Post-Construction Stormwater Management (PCSM)

January 22, 2025

HNTB

NextLevel INDIANA

Outline

- Introductions
- Background (MS4GP and CSGP)
- PCBMPs on INDOT Projects
- PCBMP Selection
- Infeasibility Analysis
- Hydrologic Design
- Overview and design for common PCBMPs
- Inspection and Maintenance Forms
- Submittal Documentation and Process
- Design Example 1
- Design Example 2
- Design Example 3
- Construction
- Frequently Asked Questions
- Q&A - PCSM@indot.in.gov

The PCSM Team

INDOT

- Sandy Bowman
- Greg Couch
- Reed Hathaway
- Jim Emerick
- Ollie the Otter

HNTB

- PCSM Implementation
- PCSM Design Reviews
- PCBMP Inspection
- PCBMP Maintenance Oversight

RGI

- PCSM Design Reviews
- PCBMP Inspection

HWC

- PCBMP Maintenance

Why are we doing this? – The Clean Water Act

- Originally the Federal Water Pollution Control Act (1948) – Significantly reorganized and expanded in 1972
- Requires stormwater discharges be permitted under the National Pollutant Discharge Elimination System (NPDES) program
  - Phase I (1987) and Phase II (1995)
- INDOT is an MS4 – Covered by IDEM's MS4GP (coverage for Phase II MS4 entities)
  - Includes 6 Minimum Control Measures
  - #4 – Management of Construction Site Runoff – In Indiana, must apply for converge under the Construction Stormwater General Permit (CSGP) for one or more acres of land disturbance – Replaced Rule 5 in 2021 – Requires Post-Construction measures, Post-Construction measures are a permit condition of CSGP
  - #5 – Management of Post Construction Site Runoff – Agency wide program requiring implementation, inspection, and maintenance of Post-Construction measures
- CSGP permit condition requires PCBMPs as part of the MS4 program
- To learn More: https://www.in.gov/idem/stormwater/files/final_gen_permit_ms4.pdf
- https://www.in.gov/idem/stormwater/files/final_gen_permit_inra00000_construction.pdf

What is a PCBMP?

- Post-Construction Stormwater Best Management Practice (PCBMP)
  - A method that has been determined to be the most effective and practical means of preventing or reducing non-point source pollution to help achieve water quality and quantity goals
  - Can be structural or non-structural (activity based, such as using less salt to de-ice roads)
- Structural PCBMPs for INDOT projects:
  - Dry Grass Swales (turf or native grass)
  - Vegetated Filter Strips
  - Dry Detention (modified)
  - Wet Swale
  - Wet Retention Pond
  - Infiltration (swale or basin)
  - Hydrodynamic Separators
- Post-Construction Stormwater Management (PCSM)
  - The management efforts connected to planning for, designing, constructing, and maintaining PCBMPs

Dry Grass Swale, Hendricks County, Indiana

Target Pollutant

- Sediment
  - Most common water pollutant (US EPA)
  - Primary pollutant in stormwater run-off from pavement
  - Permanent measure target
- Design to 80 % sediment removal rate as Total Suspended Solids (TSS)
  - When 80% TSS removal is achieved, other contaminants and floatables are removed as well

