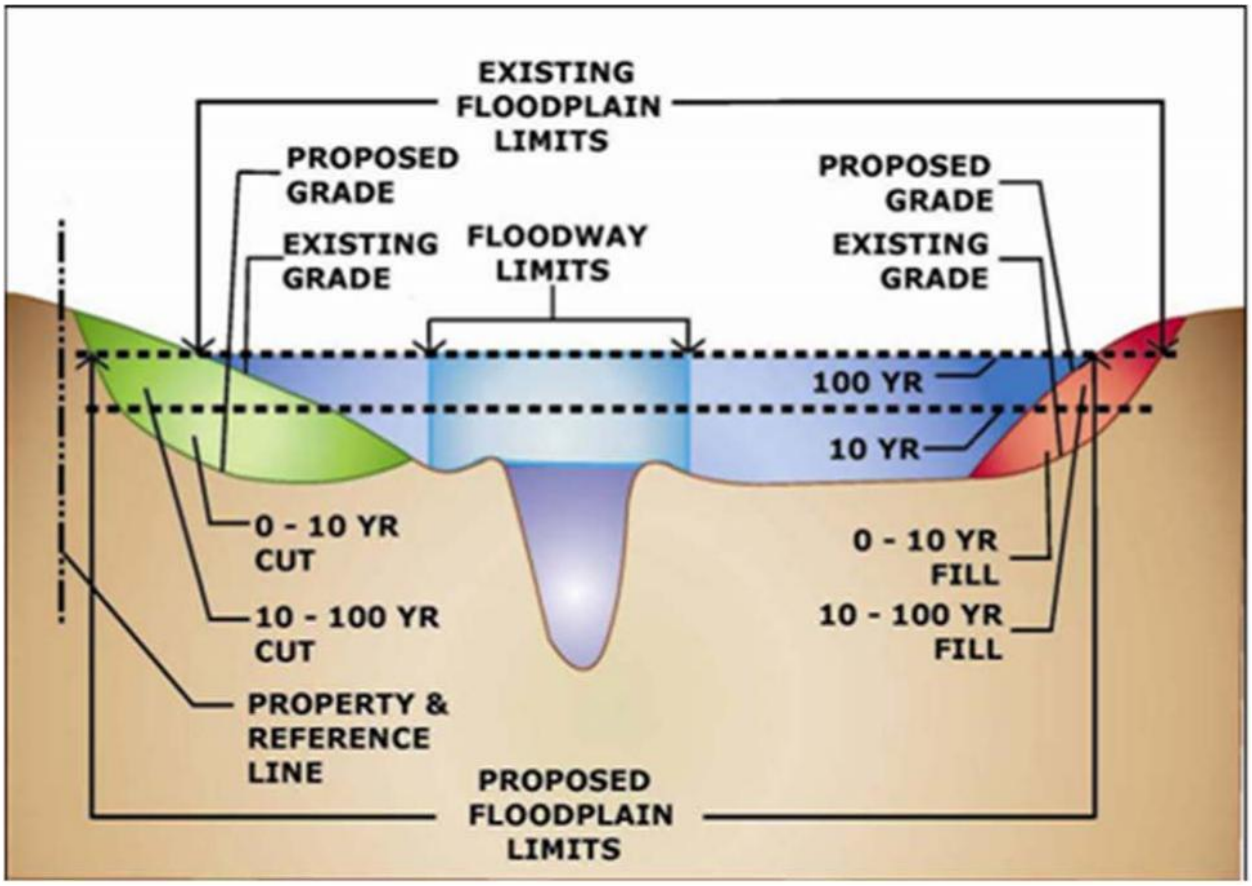

Figure 11-4: Example cross section D-D

Table 11-1: Example compensatory storage calculations for 0-10% AEP events.

Cross Section	Distance Between Sections (ft)	Fill Area (ft^2)	Average Fill Area (ft^2)	Volume of Fill (ft^3)	Cut Area (ft^2)	Average Cut (ft^2)	Volume of Cut (ft^3)
A		0			0		
	150		50	7,500		0	
B		100			0		
	90		125	11,250		20	1,800
C		150			40		
	100		125	12,500		65	6,500
D		100			90		
	100		50	5,000		100	10,000
E		0			110		
	100		0	0		120	12,000
F		0			130		
	85		0	0		85	7,225
G		0			40		
	Total Fill			**36,250**	Total Cut		**37,525**

Since the total amount of cut provided (37,525 ft^3 as shown in the table) is larger than that required (36,250 ft^3), the design meets the compensatory storage requirement for the 10%AEP flood. An additional table and calculation should be completed for the flood storage between the 10% AEP and 1% AEP plus 2 feet flood elevation in a similar manner to determine whether the design meets the compensatory storage requirement for the 1% AEP flood.

(5) Location of Compensatory Storage

(a) Compensatory storage must be located on-site and adjacent to or opposite the areas filled or occupied by a structure. In those rare instances when compensatory storage cannot be located adjacent to or opposite to the areas filled or occupied, engineering computations demonstrating that hydraulically equivalent compensatory storage has been provided is required. These computations must show that no increase in flood flows or flood depths will result as a result of the location of the proposed compensatory storage.

(b) Compensatory storage must be constructed to drain freely and openly to watercourses. In some rare cases it may be necessary to install pipes to construct and/or operate a compensatory storage basin. This may occur when site constraints, such as a roadway or sidewalk, separate the waterway from the compensatory storage area. This is illustrated in the top half of Figure 11-5.

(c) Another scenario may occur when a site cannot meet the incremental storage requirements discussed in this document. If incremental storage requirements from the 10% AEP to 1% AEP plus 2 feet elevations cannot be met, pipes could be installed with a flap gate to prevent the water from entering from the stream bed at lower elevations. The berm could then be set at the elevation of the 10% AEP flood elevation, thus allowing the storage to only become effective above the 10% AEP flood elevation. This is illustrated in the bottom half of the illustration in Figure 11-5.

(d) The use of pipes in compensatory storage will require approval by the MS4 Coordinator. Pipes must be a minimum of fifteen (15) inches in diameter so as to allow water to enter and exit freely with a minimum head differential. If the proposed compensatory storage is to be combined with detention, it must be demonstrated the compensatory storage and detention do not interfere with one another.

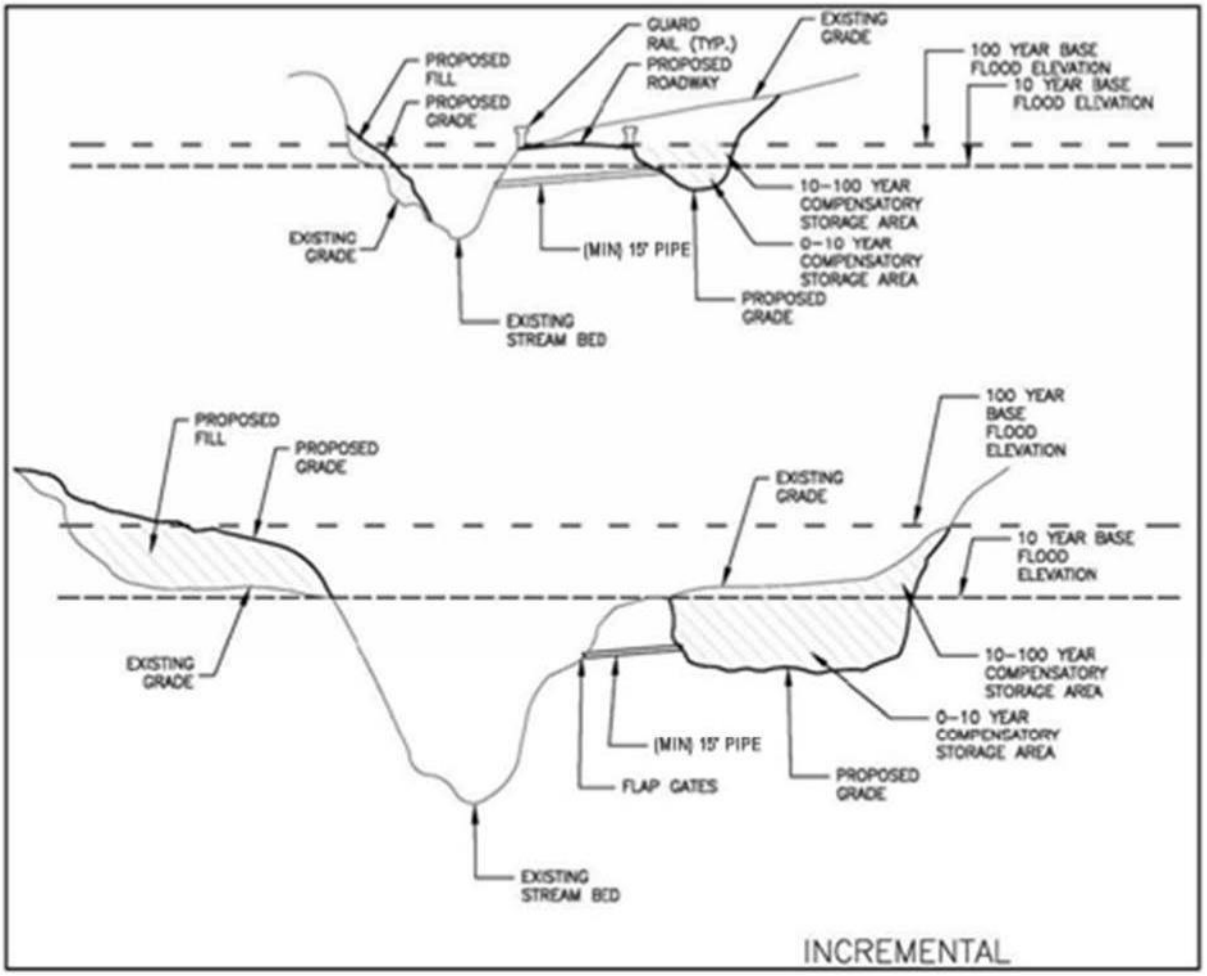

Figure 11-5: Example of compensatory storage connection to stream through pipe.

