IOWA STORMWATER MANAGEMENT MANUAL

1.05 STORMWATER MANAGEMENT PLAN

IOWA DEPARTMENT OF NATURAL RESOURCES

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1.05-1 PURPOSE

A. INTRODUCTION

A Stormwater Management Plan (SWMP) should be prepared for any project that includes the design of stormwater management practices or conveyance facilities. Local jurisdictions may require SWMPs to be submitted with large-scale master plans, preliminary plats and site plan submittals. They may also be prepared to accompany construction documents for the design of stormwater management or conveyance facilities.

The SWMP will be prepared by a licensed professional engineer to describe the general nature of the project and the methods used to design storm sewers, culverts and best management practices (BMPs). The SWMP will be used by reviewers working on behalf of local jurisdictions to determine if the proposed improvements are in general compliance with local requirements.

The purpose of this section is to outline the information that needs to be included in the SWMP and how that information can be organized. This will aid reviewers by presenting information in an organized and standardized fashion, making it easier to determine that plans are complete, with all information required for review and a common location where various pieces of design information can be found.

The format of the SWMP outlined by this section is primarily intended to aid in review of plans by local jurisdictions and other agencies which may need to review plans to determine if practices meet the requirements of grant funding programs. Preparation of this report does not waive or satisfy any other federal, state or local permit requirements, which may require additional information or studies to be prepared (e.g., dam construction, floodplain, NDPES, COSESCO, 404 permitting, etc.).

1.05-2 INSTRUCTIONS

1. The Stormwater Management Plan (SWMP) shall be prepared by the Engineer of Record for the project.
   a. They will be responsible for preforming all analyses according to accepted methods such as those described within ISWMM, the Statewide Urban Design Standards and Specifications (SUDAS) and other standards as acceptable to the local jurisdiction or review authority, based on project type.
   b. It is the responsibility of the Engineer to verify that all data used to prepare the SWMP is correct and appropriate based on site conditions and in alignment with local requirements and design guidance in ISWMM, SUDAS and other applicable standards.
   c. The Engineer will attach a cover sheet to the SWMP, which will include at a minimum:
      i. The project name, address and city/county (local jurisdiction)
      ii. Any project ID number assigned by the local jurisdiction
      iii. The firm or agency preparing the report
      iv. The owner or client that has authorized preparation of the report
      v. An Engineer's signed, dated and sealed certification, complying with Iowa Administrative Code 193C-6.1(542B); draft or preliminary versions of reports may not be signed if they are clearly marked "PRELIMINARY" on the page which includes the Engineer's seal
   d. The SWMP will include a table of contents, including the items referenced in Section 1.05-3 and noting all Appendices which include more detailed design calculations and reference information.
   e. The SWMP should be complete and address all topics referenced in the outline. If a certain heading within the outline does not apply to a project, the SWMP should note that it is not applicable and offer a brief explanation if appropriate.
   f. More technical information detailing design calculations and supporting information will be organized into Appendices and attached as part of the SWMP.
2. The jurisdiction or review agency will develop a process to receive and review the SWMP.
   a. The review will determine if the SWMP is consistent with locally adopted design standards and requirements. This does not constitute full acceptance of the improvement plans, alignments, grades or other project design elements.
   b. The Engineer of Record maintains sole responsibility for project design and all calculations presented within the SWMP.
3. When reporting routing calculation results, values may be rounded to an appropriate number of significant digits. This is left to the discretion of the designer, but it is suggested that smaller values such as flow rate (when reported in cfs) be rounded to the nearest 0.01 when values are under 1, to the nearest 0.1 when values are under 10 and to the nearest whole number in all other cases. Flow volumes (when reported in cubic feet) may be rounded to the nearest 100 when values are below 10,000, to the nearest 1,000 when values are below 100,000 and to the nearest 10,000 in all other cases.

1.05-3 CONTENT

The Stormwater Management Plan (SWMP) should include the following information and be organized in this manner, unless amended by the local jurisdiction:

I. PROJECT DESCRIPTION

Provide a basic description of the project and its purpose.