Sediment-laden run-off in Marsh River (MN) – pca.state.mn.us

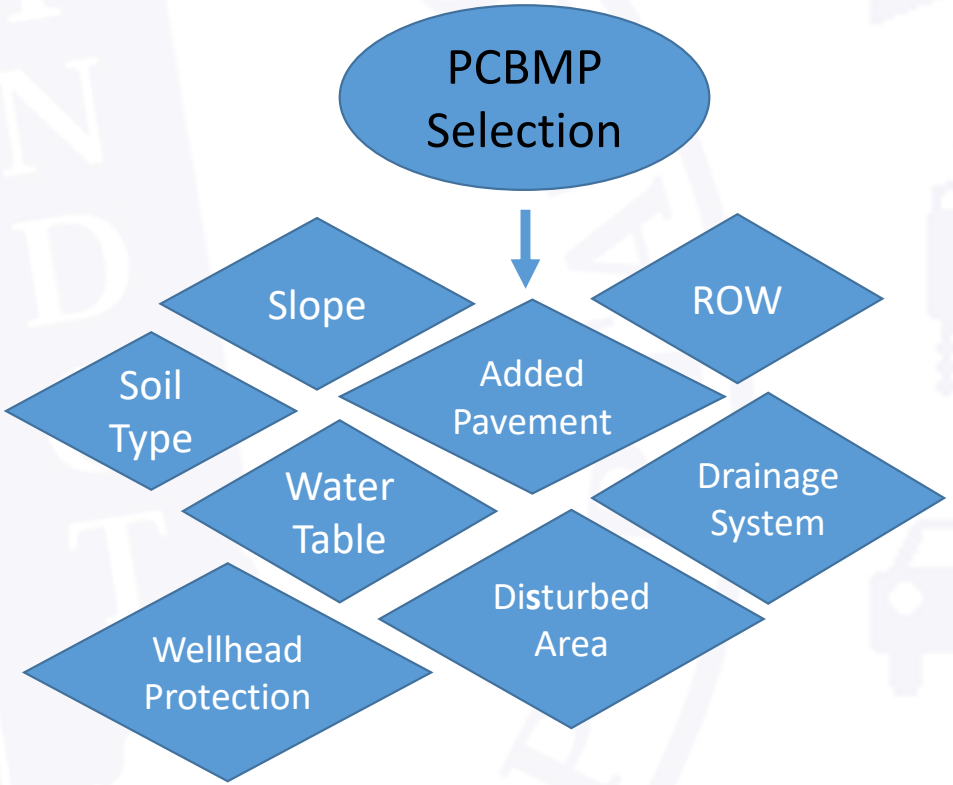
Design Memorandum No. 22-22

- SUBJECT: Post-Construction Stormwater Management (November 2022)
- Post-Construction stormwater management guidance document
  - #1 Project requires CSGP for 1 acre or greater of estimated disturbance
  - #2 Added net impervious area of 1 acre or more
  - INDOT worked with IDEM to create our MS4 net impervious minimum
  - Updates in progress

PCBMP Selection Flowchart

Considerations

- Disturbed area, added pavement
- Available ROW
- Drainage system type
- Soil type
- Water table depth
- Bedrock depth
- Slope
- Wellhead protection area
- Peak flow mitigation
- Offsite drainage area



Each outfall that includes added impervious surface requires treatment in a PCBMP. If a given outfall does not include added impervious surface, a PCBMP is not required for that outfall.

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Roadway Project Layout/Site-Specific Conditions

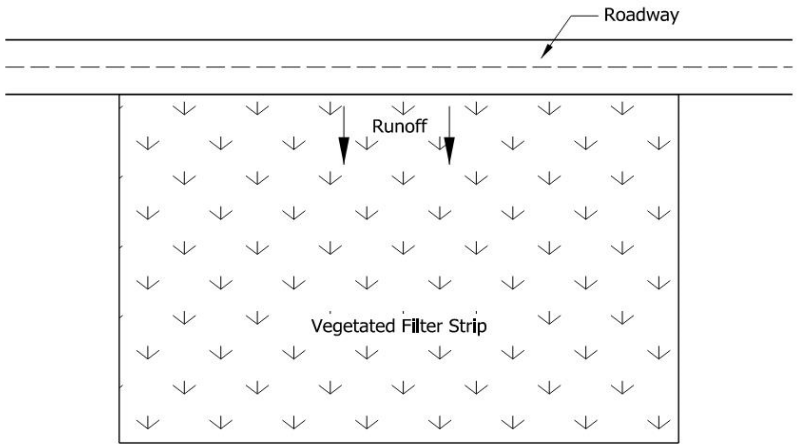
Site-specific factors that limit PCBMP selection

- Available right-of-way
- Steep slopes and other topographic constraints
- Infiltration not allowed in karst or wellhead protection areas
- High water-table, some PCBMPs must drain between rainfall events
- Bedrock near ground surface – expensive to excavate
- Large off-site areas draining to PCBMPs – require more space – velocities increased
- Adjacent land-use draining to INDOT right-of-way
- Underlying soil type – affects infiltration and support for needed vegetation