(6) Compensatory Storage in the Regulatory Floodway

Only fill associated with appropriate uses of the regulatory floodway may be allowed to be placed within the limits of the floodway. When in rare circumstances, fill is allowed, all provisions discussed above relating to compensatory storage must be met in addition to the items discussed below:

(a) Any fill placed within the existing floodway must be compensated for within the proposed floodway.
(b) All floodway storage lost below the existing 10% AEP base flood elevation shall be replaced below the proposed 10% AEP base flood elevation.
(c) All floodway storage lost between the existing 10% AEP flood elevation and the existing 1% AEP flood plus 2 feet elevation shall be replaced between the proposed 10% AEP and proposed 1% AEP flood plus 2 feet elevation.

Should excavation within a floodway be allowed in special circumstances, there shall be no reduction in floodway surface area as a result of a floodway modification, unless such modification is part of a stream-wide plan or necessary to reduce flooding at an existing structure.

CHAPTER TWELVE
STANDARDS ASSOCIATED WITH DAMS AND LEVEES

(A) Standards for New Dams and Levees or Improvements to Existing Dams and Levees

Dams and levees have the potential for significant, sometimes catastrophic consequences should they fail. In order to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and disaster costs, and safeguard the downstream property rights, the following shall be required by the MS4 Coordinator for any proposed new dam or levee, or improvements to any existing dam or levee. These requirements are in addition to what is required for developments subject to this Ordinance and/or that required by State or Federal agencies.

(1) Design of dams shall follow the requirements of the latest editions of IDNR-Division of Water's "General Guidelines for New Dams and Improvements to Existing Dams in Indiana" and "Indiana Dam Safety Inspection Manual."

(2) Design of levee/floodwalls shall follow the FEMA requirements and guidelines provided in 44 CFR Section 65.10 and USACE Engineer Manual 1110-2-193, Design and Construction of Levees.

(3) An Incident and Emergency Action Plan (IEAP), including a detailed dam breach inundation map, shall be developed in accordance with the template provided in the latest edition of "Indiana Dam Safety Inspection Manual" and submitted to the MS4 Coordinator. The detailed dam breach inundation map referenced in this paragraph shall be developed for both "Sunny Day Breach" Scenario (breach during normal loading conditions) and for maximum loading condition with breach assumed to occur as the spillway system is passing the Spillway Design Flood associated with the dam ("SDF + Breach" Scenario).

(4) Unless the "Sunny Day Breach Inundation Area" is entirely contained within the applicant's property and/ or contained within the existing 1% AEP floodplain, a copy of recorded flood inundation easement or a recorded written consent for every property within the potential "Sunny Day Breach Inundation Area" shall be submitted to the MS4 Coordinator. Also required is the ownership or recorded easement of all property around the lake with an elevation below the top of the dam. In addition, all the affected property owners whose properties are located within the "SDF + Breach Inundation Area" must be notified of a hearing relevant to the proposed added flooding risk, should such a man-made structure suffer a catastrophic failure. Notification of the time and place of the hearing shall be made in person or by certified mail at least five (5) to ten (10) days prior to the hearing. Proof of notice to each landowner shall be filed by affidavit with the MS4 Coordinator prior to the hearing.

(5) A copy of a Management and Maintenance Plan for the proposed dam or levee developed in accordance with the latest edition of "Indiana Dam Safety Inspection Manual" shall be submitted to the MS4 Coordinator.

(6) Unless the dam is subject to and regulated by IDNR, following the permitting and construction of the dam or levee, a copy of a formal periodic inspection report prepared in accordance with the recommendations contained in the latest edition of "Indiana Dam Safety Inspection Manual" shall be submitted to the MS4 Coordinator along with evidence that the identified maintenance deficiencies have been corrected. The inspection report has to be submitted as it gets completed in accordance with the inspection frequency recommended in the latest edition of "Indiana Dam Safety Inspection Manual".

(7) Existing berms or dams which are in new major subdivisions, and which are over ten (10) feet high shall either be breached and the area restored, or the dam brought up to the standards for new ponds (excluding the provisions required for detention, unless the pond is to be used for detention).

(B) Standards for Proposed Developments Downstream of Existing Dams

Placing new development downstream of an existing dam exposes future residents or users of the newly developed areas to a potential new significant risk and could also have an impact on the hazard rating of the dam itself, which can in turn make the dam non-compliant with the state and federal standards. In order to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and

disaster costs, and safeguard the upstream dam owner's rights, the following shall be required by the MS4 Coordinator for any proposed new development or redevelopment downstream of an existing dam. These requirements are in addition to what is required for new development or redevelopment subject to Chapter 761.

(1) Dam breach inundation maps have been created for several existing dams within the State of Indiana by the dam owners, IDNR, or others as part of development of individual IEAPs for these dams. When the development location is suspected by the applicant or the MS4 Coordinator to be within an existing dam's breach inundation zone, the applicant is required to include a copy of the breach inundation mapping associated with that dam as part of its Stormwater Permit application. To locate such a mapping, the applicant should contact the dam owner, IDNR Division of Water, the MS4 Coordinator, or other agencies to obtain the breach inundation map for the dam, if available. If no dam breach inundation map can be located for the dam, it will be the applicant's responsibility to produce a County-acceptable dam breach inundation map through directly contracting with a qualified engineer to do the work in accordance with standards and guidelines established by the IDNR Division of Water.

(2) If the location of the proposed development falls within the mapped dam breach inundation zone, additional requirements as determined by MS4 Coordinator may be imposed before a Stormwater Permit is issued and the development is allowed to occur. The noted additional requirements depend on several variables and are expected to vary case by case. Typical requirements could include relocating a portion or all of the proposed development to areas outside of the dam breach inundation zone, cost-sharing with the dam owner in necessary upgrades to the dam as a result of a potential hazard classification increase, addition of structural protection measures (such as flood protection levees), additional freeboard requirements, development and periodic exercise of warning and evacuation plans, and other measures considered necessary by MS4 Coordinator to minimize the potential for loss of life and public safety, decrease the potential for increased flood damage and disaster costs, and safeguard the upstream dam owner's rights.

CHAPTER THIRTEEN
STORMWATER STANDARDS FOR SOLAR FARMS

Solar development has expanded over the last several years as Indiana and other states have invested in this important resource to further greenhouse gas emission reductions. The large amount of impervious surface inherent in the construction of a large-scale solar array entails challenges not encountered in traditional development projects. If not properly managed through appropriate design and mitigation measures, stormwater discharged during and after the construction of solar arrays can be a significant source of pollution resulting from increased runoff, erosion, and sedimentation, which can adversely impact adjoining properties, streams, wetlands, or other natural resources.

Solar projects that use traditional elevated solar panels are unique because they contain an impervious surface (elevated solar panel) that often has a pervious surface (vegetation) underneath the panel. Stormwater runoff from solar projects is generated primarily from rain that falls on access roads, inverter pads, and solar panels. Water that falls off solar panels runs across the panel to the dripline, and eventually falls to the underlying surface. Some of this water will infiltrate and some will run-off downslope and eventually off site.

(A) Stormwater Pollution Prevention for Solar Farms

Solar installations must be properly designed to assure soil stabilization, minimize soil disturbance and soil compaction, and address ineffective controls to manage the total runoff volume and velocity that can lead to the loss of topsoil, erosion and sediment discharges from disturbed areas and stormwater outlets, and erosion along downstream channels and streambanks.

To minimize the erosion and/or scour at the dripline, the lowest vertical clearance of any solar array shall be no greater than ten (10) feet. Erosion prevention and sediment control Best Management Practices (BMPs) as detailed in Chapter 7 of these Standards must be utilized during construction.

(B) Post-Construction Stormwater Management for Solar Farms

(1) Solar projects must adhere to the post-construction stormwater management requirements, including providing the required Water Quality Volume (WQv) and Channel Protection Volume (CPv) described in Chapter 8 of these Standards, as well as peak flow control (detention) requirements described in Chapter 6. However, because solar farms—particularly the panels— have unique characteristics, not like constructing a building or road, they often inherently include stormwater disconnection features that qualifies them for recognition/credit afforded to the Stormwater Disconnection BMP, which similar to typical solar panel farms rely on maintaining sheet flow and infiltration in adequately-sized, vegetative areas receiving runoff. The Stormwater Disconnection BMP is detailed in Appendix D1. Per recommendations from the Center for Watershed Protection, the following Stormwater Disconnection recognitions/credits are established as part of these standards for solar farms that meet the conditions stated in these standards:

- **(a) WQv**: Up to 100% of the required Water Quality Volume, proportionate to the percentage of total disconnected area to total site impervious area, may be subtracted from the required WQv.
- **(b) CPv**: For determining the Channel Protection Volume (CPv), the post-construction CN for the impervious area treated by the stormwater disconnection BMP may be determined assuming the treated area is "wood in good condition" (for the next less infiltrating hydrologic soil group than the pre-construction hydrologic soil group, since the area underneath panels is assumed disturbed/compacted during construction).
- **(c) Qp (2, 10, 100)**: For determining the peak flow controls (detention), the post-construction CN for the area treated by the stormwater disconnection BMP needed for determining post-construction peak flows (Qp) for 2, 10, and 100-year storms, may be determined assuming the treated area is "wood in good condition" (for the next less infiltrating hydrologic soil group than the pre-construction

hydrologic soil group, since the area underneath panels is assumed disturbed/compacted during construction).