Include a summary of local jurisdictional stormwater management requirements.

Indicate if the proposed project considers future development plans within the watershed being studied (e.g., are the practices being designed at this time intended to manage runoff from future phases, or are additional practice planned to be implemented later?). Detail to what extent existing upstream or downstream stormwater practices were considered as part of the project.

Describe how runoff from upstream off-site areas is being considered (e.g., are these flows being detained or are adjustments being made to pass these flows through the practice?).

Complete Table 1.05-3.1 with information based on local site and watershed conditions. If the project will drain to multiple outfall locations, provide a separate column for each.

TABLE 1.05-3.1: EXISTING SITE CONDITIONS

PARAMETER	UNIT	WATERSHED #1	WATERSHED #2
On-Site Area	acres		
Upstream Off-Site Area	acres		
Direct Discharge Area	acres		

II. SUMMARY OF PROJECT IMPACTS

Provide a quick summary of the expected hydrologic changes and management practices to be used to mitigate negative impacts. Be aware that information to be provided in greater detail later in this report will be needed to complete this table.

Complete Table 1.05-3.2 with information based on project stormwater calculations. Values in the "Required" column should be based on local jurisdictional application of ISWMM and account for release rate adjustments for upstream off-site and/or direct discharge runoff.

NOTE

Throughout this report, if more than one table of a given type is needed, add a letter suffix to the table number (e.g., 1a, 1b, etc.)

For developments draining to more than one location or BMP, provide separate tables for the watershed area draining to each location.

For more information on release rate adjustments, look ahead to Part III.G, Part IV.B and Part V.C of this plan.

TABLE 1.05-3.2: STORMWATER MANAGEMENT SUMMARY

BMP NAME OR IDENTIFICATION			
		REQUIRED [1]	PROVIDED
Rev	Recharge Volume [1]		
WQv	Water Quality Volume [1]		
CPv 1-year	Maximum Peak Release Rate (at outlet)		
	Max. Storage—site watershed total (in watershed-inches)		
	High-Water Elevation within Stormwater BMP		
10-year	Maximum Peak Release Rate (at outlet)		
	Max. Storage—site watershed total (in watershed-inches)		
	High-Water Elevation within Stormwater BMP		
100-year	Maximum Peak Release Rate (at outlet)		
	Max. Storage—site watershed total (in watershed-inches)		
	High-Water Elevation within Stormwater BMP		
	Auxiliary Spillway Elevation		
	Crest of Dam Elevation		

1. For watershed area to be treated by the BMP. Refer to Part V.C of the SWMP for calculations for allowable release rates.

III. PRE-PROJECT CONDITIONS

A. SOIL CONDITIONS

1. Soil Types and Hydrologic Soil Groups

Provide a brief description of site soil conditions including drainage characteristics. Use the best available information for the project site based on geotechnical reports or county soil maps. Relevant soil maps should be included in Appendix F.

Complete Table 1.05-3.3 based on site conditions.

TABLE 1.05-3.3: SITE SOIL PROPERTIES

SOIL CLASSIFICATION	AREA (ACRES)	HYDROLOGIC SOIL GROUP (HSG)
Site Total		

2. Depth to Water Table

Include details about seasonal groundwater levels (can influence grading, buildings, infiltrative practices).

3. Presence of Hydric Soils

List any areas or soil types with hydric soil properties.

4. Soil Conditions for Infiltration-Based Practices

Describe supporting information or tests used to project subsoil infiltration rates (if applicable). Provide estimated infiltration and percolation rates or hydraulic conductivities of surface and subsurface soils. Are there potential sites that have sandy soils with high percolation rates? Refer to ISWMM Section 7.02 as applicable.

5. Bedrock or Karst Topography

Note conditions such as the depth to bedrock or the presence of Karst topography, based on information from soil surveys or geotechnical reports.

B. SITE VEGETATION

Provide a general description of existing surface conditions. Briefly describe existing surface vegetation (farmstead, row crops, woodlands, native prairie, savanna, etc.).