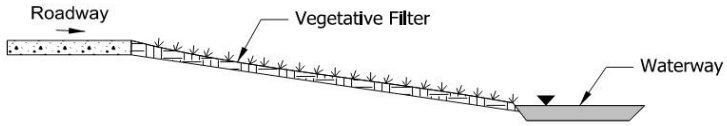
Structural Measure Selection Priority

Priority

1. Dry turf grass swale
1. Dry native grass swale
1. Filter strip
1. Dry detention
2. Wet swale
2. Wet retention pond
3. Infiltration swale
3. Infiltration basin
4. Hydrodynamic separators



Plan View



Profile View

See INDOT guidance documents for references/definitions.

Infeasibility Analysis

- Economically infeasible
  - Limited right-of-way, utility relocations, topographic constraints, and amount of added flow from offsite
  - Option to treat the same amount of pavement (could be existing pavement) in a different outfall – must go to the same receiving stream
    - First blue lined stream on a 1:24,000 USGS Topo Quadrangle Map
    - If this option is utilized, the project is considered to meet requirements and does not need an infeasibility exception
- TMDLs
  - Must consider receiving streams on the current 303(d) list of impaired waters
  - Pollutants not from INDOT ROW may be infeasible to remove by PCBMPs
  - Work with PCSM Team if discharging to a TMDL stream

Infeasibility Documentation

- Prior coordination with INDOT is required for infeasibility exception
- For small projects, infeasibility exception may be for entire project
  - Submit documentation to PCSM Team
  - PCSM Team will provide an infeasibility memo, to be submitted with permit applications
- For larger projects infeasibility exception will be provided on a per-outfall basis and noted in the PCSM approval memo
- See PCSM Guidance Document for information required to submit for infeasibility

West Fork White River, Morgan County, Indiana

Hydrologic and Hydraulic Design

- Water Quality Event: A rainfall event of one inch, assumed to remove a significant percentage of pollutant from the roadway
  - Also known as the “first flush”
- Water Quality Volume: The volume of run-off generated by the Water Quality Event for treatment in PCBMPs
- Water Quality Treatment Rate: The peak flow rate of stormwater run-off generated by the Water Quality Event

Rain on grass – edu.rsc.org

Water Quality Volume

$WQv = (P * Rv * A) \div 12$

Where:

WQv = water quality volume, acre-feet

P = rainfall, inches (use 1.0 inches)

Rv = volumetric run-off coefficient

A = total proposed onsite drainage area, acres

And:

$Rv = 0.05 + (0.009 * I)$

Where:

I = percent new impervious cover, %

And:

$I = [(Pia - Eia) \div A] * 100$

Where:

Pia = Proposed Onsite Impervious Area

Eia = Existing Onsite Impervious Area

INDOT Stormwater Webpage:
https://www.in.gov/indot/engineering/environmental-services/storm-water/

Water Quality Treatment Rate

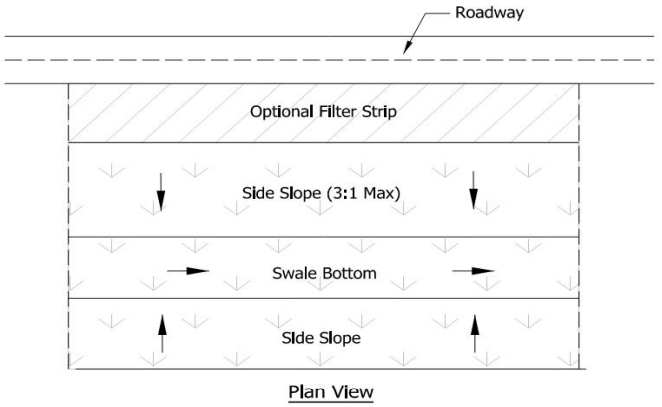
- Qwq
  - Calculate Tc using TR-55 methodology
  - Calculate CNwq using provided graph
  - Compute Qwq in cfs following hydrograph-oriented procedures approved in IDM Chapter 202
  - Use NRCS Type II rainfall distribution and depth of 1 inches