(2) For solar farm developments to be eligible for Stormwater Disconnection BMP recognitions/credits, the following design and construction guidelines must be met (Items (iv) and (vii) are required for all proposed solar farms regardless of whether Stormwater Disconnection recognition/credit is being sought):

(a) Roadways, gravel surfaces, transformer pads, and level spreaders within the solar field are considered effective impervious cover for the purposes of calculating Water Quality Volume (WQv), Channel Protection Volume (CPv), and post-construction peak flows.

(b) All solar panels in the array should also be considered additional effective impervious cover for the purposes of calculating the WQv, CPv, and post-construction peak flow unless ALL the following conditions are met:

(i) The vegetated area receiving runoff between rows of solar panels is equal to or greater than the average width of the row of solar panels draining to the vegetated area.

(ii) Overall site conditions and solar panel configuration within the array are designed and constructed such that the runoff remains as sheet flow across the entire site. The array shall be designed to ensure a perpendicular layout of drip edge to slope direction or devices shall be installed such as level spreaders to ensure sheet flow from the drip edge. Level spreaders shall be designed in accordance with the Level Spreader fact sheet contained in Appendix D1.

(iii) The following conditions are satisfied regarding the design of the post-construction slope of the site:

a. For slopes less than or equal to 5%, appropriate vegetation shall be established as indicated in Figure 13-1, below.

b. For slopes greater than 5%, but less than 10%, practices including, but not limited to, the use of level spreaders, infiltration trenches, or similar energy dissipating practices as described in Figure 13-2, below, shall be used to ensure long term sheet flow conditions.

c. For slopes equal to or greater than 10% and less than 15%, the Plan includes specific engineered stormwater control measures, such as level spreaders, infiltration trenches, or similar energy dissipating practices, with detailed specifications that are designed to provide permanent stabilization and non-erosive conveyance of runoff to the property line of the site or downgradient from the site.

d. Slopes greater than 15% are not qualified for a stormwater disconnection recognition/credit.

(iv) The lowest vertical clearance of the solar panels above the ground should not be greater than ten (10) feet. The panels should, however, be at an adequate height to support vegetative growth and maintenance beneath and between the panels. If the lowest vertical clearance of the solar panels above the ground is greater than ten (10) feet, non-vegetative control measures will be necessary to prevent/control erosion and scour along the drip line or otherwise provide energy dissipation from water running off the panels.

(v) Disconnecting impervious surfaces works best in undisturbed soils. To minimize disturbance and compaction, construction vehicles and equipment should avoid areas used for disconnection during installation of the solar panels. Hydrologic Soil Group D soils or soils that are compacted by construction equipment may need to be tilled to a depth of four to six inches and/or amended to increase permeability.

(vi) Groundcover vegetation must be maintained in good condition in those areas receiving disconnected runoff. Areas receiving runoff should be protected (e.g., planting shrubs or trees along the perimeter) from future compaction. Vegetated areas shall not be subject to chemical fertilization or herbicides/pesticides except for those applications that are necessary to get vegetation established and which follow an approved Erosion and Sediment Pollution Control Plan. To maximize the potential for infiltration and reduce maintenance, the use of native deep-rooted vegetative cover under the panels and between the panel rows is highly encouraged. To achieve a native deep-rooted vegetative cover, a mixture of perennial grasses and wildflowers is recommended with a diversity of forbs or flowering plants that bloom throughout the growing

season. Blooming shrubs may also be used in buffer areas as appropriate for visual screening. Perennial vegetation (grasses and forbs) should be native to Indiana, but where appropriate to the vegetative management plan goals, may also include other naturalized and non-invasive species which provide habitat for pollinators and wildlife and/or other ecosystem services.

(vii) A fifty (50) foot buffer should be maintained between any part of the solar array and any " watercourse" or "waterbody) as that term as defined. The buffer shall consist of undisturbed existing vegetation or native shrub plantings.

(viii) Similar to other post-construction BMPs, the vegetated area underneath the panels, the vegetated area receiving runoff, and any buffer areas will need to be mapped, maintained in accordance with the Stormwater Operations and Maintenance Manual, and covered by the recorded maintenance agreement described in Chapter 8 of these standards.

(3) Depending on the layout and number of panels installed, the stormwater disconnection BMP may address some or all of the stormwater management requirements (WQv) for an individual project. Where the imperviousness is high or there is other infrastructure (e.g., access roads, transformers), additional runoff may need to be treated. Further reduction in the remaining required Water Quality, Channel Protection, and Peak flow control volumes is possible through utilizing the BMPs described as part of the LID track in Chapter 8 of these standards.

(4) A solar panel project should ideally be installed and placed outside of the floodplain or detention facilities. If proposed to be placed within a floodplain or in a dry detention facility, panels (all tilt positions) must be installed at or above the flood protection grade (2 feet above the BFE) or at or above the 100-year emergency overflow of the detention facility plus one foot. This includes all electrical systems associated with the panels. If the solar array project is proposed within floodway portion of the floodplain, the project shall also require a Construction in Floodway Permit from the IDNR.

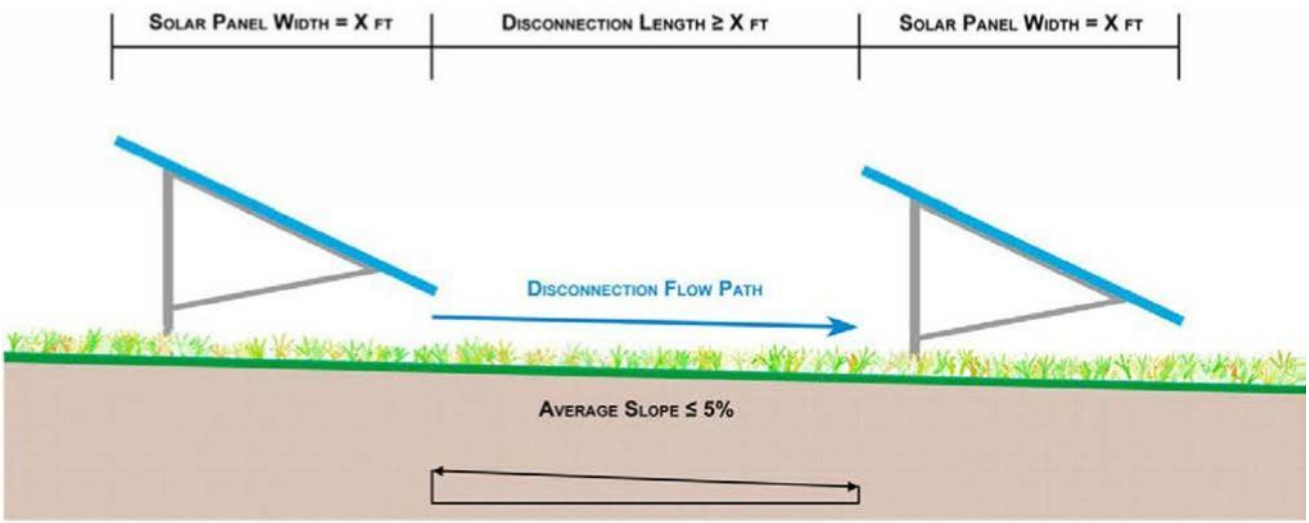

Figure 13-1: Typical Solar Panel Installation with Slopes ≤ 5%

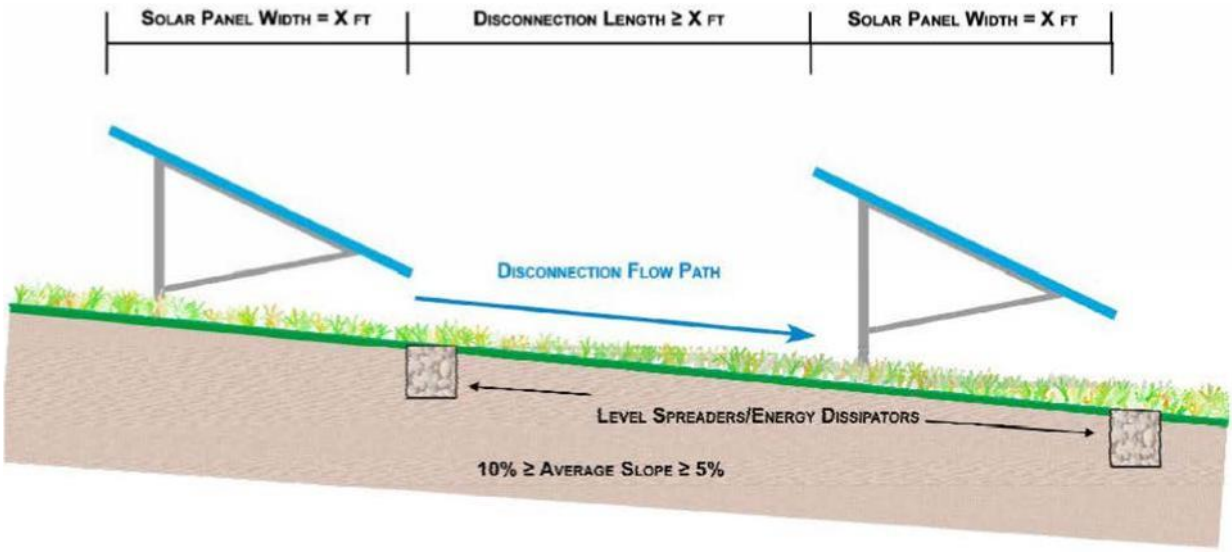

Figure 13-2: Typical Solar Panel Installation with Slopes > 5% and ≤ 10%

Source: Maryland Department of the Environment: Stormwater Design Guidance – Solar Panel Installations

APPENDIX A
REFERENCES

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City of Tacoma, Surface Water Management Manual, 2003 or later

Maryland Stormwater Design Manual, Volume II, Appendix D.10, 2000.