For woodland areas or native prairie, provide a general description of the woodland area (e.g., volunteer growth, small-diameter trees, larger mature trees, invasive species, restored prairie, historic prairie remnant, etc.). Include a brief overview of any information about the presence of wetlands within the project area (e.g., National Wetland Inventory maps, delineation report, etc.).

C. TOPOGRAPHY AND GENERAL DRAINAGE PATTERNS

Include a brief description of site topography (slopes, ridgelines, drainage patterns). Note if any areas have critical or unstable slopes. Topographic maps may be included in Appendix E. Some jurisdictions may have sensitive-area ordinances or other restrictions related to surface slopes, which may need to be included in the response to this topic.

D. EXISTING STREAMS AND FLOODPLAINS

1. Streams or Drainageways Passing through Site

Identify any perennial or intermittent streams and/or concentrated flow paths that pass through the site work area.

2. Receiving Waters

Identify the first uniquely named stream or waterbody located downstream of the project area. Note the approximate distance to that waterbody.

3. FEMA FIRM Panel Information

Complete the information below for the site area:

Map Number: _____

Revision Date: MONTH DAY, YEAR

The site is located within Zone ____ – _____(Description)

Source: FEMA Flood Map Service Center – *www.msc.fema.gov/portal/home*

Attach maps in Appendix H.

4. Floodplain Protection or Stream Buffer Requirements

Note any expected protection requirements.

5. Floodplain or Stream Buffer Impacts

Note any expected grading, obstructions or alterations within these areas and any mitigation or permit requirements. Note if proposed construction activities require any state or local floodplain construction permits. The designer may wish to review historical aerial photos or other maps to review historic stream locations if the project is along a perennial stream or river. Such maps may also be included in Appendix H.

NOTE

IDNR mapping resources can be found at: *www.iowadnr.gov/Conservation/Mapping–GIS*

E. HISTORIC (NATURAL) SITE CONDITIONS

Describe historic (natural) site conditions. Note the Curve Number(s) or other rainfall loss parameters used to represent natural site conditions (refer to ISWMM Section 3.01 or as adopted by local jurisdictional ordinances or policies).

F. EXISTING SITE CONDITIONS

Describe existing site conditions, land uses and impervious surface coverage. These should specifically relate to factors which would be used to select site rainfall loss parameters. Refer to ISWMM Sections 2.05, 3.01 and 7.03 for additional information.

Detailed calculations may be included in Appendices A and E.

Adapt Table 1.05-3.4 with information as appropriate to reference the various land uses at a given site. Divide the site into separate watersheds when the site discharges to multiple outflow points or where multiple stormwater detention BMPs are proposed.

TABLE 1.05-3.4: EXISTING SITE CONDITIONS

PARAMETER	UNIT	WATERSHED #1	WATERSHED #2
Total Site Area	acres		
Row Crop Agriculture	acres		
Woodland	acres		
Natural	acres		
Lawns or Open Spaces	acres		
Impervious Surfaces	acres		
Impervious %	%		
Weighted Curve Number (1)			
Time of Concentration (1)	minutes		

1. May be changed to other relevant runoff loss parameter used in stormwater management modeling.

G. CONTRIBUTING OFF-SITE DRAINAGE

Detail the property of watershed areas where flows enter the project site and any stormwater management practices in those areas.

Adapt Table 1.05-3.5 with information as appropriate to reference the various land uses for upstream areas. List information about watersheds to different practices separately when multiple stormwater detention BMPs are proposed.

TABLE 1.05-3.5: UPSTREAM OFF-SITE CONDITIONS [1]

PARAMETER	UNIT	WATERSHED #1	WATERSHED #2
Total Site Area	acres		
Row Crop Agriculture	acres		
Woodland	acres		
Natural	acres		
Lawns or Open Spaces	acres		
Impervious Surfaces	acres		
Impervious %	%		
Weighted Curve Number [2]			
Time of Concentration	minutes		

1. Separate tables may be required if both existing and future conditions are reviewed.
2. May be changed to other relevant runoff loss parameter used in stormwater management modeling.