Dry Swales

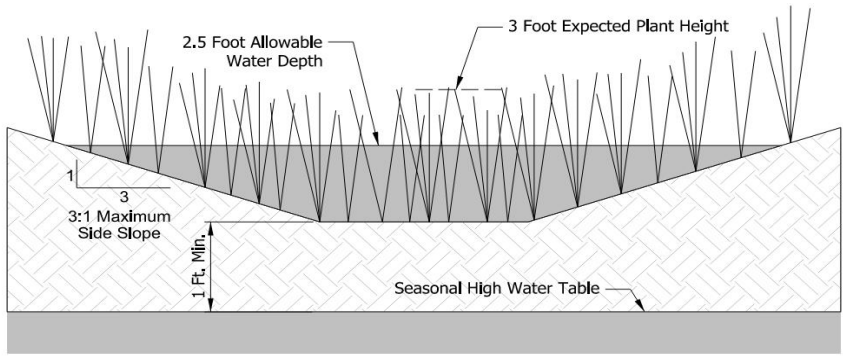
- Designed to fully drain between rainfall events
- Planted with turf grass or native grasses
  - If possible, avoid using native grass if within 30 feet of the edge of pavement due to typical INDOT mowing process
- Trapezoidal, V-shaped, or natural cross section
- No underdrain
- Water depth during Water Quality Event at or below grass height (6 inches for turf, 2.5 feet for native)
- Sized using Water Quality Treatment Rate and Hydraulic Residence Time

  Tahr = (Lswale ÷ vwq) ÷ 60

  Where:
  Tahr = hydraulic residence time, minutes
  Lswale = length of swale, feet
  vwq = peak flow velocity at water quality event, ft/s
  Tahr of 9 minutes = 80% TSS removal



Plan View



Cross Section View

Dry Grass Swale

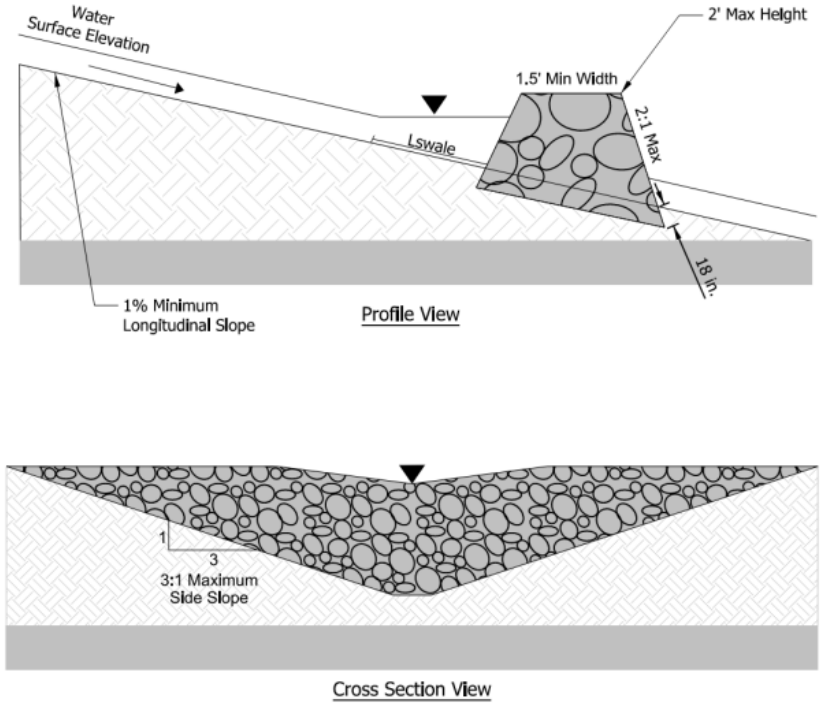
Grass Swale in I-70 Median – Maryland DOT State Highway Administration

Offsite Flow Entering a Swale

- If offsite flow cannot be bypassed it must be accounted for
- Calculations
  - Two basins can be modeled, one for onsite and one for offsite
  - Derive Tc for both basins following typical procedures
  - CN for both basins will be derived using the same process as CNwq for swales
    - Use percent impervious area instead of percent *added* impervious area
  - The swale is the outlet for both basins in model
  - 1 inch of rainfall
  - Typical water quality swale sizing design process
  - Alternatively, can combine the onsite and offsite into one area with one water quality treatment rate calculation