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APPENDIX B
LIST OF MONROE COUNTY CRITICAL WATERSHEDS

1. Clear Creek (upstream from Dillman Wastewater Treatment Plant)
2. Sinking Creek
3. Cave Creek
4. Bunger Branch
5. Jacks Defeat Creek
6. McCormick's Creek
7. Kerr Creek

APPENDIX C
CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs)

BMP CN-101: Wheel Wash
BMP CN-102: Dewatering Structure
BMP CN-103: Spill Prevention and Control
BMP CN-104: Solid Waste Management
BMP CN-105: Hazardous Waste Management

BMP CN-101
WHEEL WASH

DESCRIPTION

When a stabilized construction entrance is not preventing sediment from being tracked onto pavement, a wheel wash may be required. Wheel washing is generally an effective BMP when installed with careful attention to topography. For example, a wheel wash can be detrimental if installed at the top of a slope abutting a right-of-way where the water from the dripping truck can run unimpeded into the street. Pressure washing combined with an adequately sized and surfaced pad with direct drainage to a large 10 foot by 10 foot sump can be very effective.

ADVANTAGES

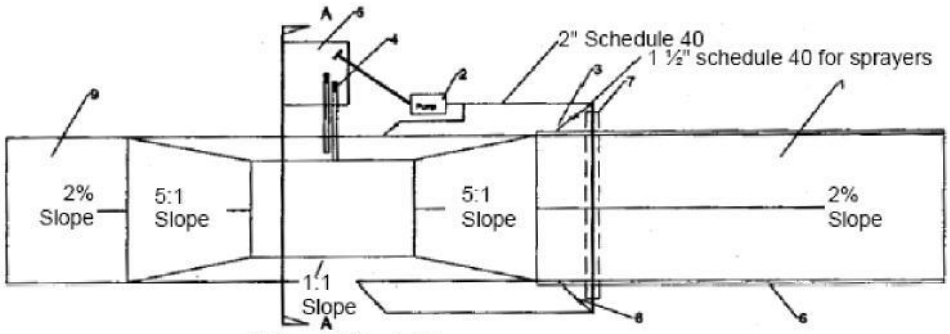
1. Wheel washes reduce the amount of sediment transported onto paved roads by motor

vehicles. **DESIGN CRITERIA**

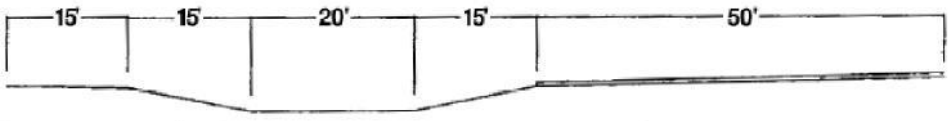
1. Suggested details are shown in Figure CN-101-A. Monroe County may allow other designs.
2. A minimum of 6 inches of asphalt treated base (ATB) over crushed base material or 8 inches over a good subgrade is recommended to pave the wheel wash.
3. Use a low clearance truck to test the wheel wash before paving. Either a belly dump or lowboy will work well to test clearance.
4. Keep the water level from 12 to 14 inches deep to avoid damage to truck hubs and filling the truck tongues with water.
5. Midpoint spray nozzles are only needed in extremely muddy conditions.
6. Wheel wash systems should be designed with a small grade change, 6 to 12 inches for a 10-foot-wide pond, to allow sediment to flow to the low side of pond to help prevent re-suspension of sediment.
7. A drainpipe with a 2- to 3-foot riser should be installed on the low side of the pond to allow for easy cleaning and refilling.
8. Polymers may be used to promote coagulation and flocculation in a closed-loop system. Polyacrylamide (PAM) added to the wheel wash water at a rate of 0.25 - 0.5 pounds per 1,000 gallons of water increases effectiveness and reduces cleanup time.
9. If PAM is already being used for dust or erosion control and is being applied by a water truck, the same truck can be used to change the wash water.
10. The wheel wash should start out the day with fresh water. The wash water should be changed a minimum of once per day.
11. On large earthwork jobs where more than 10-20 trucks per hour are expected, the wash water will need to be changed more often.
12. Wheel wash or tire bath wastewater shall be discharged to a separate on-site treatment system, such as closed-loop recirculation or land application, or to the sanitary sewer with proper local sewer utility approval.

REFERENCE

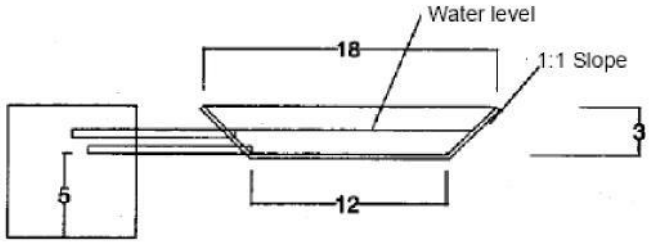
City of Tacoma, Surface Water Management Manual, 2003 or later



Wheel Wash Plan



Elevation View



Section A-A
NTS

Notes:

1. Asphalt construction entrance 6 in. asphalt treated base (ATB).
2. 3-inch trash pump with floats on the suction hose.
3. Midpoint spray nozzles, if needed.
4. 6-inch sewer pipe with butterfly valves. Bottom one is a drain. Locate top pipe's invert 1 foot above bottom of wheel wash.
5. 8 foot x 8 foot sump with 5 feet of catch. Build so can be cleaned with trackhoe.
6. Asphalt curb on the low road side to direct water back to pond.
7. 6-inch sleeve under road.
8. Ball valves.
9. 15 foot. ATB apron to protect ground from splashing water.

Figure CN-101A

BMP CN-102
DEWATERING STRUCTURE

DESCRIPTION

Water which is pumped from a construction site usually contains a large amount of sediment. A dewatering structure is designed to remove the sediment before water is released off-site.

This practice includes several types of dewatering structures which have different applications dependent upon site conditions and types of operation. Other innovative techniques for accomplishing the same purpose are encouraged, but only after specific plans and details are submitted to and approved by Monroe County.

DESIGN CRITERIA

1. A dewatering structure must be sized (and operated) to allow pumped water to flow through the filtering device without overtopping the structure.
2. Material from any required excavation shall be stored in an area and protected in a manner that will prevent sediments from eroding and moving off-site.
3. An excavated basin (applicable to "Straw Bale/Silt Fence Pit") may be lined with filter fabric to help reduce scour and to prevent the inclusion of soil from within the structure.
4. Design criteria more specific to each particular dewatering device can be found in Figures CN-102-A through CN-102-C.
5. A dewatering structure may not be needed if there is a well-stabilized, vegetated area onsite to which water may be discharged. The area must be stabilized so that it can filter sediment and at the same time withstand the velocity of the discharged water without eroding. A minimum filtering length of 75 feet must be available in order for such a method to be feasible.
6. The filtering devices must be inspected frequently and repaired or replaced once the sediment build-up prevents the structure from functioning as designed.
7. The accumulated sediment which is removed from a dewatering device must be spread on-site and stabilized or disposed of at an approved disposal site as per approved plan.

Portable Sediment Tank (see Figure CN102-A)

- The structure may be constructed with steel drums, sturdy wood or other material suitable for handling the pressure exerted by the volume of water.
- Sediment tanks will have a minimum depth of 2 ft.
- The sediment tank shall be located for easy clean-out and disposal of the trapped sediment and to minimize the interference with construction activities.
- The following formula shall be used to determine the storage volume of the sediment tank:

Pump discharge (gallons/min.) x 16 = cubic feet of storage required

- Once the water level nears the top of the tank, the pump must be shut off while the tank drains and additional capacity is made available.
- The tank shall be designed to allow for emergency flow over top of the tank. Clean-out of the tank is required once one-third of the original capacity is depleted due to sediment accumulation. The tank shall be clearly marked showing the clean-out point.

Filter Box (see Figure CN-102-B)

- The box selected should be made of steel, sturdy wood or other materials suitable to handle the pressure requirements imposed by the volume of water. Normally readily available 55-gallon drums welded top to bottom will suffice in most cases.
- Bottom of the box shall be made porous by drilling holes (or some other method).

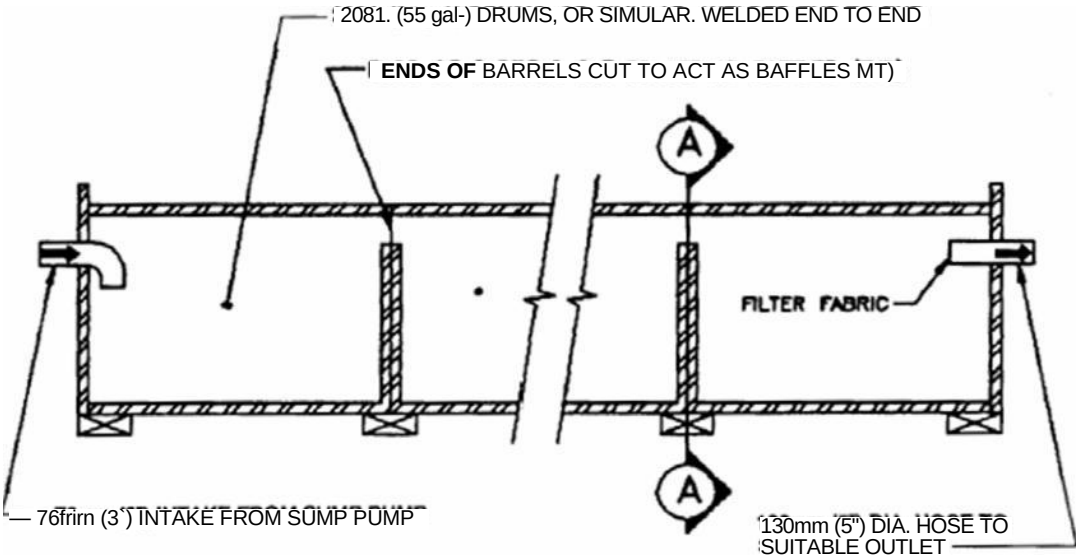
- Coarse aggregate shall be placed over the holes at a minimum depth of 12 inches, metal "hardware" cloth may need to be placed between the aggregate and the holes if holes are drilled larger than the majority of the stone.
- As a result of the fast rate of flow of sediment-laden water through the aggregate, the effluent must be directed over a well-vegetated strip of at least 50 feet after leaving the base of the filter box.
- The box shall be sized as follows:

Pump discharge (gallons/min.) x 16 = cubic feet of storage required

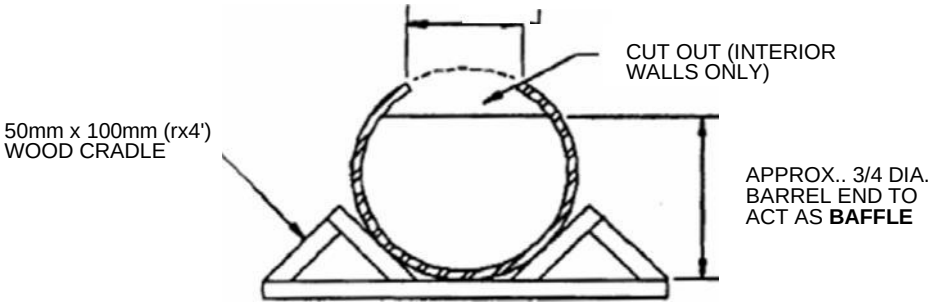
- Once the water level nears the top of the box, the pump must be shut off while the box drains and additional capacity is made available.
- The box shall be designed/constructed to allow for emergency flow over the top of this box.
- Clean-out of the box is required once one-third of the original capacity is depleted due to sediment accumulation. The tank shall be clearly marked showing the clean-out point.
- If the stone filter does become clogged with sediment so that it no longer adequately performs its function, the stones must be pulled away from the inlet, cleaned and replaced.
- Using a filter box only allows for minimal settling time for sediment particles; therefore, it should only be used when site conditions restrict the use of the other methods.

REFERENCE

United States Army Corps of Engineers, Handbook for the Preparation of Storm Water Pollution Prevention Plans for Construction Activities, 1997 or later.



ELEVATION



CROSS—SECTION A—A

Figure CN-102-A
Portable Sediment Tank

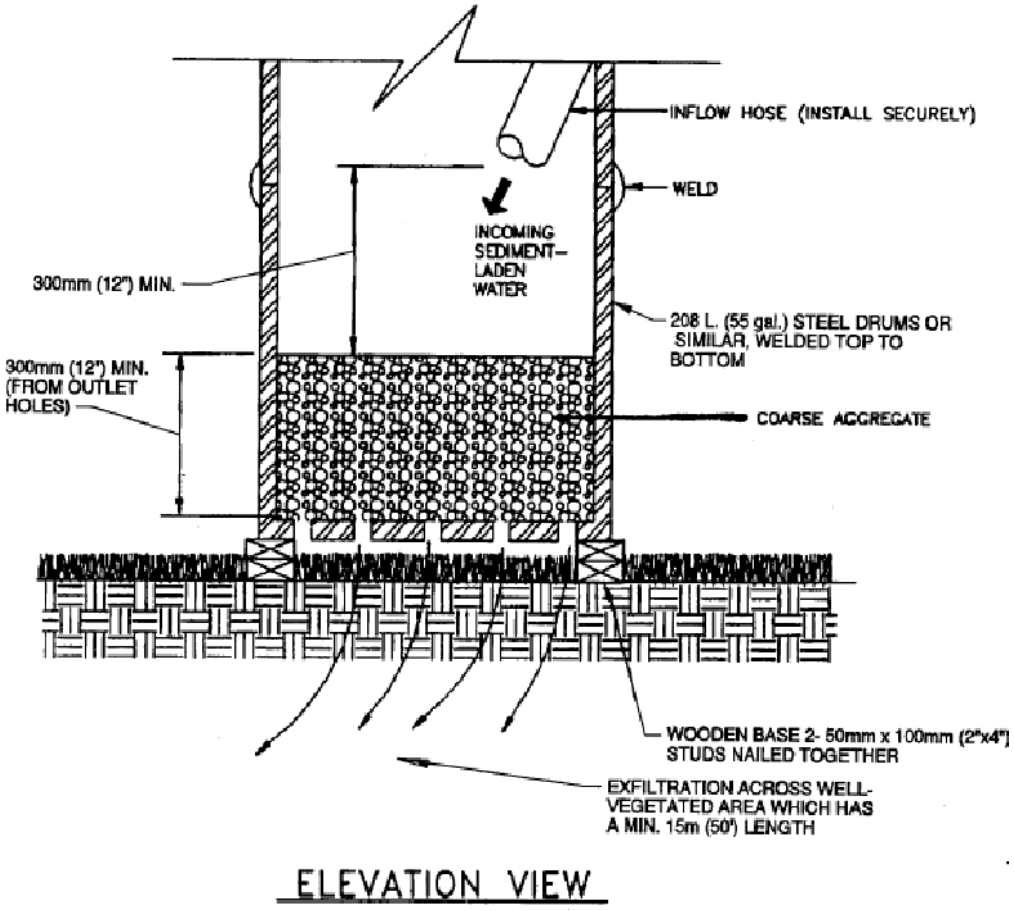


Figure CN-102-B
Filter Box

BMP CN-103
SPILL PREVENTION AND CONTROL

DESCRIPTION

These procedures and practices are implemented to prevent and control spills in a manner that minimizes or prevents the discharge of spilled material to the drainage system or watercourses.

This best management practice (BMP) applies to all construction projects. Spill control procedures are implemented anytime chemicals and/or hazardous substances are stored. Substances may include, but are not limited to:

- Soil stabilizers/binders
- Dust Palliatives
- Herbicides
- Growth inhibitors
- Fertilizers
- Deicing/anti-icing chemicals
- Fuels
- Lubricants
- Other petroleum distillates

To the extent that the work can be accomplished safely, spills of oil, petroleum products, sanitary and septic wastes, and substances listed under 40 Code of Federal Regulations (CFR) parts 110, 117, and 302 shall be contained and cleaned up immediately.

LIMITATIONS

1. This BMP only applies to spills caused by the contractor.
2. Procedures and practices presented in this BMP are general. The contractor shall identify appropriate practices for the specific materials used or stored on-site in advance of their arrival at the site.

DESIGN CRITERIA

1. To the extent that it doesn't compromise cleanup activities, spills shall be covered and protected from stormwater runoff during rainfall.
2. Spills shall not be buried or washed with water.
3. Used clean up materials, contaminated materials, and recovered spill material that is no longer suitable for the intended purpose shall be stored and disposed of in conformance with BMP CN-105: Hazardous Waste Management.
4. Water used for cleaning and decontamination shall not be allowed to enter storm drains or watercourses and shall be collected and disposed of in accordance with BMP CN-105: Hazardous Waste Management.
5. Water overflow or minor water spillage shall be contained and shall not be allowed to discharge into drainage facilities or watercourses.
6. Proper storage, clean-up and spill reporting instruction for hazardous materials stored or used on the project site shall be posted at all times in an open, conspicuous and accessible location.
7. Waste storage areas shall be kept clean, well organized and equipped with ample clean-up supplies as appropriate for the materials being stored. Perimeter controls, containment structures, covers and liners shall be repaired or replaced as needed to maintain proper function.
8. Verify weekly that spill control and clean up materials are located near material storage, unloading, and use areas.

9. Update spill prevention and control plans and stock appropriate clean-up materials whenever changes occur in the types of chemicals used or stored onsite.

Cleanup and Storage Procedures for Minor Spills

- Minor spills typically involve small quantities of oil, gasoline, paint, etc., which can be controlled by the first responder at the discovery of the spill.
- Use absorbent materials on small spills rather than hosing down or burying the spill.
- Remove the absorbent materials promptly and dispose of properly.
- The practice commonly followed for a minor spill is:
  - Contain the spread of the spill.
  - Recover spilled materials.
  - Clean the contaminated area and/or properly dispose of contaminated materials.

Cleanup and Storage Procedures for Semi-Significant Spills

- Semi-significant spills still can be controlled by the first responder along with the aid of other personnel such as laborers and the foreman, etc. This response may require the cessation of all other activities.
- Clean up spills immediately.
- Notify the project foreman immediately. The foreman shall notify the jurisdiction's Emergency Management Agency's Hazardous Materials Response Team.
- Contain spread of the spill.
- If the spill occurs on paved or impermeable surfaces, clean up using "dry" methods (absorbent materials, cat litter and/or rags). Contain the spill by encircling with absorbent materials and do not let the spill spread widely.
- If the spill occurs in dirt areas, immediately contain the spill by constructing an earthen dike. Dig up and properly dispose of contaminated soil.
- If the spill occurs during rain, cover spill with tarps or other material to prevent contaminating runoff.

Cleanup and Storage Procedures for Significant/Hazardous Spills

- For significant or hazardous spills that cannot be controlled by personnel in the immediate vicinity, notify the local emergency response by dialing 911. In addition to 911, the contractor will notify the proper jurisdiction's officials. It is the contractor's responsibility to have all emergency phone numbers at the construction site.
- For spills of federal reportable quantities, in conformance with the requirements in 40 CFR parts 110,119, and 302, the contractor shall notify the National Response Center at (800) 424-8802.
- Notification shall first be made by telephone and followed up with a written report.
- The services of a spills contractor or a Haz-Mat team shall be obtained immediately. Construction personnel shall not attempt to clean up the spill until the appropriate and qualified personnel have arrived at the job site.