The characteristics of runoff from upstream off-site areas may influence the allowable outflow rates from stormwater practices. In some cases, upstream watershed characteristics may be expected to change over time. This may require looking at both existing and future conditions to understand how a new stormwater practice is expected to operate right after construction and in the foreseeable future. ISWMM Section 3.01-5 describes how inflow from off-site areas may be considered when determining site stormwater management requirements for various scenarios.

Referring to that section, the following information may be used to determine allowable release rates when stormwater practices will receive flows from upstream, off-site areas (ISWMM Section 3.01-5.C has definitions of the various scenarios):

Scenario A:	CPv:		Natural Upstream Off–Site Volume + Developed On–Site Volume [1] Developed Peak Rate for entire watershed [1]
	Qp and Qf:		Natural Rate for entire watershed (no off–site information needed) [2]
Scenario B:	CPv:		Existing Upstream Off–Site Rate and Volume + Developed On–Site Rate and Volume [1] Developed Peak Rate for entire watershed [1]
	Qp and Qf:		Existing Upstream Off–Site Rate + Natural Rate for on–site areas [2]
Scenario C:	CPv:	Current:	Existing Upstream Off–Site Rate + Natural Rate for On–Site areas
		Future:	Natural Upstream Off–Site Volume + Developed On–Site Volume [1] Developed Peak Rate for entire watershed [1]
	Qp and Qf:	Current:	Existing Upstream Off–Site Rate + Natural Rate for On–Site areas [2]
		Future:	Natural Rate for entire watershed (no off–site information needed) [2]

1. Used in the calculation for the allowable release rate for extended detention of the CPv (see ISWMM Section 3.01).
2. Some jurisdictions may have other requirements for management of larger storm events (e.g., also not exceeding the 5-year existing rate). Refer to the local ordinance or policies for requirements.

Enter relevant data from the stormwater modeling output for upstream off-site areas into Table 1.05-3.6. Complete a table of this type for areas which drain to each stormwater detention BMP or at every point of discharge from the project.

TABLE 1.05-3.6: UPSTREAM OFF-SITE HYDROLOGIC SUMMARY

			NATURAL		EXISTING		DEVELOPED *	
		RAINFALL	PEAK RATE	VOLUME	PEAK RATE	VOLUME	PEAK RATE	VOLUME
	STORM EVENT	INCHES	CFS	CF	CFS	CF	CFS	CF
	WQv	1.25						
CPv	1-year							
Qp	2-year							
	5-year							
	10-year							
Qf	25-year							
	50-year							
	100-year							

Relevant information from Table 6 should be used to calculate the allowable release rate from stormwater practices. A summary of how allowable release rates are calculated should be included in Part V.C of the SWMP. Details of these calculations can be incorporated into Appendix C.

H. OTHER HISTORIC OR EXISTING SITE ISSUES OF NOTE

Note any other environmentally sensitive resources, water quality issues or downstream conveyance limitations which were considered in project design.

IV. PROPOSED SITE CONDITIONS

A. OVERALL SITE PROPERTIES

Describe proposed site conditions. Describe soil management and/or restoration conditions planned (which would relate to selection of CNs for open spaces—refer to ISWMM Section 7.03). Detailed calculations may be included in Appendices A and E.

Adapt Table 1.05-3.7 with information as appropriate to reference the various land uses at a given site. Divide the site into separate watersheds when the site discharges to multiple outflow points, or where multiple stormwater detention BMPs are proposed.

NOTE

If no downstream conveyance limitations are identified, an assessment of downstream hydrologic conditions may not be required (unless requested by the jurisdiction). This may be true if outflow rates from the project are limited so that (1) the post–project peak release rates meet USC guidelines for extended detention of the CPv event, and (2) peak release rates for the Qp and Qf events are below those expected from on–site areas using a CN=58 and natural condition Tc. If such an analysis is required, summarize results in Part VIII of the SWMP and include relevant calculations in Appendix C. Refer to ISWMM Sections 3.01 and 9.07 for more information.