Dry Swales with Check Dams

- Minimum longitudinal swale slope of 1%
- Check Dam Geometry
  - Foreslope and backslope 2:1 or flatter
  - 1.5-foot minimum width at the top
  - No opening
  - Revetment riprap, keyed in 1.5 feet below the flowline
  - Max height of 2 feet
- Completely made of riprap (no filter stone) and no geotextiles
- Fully dries between rainfall events
- Store Water Quality Volume behind check dam(s)
  - Use % *added* impervious for calculation



DRY SWALE CHECK DAM

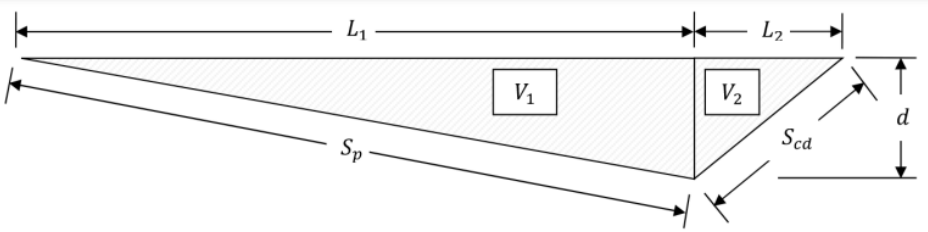
Check Dam Storage Volume

Volume of Storage Behind Check Dam

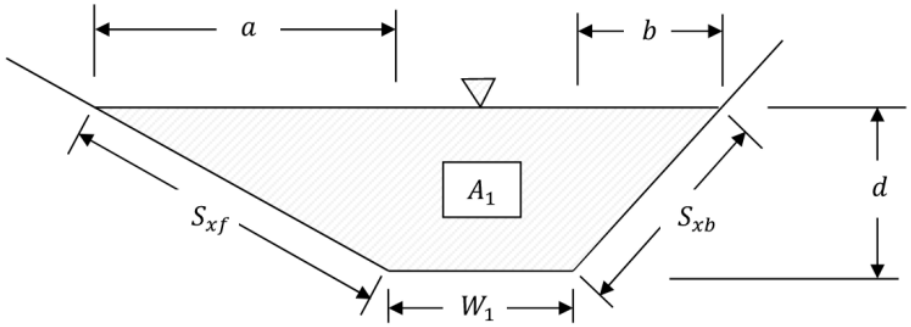
$$V_1 = \left[\frac{W_1 S_p {L_1}^2}{2} + \frac{{S_p}^2}{6S_{xf}}{L_1}^3 + \frac{{S_p}^2}{6S_{xb}}{L_1}^3\right]$$

Where:

V_1 = storage volume above swale, cubic feet
W_1 = swale bottom width, feet
S_p = profile slope of swale, feet/feet
L_1 = distance water can be stored from the toe of dam, feet
S_{xf} = swale foreslope, feet/feet
S_{xb} = swale backslope, feet/feet
S_{cd} = check dam face slope, feet/feet
d = height of dam, feet, where $S_p L_1 \leq d$
a = horizontal distance of swale foreslope, feet
b = horizontal distance of swale backslope, feet