REFERENCE

California Department of Transportation, Construction Site BMP Manual, 2000 or later

BMP CN-104
SOLID WASTE MANAGEMENT

DESCRIPTION

Solid waste management procedures and practices are designed to minimize or eliminate the discharge of pollutants to the drainage system or to watercourses as a result of the creation, stockpiling, or removal of construction site wastes.

Solid waste management procedures and practices are implemented on all construction projects that generate solid wastes.

Solid wastes include but are not limited to:

- Construction wastes including brick, mortar, timber, steel and metal scraps, sawdust, pipe and electrical cuttings, non-hazardous equipment parts, styrofoam and other materials used to transport and package construction materials.
- Landscaping wastes, including vegetative material, plant containers, and packaging materials.
- Litter, including food containers, beverage cans, coffee cups, paper bags, plastic wrappers, and smoking materials, including litter generated by the public.

LIMITATIONS

1. Temporary stockpiling of certain construction wastes may not necessitate stringent drainage related controls during the non-rainy season.

DESIGN CRITERIA

1. Dumpsters of sufficient size and number shall be provided to contain the solid waste generated by the project and properly serviced.
2. Littering on the project site shall be prohibited.
3. To prevent clogging of the storm drainage system, litter and debris removal from drainage grates, trash racks, and ditch lines shall be a priority.
4. Trash receptacles with lids shall be provided in the contractor's yard, field trailer areas, and at locations where workers congregate for lunch and break periods.
5. Construction debris and litter from work areas within the construction limits of the project site shall be collected and placed in watertight dumpsters at least weekly regardless of whether the litter was generated by the contractor, the public, or others. Collected litter and debris shall not be placed in or next to drain inlets, storm water drainage systems or watercourses.
6. Full dumpsters shall be removed from the project site and the contents shall be disposed of, off-site, in an appropriate manner.
7. Litter stored in collection areas and containers shall be handled and disposed of by trash hauling contractors.
8. Construction debris and waste shall be removed from the site every two weeks.
9. Stormwater run-off shall be prevented from contacting stored solid waste through the use of berms, dikes, or other temporary diversion structures or through the use of measures to elevate waste from site surfaces.
10. Solid waste storage areas shall be located at least 50 ft from drainage facilities and watercourses and shall not be located in areas prone to flooding or ponding.
11. Except during fair weather, construction and landscaping waste not stored in watertight dumpsters shall be securely covered from wind and rain by covering the waste with tarps, plastic sheeting, or equivalent.
12. Dumpster washout on the project site is not allowed.

13. Notify trash hauling contractors that only watertight dumpsters are acceptable for use on-site.
14. Plan for additional containers during the demolition phase of construction.
15. Plan for more frequent pickup during the demolition phase of construction.
16. Construction waste shall be stored in a designated area. Access to the designated area shall either be well vegetated ground, a concrete or asphalt road or drive, or a gravel construction entrance, to avoid mud tracking by trash hauling contractors.
17. Segregate potentially hazardous waste from non-hazardous construction site waste.
18. Keep the site clean of litter debris.
19. Make sure that toxic liquid wastes (e.g., used oils, solvents, and paints) and chemicals (e.g., acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for construction debris.
20. For disposal of hazardous waste, see BMP CN-105: Hazardous Waste Management. Have hazardous waste hauled to an appropriate disposal and/or recycling facility.
21. Salvage or recycle useful vegetation debris, packaging and/or surplus building materials when practical. For example, trees and shrubs from land clearing can be converted into wood chips, then used as mulch on graded areas. Wood pallets, cardboard boxes, and construction scraps can also be recycled.
22. Prohibit littering by employees, subcontractors, and visitors.
23. Wherever possible, minimize production of solid waste materials.

REFERENCE

California Department of Transportation, Construction Site BMP Manual, 2000 or later

BMP CN-105
HAZARDOUS WASTE MANAGEMENT

DESCRIPTION

These are procedures and practices to minimize or eliminate the discharge of pollutants from construction site hazardous waste to the storm drain systems or to watercourses.

This best management practice (BMP) applies to all construction projects.

Hazardous waste management practices are implemented on construction projects that generate waste from the use of:

- Petroleum Products,
- Asphalt Products,
- Concrete Curing Compounds,
- Pesticides,
- Acids,
- Paints,
- Stains,
- Solvents,
- Wood Preservatives,
- Roofing Tar, or
- Any materials deemed a hazardous waste in 40 CFR Parts 110, 117, 261, or 302.

DESIGN CRITERIA

Storage Procedures

1. Wastes shall be stored in sealed containers constructed of a suitable material and shall be labeled as required by 49 CFR Parts 172,173, 178, and 179.
2. All hazardous waste shall be stored, transported, and disposed as required in 49 CFR 261-263.
3. Waste containers shall be stored in temporary containment facilities that shall comply with the following requirements:
    - Temporary containment facility shall provide for a spill containment volume able to contain precipitation from a 24-hour, 25 year storm event, plus the greater of 10% of the aggregate volume of all containers or 100% of the capacity of the largest tank within its boundary, whichever is greater.
    - Temporary containment facility shall be impervious to the materials stored there for a minimum contact time of 72 hours.
    - Temporary containment facilities shall be maintained free of accumulated rainwater and spills. In the event of spills or leaks accumulated rainwater and spills shall be placed into drums after each rainfall. These liquids shall be handled as a hazardous waste unless testing determines them to be non-hazardous. Non-hazardous liquids shall be sent to an approved disposal site.
    - Sufficient separation shall be provided between stored containers to allow for spill cleanup and emergency response access.
    - Incompatible materials, such as chlorine and ammonia, shall not be stored in the same temporary containment facility.
    - Throughout the rainy season, temporary containment facilities shall be covered during non-working days, and prior to rain events. Covered facilities may include use of plastic tarps for small facilities or constructed roofs with overhangs. A storage facility having a solid cover and sides is preferred to a temporary tarp. Storage facilities shall be equipped with adequate ventilation.
4. Drums shall not be overfilled and wastes shall not be mixed.

5. Unless watertight, containers of dry waste shall be stored on pallets.
6. Paint brushes and equipment for water and oil based paints shall be cleaned within a contained area and shall not be allowed to contaminate site soils, watercourses or drainage systems. Waste paints, thinners, solvents, residues, and sludge that cannot be recycled or reused shall be disposed of as hazardous waste. When thoroughly dry, latex paint and paint cans, used brushes, rags, absorbent materials, and drop cloths shall be disposed of as solid waste.
7. Ensure that adequate hazardous waste storage volume is available.
8. Ensure that hazardous waste collection containers are conveniently located.
10. Designate hazardous waste storage areas on site away from storm drains or watercourses and away from moving vehicles and equipment to prevent accidental spills.
11. Minimize production or generation of hazardous materials and hazardous waste on the job site.
12. Use containment berms in fueling and maintenance areas and where the potential for spills is high.
13. Segregate potentially hazardous waste from non-hazardous construction site debris.
14. Keep liquid or semi-liquid hazardous waste in appropriate containers (closed drums or similar) and under cover.
15. Clearly label all hazardous waste containers with the waste being stored and the date of accumulation.
16. Place hazardous waste containers in secondary containment.
17. Do not allow potentially hazardous waste materials to accumulate on the ground.
18. Do not mix wastes.

Disposal Procedures

1. Waste shall be removed from the site within 90 days of being generated.
2. Waste shall be disposed of by a licensed hazardous waste transporter at an authorized and licensed disposal facility or recycling facility utilizing properly completed Uniform Hazardous Waste Manifest forms.
3. A certified laboratory shall sample waste and classify it to determine the appropriate disposal facility.
4. Make sure that toxic liquid wastes (e.g., used oils, solvents, and paints) and chemicals (e.g., acids, pesticides, additives, curing compounds) are not disposed of in dumpsters designated for solid waste construction debris.
5. Properly dispose of rainwater in secondary containment that may have mixed with hazardous waste.
6. Recycle any useful material such as used oil or water-based paint when practical.

Maintenance and Inspection

1. A foreman and/or construction supervisor shall monitor on-site hazardous waste storage and disposal procedures.
2. Waste storage areas shall be kept clean, well-organized, and equipped with ample clean-up supplies for the materials being stored. Storage areas shall be inspected in conformance with the provisions in the contract documents.
3. Perimeter controls, containment structures, covers, and liners shall be repaired or replaced as needed to maintain proper function.
4. Hazardous spills shall be cleaned up and reported in conformance with the applicable Material Safety Data Sheet (MSDS) and the instructions posted at the project site.
5. The National Response Center, at (800) 424-8802, shall be notified of spills of Federal reportable quantities in conformance with the requirements in 40 CFR parts 110, 117, and 302.
6. Copy of the hazardous waste manifests shall be provided to the owner.

REFERENCE

California Department of Transportation, Construction Site BMP Manual, 2000 or later

APPENDIX D
POST-CONSTRUCTION BEST MANAGEMENT PRACTICES (BMPs)

Separate Document

STORMWATER MANAGEMENT MAINTENANCE AGREEMENT

Town of Ellettsville, IN Stormwater Management and Construction Site Regulations

TOWN OF ELLETTSVILLE, INDIANA CODE OF ORDINANCES (amlegal.com)

Instructions:

This document is to be submitted with the Construction/Stormwater Pollution Prevention Plan Technical Review form to the Town. This document certifies that the property owner understands that the stormwater quality and/or quantity post-construction measure(s) installed on the property shall be operated and maintained per the submitted and approved Post-Construction Operations & Maintenance (O&M) Manual for the property.