TABLE 1.05-3.7: PROPOSED SITE CONDITIONS

PARAMETER	UNIT	WATERSHED #1	WATERSHED #2
Total Site Area	acres		
Woodland	acres		
Natural	acres		
Lawns or Open Spaces	acres		
Impervious Surfaces	acres		
Impervious %	%		
Curve Number[1]			
Time of Concentration	minutes		

1. May be changed to other relevant runoff loss parameter used in stormwater management modeling.

B. DIRECT DISCHARGE AREAS

If there are site areas that will drain from the site without passing through a stormwater management practice, describe those in this part of the SWMP. Allowable outflow rates from on-site stormwater practices may need to be adjusted to offset for such flows. A summary of how allowable release rates are calculated should be included in Part V.3 of the SWMP. Details of these calculations can be incorporated into Appendix C.

Adapt Table 1.05-3.8 with information as appropriate to reference the various land uses within watershed areas which leave the site area without passing through a stormwater water quality and/or detention practice. Divide these areas by watersheds when the site discharges to multiple outflow points.

TABLE 1.05-3.8: DIRECT DISCHARGE SUMMARY

PARAMETER	UNIT	AREA #1	AREA #2
Direct Discharge Area	acres		
Woodland	acres		
Natural	acres		
Lawns or Open Spaces	acres		
Impervious Surfaces	acres		
Impervious %	%		
Curve Number[1]			
Time of Concentration	minutes		

1. May be changed to other relevant runoff loss parameter used in stormwater management modeling.

NOTE

Refer to ISWMM Section 3.01–5.A for additional information.

V. STORMWATER MODELING INFORMATION

A. STORMWATER MODEL(S) USED

List the software programs used to simulate the stormwater model for the site area.

B. PARAMETERS

1. Time of Concentration

Note the method used to calculate times of concentration. Refer to ISWMM Section 2.03 for more information. Details of these calculations may be included in Appendices A and/or C.

2. Precipitation

Describe the rainfall depths and distribution used for stormwater management and conveyance calculations. Refer to ISWMM Section 2.02 for rainfall values.

Complete Table 1.05-3.9 with the rainfall values used for stormwater modeling for detention BMPs.

TABLE 1.05-3.9: DESIGN RAINFALL VALUES

STORM EVENT	RAINFALL
1-year	
2-year	
5-year	
10-year	
25-year	
50-year	
100-year	
500-year	

3. Rainfall Losses

List the runoff loss method and parameters used for stormwater models and calculations. Refer to ISWMM Sections 2.04 and 2.05, as applicable.

Provide related tables of values, as needed.

TABLE 1.05-3.10: HYDROLOGIC MODEL RAINFALL LOSSES

SURFACE COVER	RUNOFF LOSS COEFFICIENT
Natural Conditions	
Row Crop Agriculture	
Open Spaces	
Impervious Surfaces	

NOTE

As per ISWMM, models for stormwater detention routing should be completed with software using NRCS TR–55 computational methods, unless another type of model is approved by the local jurisdiction.

TABLE 1.05-3.11: RATIONAL METHOD RUNOFF COEFFICIENTS

SURFACE COVER	C VALUE
Open Spaces	
Row Crop Agriculture	
Impervious Surfaces	

C. RELEASE RATE CALCULATIONS

For the site or subwatershed area, summarize how the allowable release rate was calculated. Generally, this will be based on local jurisdictional requirements, with appropriate adjustments to account for upstream off-site flow and direct discharge from on-site areas. Reference Part III.G and Part IV.B of the SWMP, as applicable. Detailed calculations may be included in Appendix C.

Complete a table similar to the one below for each stormwater detention practice. Adapt table as needed to reflect project conditions.

TABLE 1.05-3.12: RELEASE RATE CALCULATION SUMMARY

STORM EVENT	ALLOWABLE RELEASE RATE FOR ON-SITE AREAS (CFS)	ADJUSTMENT FOR UPSTREAM OFF-SITE AREAS (CFS)	DEDUCTION FOR DIRECT DISCHARGE FROM ON-SITE AREAS (CFS)	ADJUSTED ALLOWABLE RELEASE RATE FROM PRACTICE (CFS)
1-year (CPv)				
2-year				
5-year				
10-year				
25-year				
50-year				
100-year				

VI. STORMWATER MANAGEMENT APPROACHES

A. RECHARGE VOLUME

Briefly describe structural and non-structural stormwater BMPs employed on-site to address local requirements related to Recharge Volume (Rev).