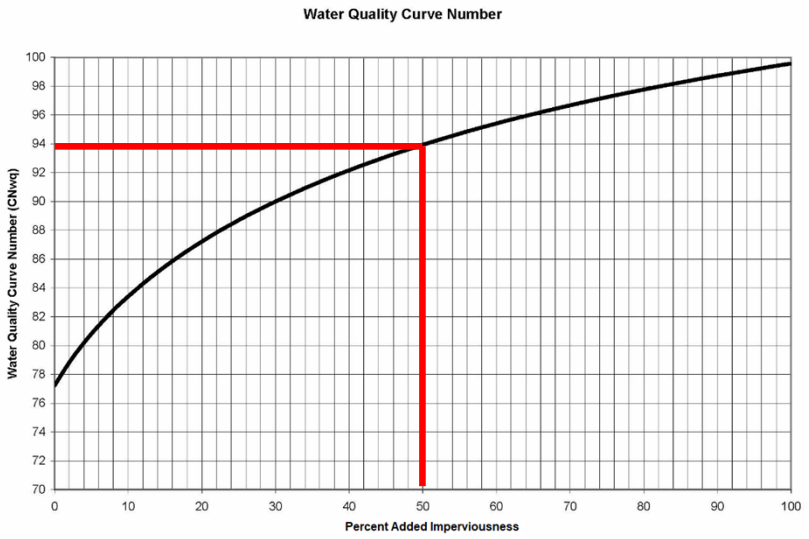
Profile View of Swale and Check Dam



Cross Section View of Swale and Check Dam

Treating in Another Outfall's Swale

- For various reasons, its sometimes infeasible or too costly to treat added pavement in a given outfall
- Option to treat the same value in acres of pavement in another outfall
  - Must drain to same receiving stream
- Outfall A: 0.15 acres of net added pavement
- Outfall B: 0.25 acres of net added pavement
- Outfall B has more right of way space for vegetated swales
- Solution
  - Treat 0.4 acres of pavement in Swale 1 in Outfall B
  - Total area draining to Swale 1 is 1 acre
    - 0.5 acres of pavement
    - 0.5 acres of grass
  - 0.5 acres of pavement treated in Swale 1
    - ✓ > 0.4 acres of added pavement



- Common mistake – calculating the water quality treatment rate for Outfall A and adding it to the water quality treatment rate for Outfall B

Dry Detention

- Capture and temporarily detain stormwater run-off
- Can be a peak flow mitigation PCBMP as well as water quality PCBMP
- 2 design options for TSS removal
- First option – model as a basin
  - Detain and release Water Quality Volume over 24 hours
  - If outlet pipe D is 6 inches or less, 50 feet of perforated pipe installed in stone trench and connected to outlet structure
  - Include a cleanout port at upstream end of perforated pipe
- Second option – model as a swale
  - Construct a meandering pilot channel (optional)
  - Design using Water Quality Treatment Rate
  - Depth of flow in channel during water quality event at or below the grass height
  - Follow design process in dry swale section
  - If modeled as a swale, the PCBMP is still referred to as a detention facility and not a swale; the swale is just how it was modeled for sediment removal

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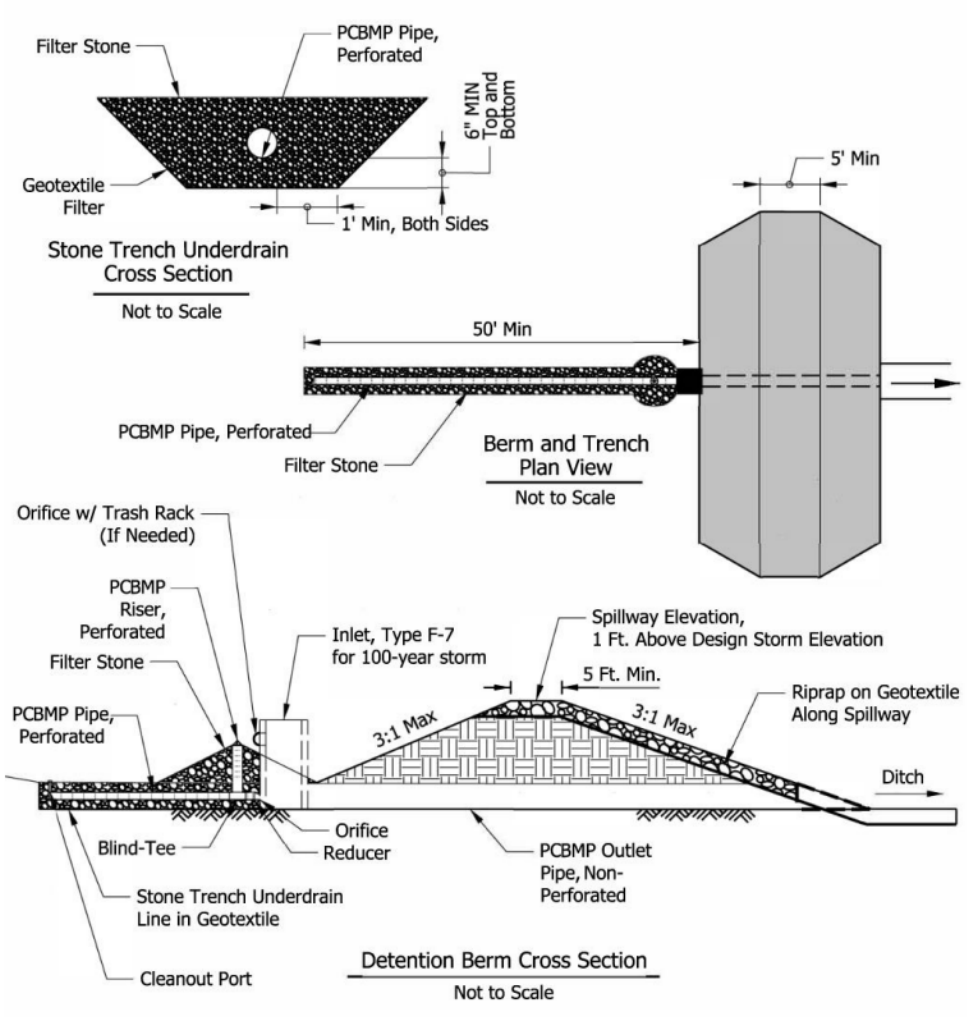
Detention Berm Detail