The approved O&M Manual shall be signed by the owner and notarized. A copy of the approved O&M Manual shall be provided to the Town. The owner shall have this form and the signed and notarized O&M Manual recorded with the property by the County Recorder's office. A copy of the O&M Manual shall be provided to each new owner before the transfer of ownership. The O&M Manual shall be signed by the new owner, notarized, and submitted to the Town to be kept on record.

Project Information:

Proposed Project Name:

Proposed Project Address (street, city, state & zip):

Describe the Best Management Practice(s):

Owner Acknowledgement:

For good and valuable consideration, the receipt and sufficiency of which are hereby acknowledged, the undersigned owner ("Owner") hereby submits this Operation and Maintenance Manual ("Manual") to Town of Ellettsville, Indiana ("Town") as a written acknowledgement of Owner's warranty and agreement to institute, maintain, and follow the stormwater Best Management Practices ("BMPs") listed above, and to follow and abide by the inspection schedule and maintenance activities listed in the O&M Manual. The Owner also hereby agrees to provide, at Owner's cost, all additional maintenance, repair, and/or replacement services reasonably necessary to maintain the function and longevity of the BMPs from and including the date this Agreement is executed by Owner to and including the date on which a new Agreement is filed with the Town by another party who assumes all of the obligations and responsibilities of Owner as set forth herein.

The Owner agrees to allow the Town and/or its representatives the right to enter the property to inspect the best management practice. The Owner shall be financially responsible for any maintenance or repairs required by the Town or its representatives during the inspections.

Owner Name:

Company (if applicable):

Owner Address (street, city, state & zip):

Phone: Email:

Signature: Date:

State of Indiana)
) SS:
County of:)

Before me, the undersigned a Notary Public in and for said County and State personally appeared _____

Owner subscribed and sworn before this _____ day of _____, 20_____

County of Residence: _____ Commission Expiration Date: _____

Printed Name: _____ Signature: _____

_____ _____

CONSTRUCTION/STORMWATER POLLUTION PREVENTION PLAN TECHNICAL REVIEW

Town of Ellettsville, IN Stormwater Management and Construction Site Regulations
Ellettsville, IN Laws (amlegal.com)
IDEM Construction Stormwater General Permit (CSGP): (INRA00000 effective 12/18/2021)
https://www.in.gov/idem/stormwater/construction-land-disturbance-permitting/

Instructions:

Complete the first page (except for Plan Reviewer) and provide an editable copy of this form and all referenced documents and fees. Submit an electronic copy of all the documents to the Town at 1150 W Guy McCown Dr., Ellettsville, IN 47429. Additional instructions are at the end of this form. NOTE: Each section element shall be provided on the plan sheets, except for the O&M Manual, in the same order as this form.

Project Contacts:

Project Name: Click or tap here to enter text

Project Address or Location Description: Click or tap here to enter text.

Scope of Project: Click or tap here to enter text.

Latitude: Click/tap to enter text. **Longitude:** Click/tap to enter text.

Plan Submittal Date: Click/tap to enter date.

Plan Review Date: Click/tap to enter date.

Plan Preparer: Click/tap to enter text. **Affiliation:** Click/tap to enter text.
Address: Click/tap to enter text.
City: Click/tap to enter text. **State:** Click/tap to enter text. **Zip:** Click/tap to enter text.
Phone: Click/tap to enter text. **Cell Phone:** Click/tap to enter text. **Email:** Click/tap to enter text.

Project Site Owner: Click/tap to enter text. **Company Name (if applicable):** Click/tap to enter text.
Address: Click/tap to enter text.
City: Click/tap to enter text. **State:** Click/tap to enter text. **Zip:** Click/tap to enter text.
Phone: Click/tap to enter text. **Cell Phone:** Click/tap to enter text. **Email:** Click/tap to enter text.

Contractor: Click/tap to enter text. **Company Name (if applicable):** Click/tap to enter text.
Address: Click/tap to enter text.
City: Click/tap to enter text. **State:** Click/tap to enter text. **Zip:** Click/tap to enter text.
Phone: Click/tap to enter text. **Cell Phone:** Click/tap to enter text. **Email:** Click/tap to enter text.

Site SWPPP Contact: Click/tap to enter text. **Company Name (if applicable):** Click/tap to enter text.
Address: Click/tap to enter text.
City: Click/tap to enter text. **State:** Click/tap to enter text. **Zip:** Click/tap to enter text.
Phone: Click/tap to enter text. **Cell Phone:** Click/tap to enter text. **Email:** Click/tap to enter text.

Plan Reviewer: Click/tap to enter text. **Affiliation:** Click/tap to enter text. **On behalf of:** Town of Ellettsville MS4
Address: Click/tap to enter text.
City: Click/tap to enter text. **State:** Click/tap to enter text. **Zip:** Click/tap to enter text.
Phone: Click/tap to enter text. **Cell Phone:** Click/tap to enter text. **Email:** Click/tap to enter text.

Documents Required for Grading Permit Approval:

- ☐ Technical Review Form (this form)
- ☐ Design plans with erosion and sediment control measures
- ☐ Draft IDEM Notice of Intent (NOI)
- ☐ Construction and Post-Construction SWPPPs
- ☐ Drainage Report (drainage, detention & water quality calculations)
- ☐ Post-Construction Operation & Maintenance Manual
- ☐ Stormwater Management Measure Maintenance Agreement
- ☐ Permit review and inspection fees

Property Owner Certification:

By signing this form, the Property Owner certifies that any land clearing, construction, or development involving the movement of earth shall be in accordance with Town of Ellettsville ordinance and standards, approved plans submitted, and the Construction Stormwater General Permit. The Property Owner acknowledges: 1) That all fees associated with this application will be paid in full; 2) That the Post-Construction Stormwater quality and/or quantity measure(s) will be operated and maintained per the Post-Construction Operation and Maintenance Manual; and 3) That submission of an application does not in any way obligate the Town to approve the application.

Property Owner Signature:		Property Owner Printed Name:	Click/tap to enter text.	Date:	Date.

Plan Review Status:		
☐	**Plan is Adequate**	A comprehensive plan review was completed and it has been determined that the plan satisfies the minimum requirements of Ellettsville's Stormwater Management and Construction Site Regulations and the CSGP.
☐	**Preliminary Review**	A comprehensive review will not be completed at this time. The plan review authority reserves the right to perform a comprehensive review later, and revisions may be required at that time.
☐	**Conditional Acceptance**	Acceptance of the plan is conditional. The conditional acceptance is contingent upon addressing the issues identified in the comment sections.
☐	**Plan is Deficient**	Significant deficiencies were identified and must be addressed. Refer to the comment sections.
Action:		
☐	**Submit a Notice of Intent:** Submit the Notice of Intent (NOI) online through the IDEM Regulatory ePortal. It is required to upload a copy of this review form when submitting the NOI through the IDEM Regulatory ePortal: (https://stormwater.idem.in.gov/ncore/external/home)	
☐	**Do not file a Notice of Intent or commence land-disturbing activities:** Deficiencies must be adequately addressed and an acceptable plan review completed. Refer to each Section's Comments in this document. Update and submit the revised application as indicated.	

Plan Review Information

- *The technical review and comments are intended to evaluate the completeness of the Construction/Stormwater Pollution Prevention Plan for the project. The Plan submitted was not reviewed for the adequacy of engineering design. All measures included in the plan, as well as those recommended in the comments should be evaluated as to their feasibility by a qualified individual with structural measures designed by a qualified engineer. The Plan has not been reviewed for other local, state, or federal permits that may be required to proceed with this project.*
- *Additional information, including design calculations may be requested to further evaluate the plan.*
- *All proposed stormwater pollution prevention measures and those referenced in this review must meet the design criteria and standards set forth in the Indiana Stormwater Quality Manual,* Town of Ellettsville Stormwater Standards and Specifications Manual *(as applicable), or similar Guidance Documents.*
- *Construction activities and unforeseen weather conditions may affect the performance of the erosion and sediment control system, individual measures, or the effectiveness of the plan. The plan must be a flexible document, with provisions to modify or substitute measures as necessary to ensure compliance.*

Section A: Construction Plan Elements

Adequate	Deficient	NA	A	*The construction plan elements include general information associated with the project site that are critical for the evaluation of the stormwater pollution prevention plan component. This information includes, but is not limited to an index, resource information, reference maps, grading information, project layout and design, and drainage plan*
☐	☐	☐	**1**	Index of the location of required plan elements in the construction plan
☐	☐	☐	**2**	A vicinity map depicting the project site location in relationship to recognizable local landmarks, towns, and major roads
☐	☐	☐	**3**	Narrative of the nature and purpose of the project
☐	☐	☐	**4**	Latitude and longitude to the nearest fifteen (15) seconds
☐	☐	☐	**5**	Legal description of the project site
☐	☐	☐	**6**	11 X 17-inch plat showing building lot numbers/boundaries and road layout/names
☐	☐	☐	**7**	Boundaries of the one hundred (100) year floodplains, floodway fringes, and floodways
☐	☐	☐	**8**	Land use of all adjacent properties
☐	☐	☐	**9**	Identification of a U.S. EPA approved or established TMDL
☐	☐	☐	**10**	Name(s) of the receiving water(s)
☐	☐	☐	**11**	Identification of discharges to a water on the current 303d list of impaired waters and the pollutant(s) for which it is impaired
☐	☐	☐	**12**	Soil map of the predominant soil types including a description of soil properties, characteristics, limitations, and hazards associated with each soil type within the project site
☐	☐	☐	**13**	Identification and location of all known wetlands, lakes, and water courses on or adjacent to the project site (construction plan, existing site layout)