Adapt Table 1.05-3.13 based on the methods used. Refer to ISWMM Section 3.01 for additional guidance.

More details of these calculations may be included in Appendix B.

NOTE

Refer to ISWMM Section 3.01–5 for more` information about adjustments to release rates to account for direct discharge of upstream off–site flows. When describing adjustments for off–site flows, identify which scenario is most applicable, based on the definitions in Section 3.01–5.C.

TABLE 1.05-3.13: RECHARGE VOLUME SUMMARY

BMP TYPE OR IDENTIFICATION	RECHARGE VOLUME RETAINED BY BMP (CF)
Recharge Volume Retained by BMPs (CF)	
Site Recharge Volume Target (CF)	
% of Site Recharge Volume Retained	

B. WATER QUALITY VOLUME

Briefly describe structural and non-structural stormwater BMPs employed on-site to address local requirements related to Water Quality Volume (WQv). If the same practices are used for both Recharge Volume and Water Quality, simply refer to Part VI.A for descriptions as applicable.

Adapt Table 1.05-3.14 based on the methods used. Refer to ISWMM Section 3.01 for additional guidance.

More details of these calculations may be included in Appendix B.

TABLE 1.05-3.14: WATER QUALITY VOLUME SUMMARY

BMP TYPE OR IDENTIFICATION	WATER QUALITY VOLUME TREATED BY BMP (CF)
Water Quality Volume Treated by BMPs (CF)	
Site Water Quality Volume Requirement (CF)	
% of Site Water Quality Volume Treated	

C. STORMWATER DETENTION PRACTICES

Briefly describe stormwater BMPs used for stormwater detention, either to provide extended detention of the Channel Protection Volume (CPv), or to address Overbank and Extreme Flood Events (Qp and Qf, respectively). Refer to ISWMM Sections 9.01–9.13 for additional information. More details on these calculations may be included in Appendix C.

Enter relevant data from the stormwater modeling output into Table 1.05-3.15. Complete a table of this type for each stormwater detention BMP or at every point of discharge from the project.

TABLE 1.05-3.15: HYDROLOGIC SUMMARY

			NATURAL		EXISTING		DEVELOPED [1]	
		RAINFALL	PEAK RATE	VOLUME	PEAK RATE	VOLUME	PEAK RATE	VOLUME
	STORM EVENT	INCHES	CFS	CF	CFS	CF	CFS	CF
	WQv	1.25						
CPv	1-year							
Qp	2-year							
	5-year							
	10-year							
Qf	25-year							
	50-year							
	100-year							

1. Flow data into the proposed management practice (prior to detention release rate control).

Enter relevant data from the stormwater modeling output into Table 1.05-3.16. Also enter the allowable release rate from the BMP, based on local jurisdictional requirements. Complete a table of this type for each stormwater detention BMP or at every point of discharge from the project. Allowable release rate should match information provided in Table 1.05-3.12.

TABLE 1.05-3.16: STORMWATER COMPLIANCE REVIEW

STORM EVENT	ALLOWABLE RELEASE RATE (CFS)	PROPOSED OUTFLOW (CFS)	WATER SURFACE ELEVATION (FEET)	MAXIMUM TEMPORARY STORAGE [1] (CF)	MAXIMUM TEMPORARY STORAGE [1] (WATERSHED INCHES)
1-year (CPv)					
2-year					
5-year					
10-year					
25-year					
50-year					
100-year					

1. Above permanent pool or lowest basin surface elevation.

NOTE

For developments draining to more than one location or BMP, provide separate tables for the watershed area draining to each location.

Enter stage-storage information for each stormwater detention BMP into Tables 1.05-3.17 and 1.05-3.18. Table 1.05-17 may be omitted if the practice does not feature a permanent pool of water. Complete tables of this type for each stormwater detention BMP or at every point of discharge from the project.

TABLE 1.05-3.17: STORMWATER DETENTION BMP PERMANENT POOL STAGE-STORAGE INFORMATION [1]

ELEVATION [FEET]	CONTOUR AREA (SF)	INCREMENTAL VOLUME (CF)	CUMULATIVE VOLUME (CF)

1. Include only stage-storage information for volume below permanent pool ("dead" storage).

TABLE 1.05-3.18: STORMWATER DETENTION BMP TEMPORARY STAGE-STORAGE INFORMATION [1]

ELEVATION [FEET]	CONTOUR AREA (SF)	INCREMENTAL VOLUME (CF)	CUMULATIVE VOLUME (CF)
		Total Permanent Pool Storage (CF)	
		Combined Permanent Pool and Temporary Storage (CF)	

1. Include only stage-storage information for temporary detention volumes ("live" storage).

Enter information to describe the various stages of outfall control for each stormwater detention BMP into Table 1.05-3.19. Complete a table of this type for each stormwater detention BMP or at every point of discharge from the project.

TABLE 1.05-3.19: STORMWATER DETENTION BMP OUTLET CONTROL INFORMATION

CONTROL STAGE	ELEVATION	SIZE	TYPE	NOTES
1				
2				
3				
4				
5				
6				Auxiliary Spillway
7				Dam Crest

VII. STORMWATER CONVEYANCE DESIGN

Describe methods used to size culverts, storm sewer pipes, inlets and channels. Details of the capacity analysis may be included in Appendices A, D and E.

VIII. DOWNSTREAM ANALYSIS

If a downstream routing analysis is required for a given project, describe its findings here. Refer to ISWMM Section 9.07 for additional information.

IX. OTHER RELEVANT INFORMATION

Include any other relevant information. Include a summary of any past related studies which were used as a basis for this report. Include PDF copies of such studies with the SWMP (as Appendix K).

X. LIST OF APPENDICES

APPENDIX A
SUBAREA LAND USE CALCULATIONS (TIME OF CONCENTRATION CALCULATIONS MAY GO HERE)

The calculations should demonstrate how data on various land uses (open spaces and impervious covers) were used to calculate rainfall loss parameters for both existing and post-project conditions.

Include calculations for individual subareas to be used for routing models (typically to calculate NRCS Curve Numbers) and to size inlets and pipes along the storm conveyance system (may be used to calculate either Curve Numbers or rational method Runoff Coefficient, depending on the calculation method used to size the storm network).

Time of concentration calculations will often need to be included here but may be omitted for calculations that are included within hydrologic modeling input in Appendix C.

APPENDIX B
RECHARGE VOLUME AND WATER QUALITY VOLUME CALCULATIONS

Show how recharge volume and water quality volume requirements were calculated, based on parameters listed in Appendix A. Include sizing calculations for individual structural and non-structural BMPs that are proposed to address these requirements. Refer to ISWMM Section 3.01-4 for additional information.

APPENDIX C
HYDROGRAPH MODELING INPUT AND OUTPUT
(TIME OF CONCENTRATION CALCULATIONS MAY GO HERE, IF CALCULATED BY SOFTWARE)

Include information to demonstrate the input parameters entered into the hydrologic model and the resulting output. Required information is detailed in ISWMM Section 9.03-7.

If hydrograph data is output in tabular or text-based format, highlight key input and output parameters such as watershed areas, Curve Numbers, time of concentration, network connections, stage-storage-discharge relationships, outlet controls, peak flow rates and runoff volumes.

Include any calculations for allowable release rates, based on adjustments for flow from upstream off-site or direct discharge areas. Refer to ISWMM Section 3.01-5 for more information.

If site conditions require a downstream hydrologic analysis, include it within this appendix.

APPENDIX D
STORM SEWER PIPE, INTAKE AND CULVERT DESIGN CALCULATIONS

Include design calculations used to size culverts, storm sewer pipes and inlet structures. If the system is not expected to convey the design storm event without surcharge, a pressure flow model showing the hydraulic grade line may be required by the jurisdiction. Include calculations for erosion protection at pipe outfalls.