Section A: Construction Plan Elements (continued)				
Adequate	Deficient	NA	A	*The construction plan elements include general information associated with the project site that are critical for the evaluation of the stormwater pollution prevention plan component. This information includes, but is not limited to an index, resource information, reference maps, grading information, project layout and design, and drainage plan*
☐	☐	☐	**14**	Identification of any other state or federal water quality permits or authorizations that are required for construction activities (e.g., wetlands, floodways, or waterway crossings)
☐	☐	☐	**15**	Identification and delineation of existing cover, including natural buffers (refer to IDEM guidance for buffer requirements)
☐	☐	☐	**16**	Existing topography at a contour interval appropriate to indicate drainage patterns
☐	☐	☐	**17**	Location(s) of where run-off enters the project site
☐	☐	☐	**18**	Location(s) of where run-off discharges from the project site prior to land disturbance. Control measures required at the discharge point.
☐	☐	☐	**19**	Location of all existing structures on the project site
☐	☐	☐	**20**	Existing permanent retention or detention facilities, including manmade wetlands, designed for the purpose of stormwater management
☐	☐	☐	**21**	Locations where stormwater may be directly discharged into ground water, such as abandoned wells, sinkholes, or karst features. These areas must be protected from polluted runoff.
☐	☐	☐	**22**	Size of the project area expressed in acres
☐	☐	☐	**23**	Total expected land disturbance expressed in acres
☐	☐	☐	**24**	Proposed final topography
☐	☐	☐	**25**	Locations and approximate boundaries of all disturbed areas
☐	☐	☐	**26**	Location, size, and dimensions of all stormwater drainage systems, such as culverts, storm sewers, and conveyance channels
☐	☐	☐	**27**	Locations of specific points where stormwater and non-stormwater discharges will leave the project site. Control measures required at the discharge point.
☐	☐	☐	**28**	Location of all proposed site improvements, including roads, utilities, lot delineation and identification, proposed structures, and common areas
☐	☐	☐	**29**	Location of all on-site soil stockpiles and borrow areas. Topsoil must be preserved, unless infeasible.
☐	☐	☐	**30**	Construction support activities that are expected to be part of the project
☐	☐	☐	**31**	Location of any in-stream activities that are planned for the project including, but not limited to stream crossings and pump arounds

Priority Status: Identify if this is a priority site based on the nature and extent of the construction activity, topography, threat to the degradation of water quality, characteristics of soils, complaints, and other factors as determined by MS4 priorities.

☐ **Not a Priority Site** ☐ **Priority Site based on:** ☐ Nature and Extent of Construction ☐ Close Proximity to Sensitive Area(s) ☐ Close Proximity to Wetlands ☐ Characteristics of the Soil ☐ Threat to Water Quality Degradation ☐ Steep Topography on Proposed Construction Site ☐ Potential for Direct Runoff to Receiving Waters

Section A – Comments:

Click/tap to enter text.

Section B: Stormwater Pollution Prevention Plan – Erosion and Sediment Control/Project Site Management				
Adequate	**Deficient**	**NA**	**B**	*The construction component of the Stormwater Pollution Prevention Plan includes stormwater quality measures to address erosion, sedimentation, and other pollutants associated with land disturbance and construction activities. Proper implementation of the plan, maintenance of measures, and administering a self-monitoring program is required to manage the project site to minimize the discharge of sediment and other pollutants. Construction activities and unforeseen weather conditions may affect the performance of the erosion and sediment control system, individual measures, or the effectiveness of the plan. The plan must be a flexible document, with provisions to modify or substitute measures as necessary to ensure compliance.*
☐	☐	☐	**1**	Description of the potential pollutant generating sources and pollutants, including all potential non-stormwater discharges
☐	☐	☐	**2**	Stable construction entrance locations and specifications. Plan to clear tracking of sediments on road. Dust suppression plan.
☐	☐	☐	**3**	Specifications for temporary and permanent stabilization. Include seeding and mulching plan and 70% coverage requirement for final stabilization. Include 7-day stabilization requirement.
☐	☐	☐	**4**	Sediment control measures for concentrated flow areas (sediment basins if used have specific requirements including withdrawing water from the top of the water surface).
☐	☐	☐	**5**	Sediment control measures for sheet flow areas
☐	☐	☐	**6**	Run-off control measures
☐	☐	☐	**7**	Stormwater outlet protection locations and specifications
☐	☐	☐	**8**	Grade stabilization structure locations and specifications
☐	☐	☐	**9**	Dewatering applications and management methods
☐	☐	☐	**10**	Measures utilized for work within waterbodies
☐	☐	☐	**11**	Maintenance guidelines for each proposed temporary stormwater quality measure
☐	☐	☐	**12**	Planned construction sequence describing the relationship between implementation of stormwater quality measures in relation to land disturbance
☐	☐	☐	**13**	Provisions for erosion and sediment control on individual building lots regulated under the proposed project
☐	☐	☐	**14**	Material handling and spill prevention and spill response plan meeting the requirements in 327 IAC 2-6.1
☐	☐	☐	**15**	Material handling and storage procedures associated with construction activity. Include management of waste materials and dumpsters for runoff and wind, concrete washout management, fueling areas, equipment washing, application of pesticides, herbicides, insecticides and fertilizers, disposal of hazardous waste and washing of paint or grout applicators.
☐	☐	☐	**16**	Monitoring and project management plan to include self-monitoring program (SMP), self-inspections and project management log
Section B – Comments: Click/tap to enter text.				

Section C: Stormwater Pollution Prevention Plan – Post-Construction				
Adequate	**Deficient**	**NA**	**C**	*The post-construction component of the Stormwater Pollution Prevention Plan includes the implementation of stormwater quality measures to address pollutants that will be associated with the final project land use. Post-construction stormwater measures should be functional upon completion of the project. Long term functionality of the measures is critical to their performance and should be monitored and maintained.*
☐	☐	☐	**1**	Description of pollutants and their sources associated with the proposed land use
☐	☐	☐	**2**	Description of proposed post-construction stormwater measures including location, dimensions, specifications, and stormwater detention and water quality treatment according to the local ordinance.
☐	☐	☐	**3**	Plan details and design calculations for each post-construction stormwater measure including stormwater detention BMPs. If a pre-approved BMP is selected from the Ellettsville Stormwater Standards and Specifications Manual, provide a discussion of how the BMP has been designed.
☐	☐	☐	**4**	Sequence describing stormwater measure implementation.
☐	☐	☐	**5**	Maintenance guidelines for proposed post-construction stormwater measures. Provide an Operation and Maintenance (O&M) Manual that meets the requirements of the Town of Ellettsville Stormwater Standards and Specifications Manual.
☐	☐	☐	**6**	Entity that will be responsible for operation and maintenance of the post-construction stormwater measures
☐	☐	☐	**7**	A formal Stormwater Management Maintenance Agreement submitted to the Town that is be signed and notarized. The agreement shall be recorded at the County Recorder's Office so that it can be a part of the property's deed.
Section C – Comments: Click/tap to enter text.				

Notice of Intent Submittal:

Provide the NOI and Notice of Sufficiency from IDEM to the Ellettsville MS4, 48 hours before the start of construction.

Town of Ellettsville Construction Inspections:

The Town, or designated representative, has the legal authority per Town ordinance to inspect all construction sites regulated under the Stormwater Management and Construction Site Regulations Ordinance. The permittee shall notify the Ellettsville MS4 48 hours before the start of construction. To obtain inspections, contact the MS4 at least 48 hours (2 business days) before the following to schedule an inspection:

(1) Installation of infrastructure (2) Installation of post-construction BMP (3) Final stabilization

If after a recommendation is provided to the project site owner, corrective action is not taken, the Town will pursue enforcement according to the Stormwater Management and Construction Site Regulations Ordinance.

Town Plan Review Process:

The Town shall review the submittal to determine its conformance with the provisions of the ordinance, Ellettsville Stormwater Standards and Specifications Manual, the CSGP, and the *Indiana Stormwater Quality Manual*.

(1) A preliminary determination will be made as to whether the application is substantially complete or insufficient within 10 days (for projects at least 1 acre but less than 5 acres), and within 14 days (for projects greater than or equal to 5 acres). Notification will be provided to the applicant within the applicable time of one of the following:
   a. If the Town provides a favorable preliminary determination, the applicant may submit the completed NOI (signed with proof of public notice) to IDEM and the Town. The applicant may commence construction 48 hours after the submission of the completed NOI.
   b. If the application is deemed insufficient, the Town will request additional information. The applicant may not submit the NOI or commence land-disturbing activities. Applicants are responsible for addressing and re-submitting any incomplete items. The initiation of construction activity following notification by the Town that the plan is deficient is a violation and subject to enforcement action. Once information is provided and after receiving approval, the applicant may submit the completed NOI to IDEM and the Town. The applicant may commence construction 48 hours after the submission of the completed NOI.
   c. If the Town provides a favorable preliminary determination and then determines the application is insufficient, the applicant must cease land-disturbing activities and provide the required information to the Town. Applicants are responsible for addressing and re-submitting any incomplete items. Notification of approval will be provided to the applicant and land-disturbing activities may recommence. The continuation of construction activity following notification by the Town that the plan is deficient is a violation and subject to enforcement action.
   d. If the Town does not provide notification of the preliminary determination within the applicable time, the applicant may submit the completed NOI to IDEM and the Town. The applicant may commence construction 48 hours after submitting the completed NOI.
(2) Any changes or deviations in the plans and specifications after approval shall be filed with, and accepted by, the town before the change. Copies of the changes, if accepted, shall be attached to the original plans and specifications.
(3) The Town will issue a letter with the preliminary determination and the Construction/Stormwater Pollution Prevention Plan Technical Review form to the applicant that is submitted with NOI form to IDEM. The department may request a pre-construction meeting prior to construction commencing.