Include calculations used to size and space inlet structures along roadways, including spread of gutter flow.

Attach relevant inlet or surface flow calculations used to determine Minimum Protection Elevations (MPEs) for structures near channels, storm inlets or stormwater BMPs.

Analyze swales, channels and catastrophic overflow paths to define easement locations for the 100-year storm event or review the need for surface erosion protection.

Refer to local requirements and SUDAS as applicable for design.

APPENDIX E
WATERSHED OR DRAINAGE AREA MAPS

Watershed or drainage maps should not exceed 11" x 17" in size and should be printed at a measurable scale. These maps should identify watershed or subwatershed boundaries and the measured flow path used to calculate time of concentration.

Maps should note the areas draining to each stormwater BMP and delineate the areas draining to individual stormwater inlets or culverts (may be separate maps, as needed for clarity).

Maps should be included that reflect both pre- and post-project watershed boundaries and topographic conditions.

Maps should include the extent of off-site flow areas which enter the project site. Such areas may need to be shown on a separate sheet, depending on the size of the drainage area.

The defined watershed areas should be numbered or labeled consistently with the storm network numbering system used on the plat, site plan or construction documents. Subareas used for stormwater detention modeling should match those used in the routing model. Additionally, watershed areas and runoff loss parameters (Curve Number or runoff coefficient, as applicable) should be labeled for each subarea.

The maps for post-project conditions should show catastrophic overflow paths at all low points. Demonstrate how runoff exceeding the capacity of intakes or the storm network will be directed through the site or to management facilities.

APPENDIX F
SOIL PROPERTY MAPS OR GEOTECHNICAL INFORMATION

Soil properties can be downloaded from the NRCS Web Soil Survey online application. Maps printed from that site should include any parameters used for design or development of this report (which may include Hydrologic Soil Group classification, depth to groundwater or soil erosion factors). Relevant parts of geotechnical reports may also be included.

APPENDIX G
WETLAND INFORMATION

Include information related to the presence of wetlands on-site, such as a map from the National Wetlands Inventory, wetland delineation report, etc.

APPENDIX H
FLOODPLAIN MAPS (IF NEEDED)

If the site is located within a Special Flood Hazard Zone as designated on a local FEMA Flood Insurance Rate Map (FIRM), provide an excerpt of the map showing the site area. Maps can be downloaded from the FEMA Flood Map Service Center. Historical aerial photographs used to evaluate stream migration patterns may also be included here.

APPENDIX I
PERMIT DOCUMENTATION

If the project is subject to federal or state permit requirements, such as floodplain, dam construction or 404 permitting, include documentation to demonstrate that the required permits are being pursued or have been obtained.

APPENDIX J
MAINTENANCE PLAN

Attach maintenance plans for stormwater BMPs as required by local jurisdictions or grant-funding sources.

APPENDIX K
PAST RELATED STORMWATER STUDIES

Include a PDF copy of any past studies which were used as a basis for development of the SWMP.

1.05-4 PLAN INTEGRATION

The SWMP may identify specific design information to be illustrated on preliminary plats, site plans or construction documents. These documents should include the following information related to the SWMP:

1. Label and number culverts, storm structures and pipes in a fashion consistent with calculations and maps included in the SWMP. Match storm structure types, pipe slopes, lengths and sizes to those listed in the calculations within the SWMP.
2. Provide details for any stormwater management control structures. The sizes and elevations of various control stages shown on the plans should match those listed in the summary information and model input within the SWMP.
3. Show any required erosion protection at pipe outfalls, labelling the surface area, depth, quantity and type of material used.
4. Show a contour line for the expected 100-year-storm high-water elevation on the site grading plan, for the purposes of defining overflow paths and the extents of required surface water flowage or drainage easements. Delineate and label any required easements.
5. Define Finished Floor or Minimum Protection Elevations for structures or single-family lots near areas where regulatory floodplains exist or where high-water elevations caused by a 100-year storm event are projected.
6. Show and label the boundaries of Special Flood Hazard Zones from a FIRM.