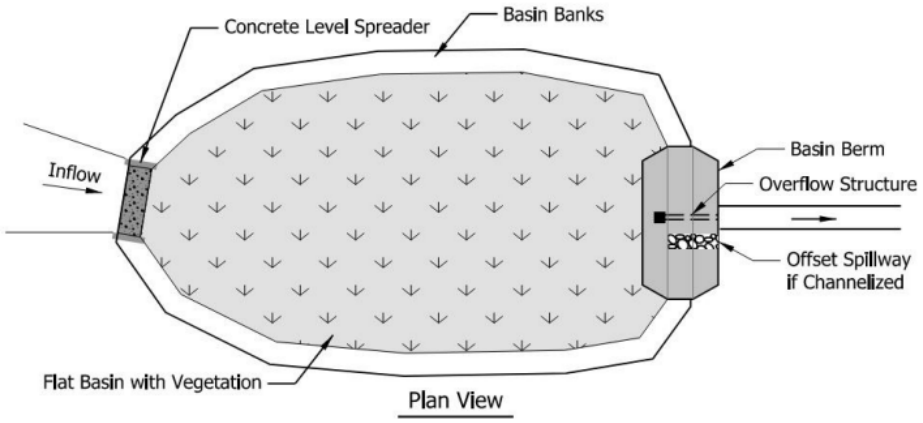
If detention pond or swale is riprap lined, must use option 1 on previous slide, often requires underdrain system as shown on the left. Consider using tied concrete block mat (allows for vegetation).

Infiltration

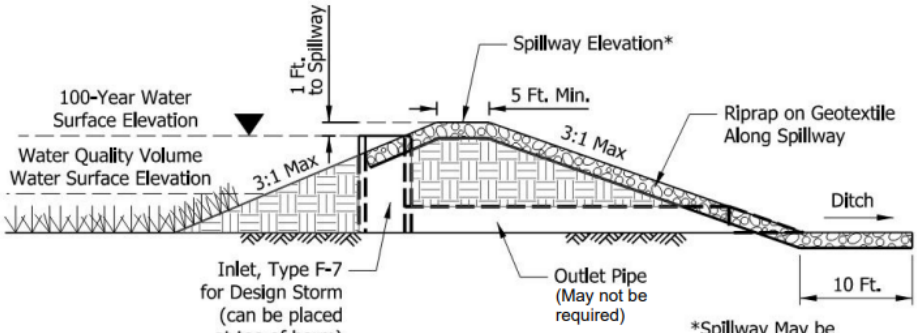
- Can be a swale or a basin
- Collect run-off and allow it to drain through the underlying soil
- No underdrain
- Dependent on the existing underlying soil – soil testing required per guidelines provided in IDM Chapter 203
- Can be used to meet water quantity and water quality goals
- Designed to infiltrate the Water Quality Volume
- If used for peak flow mitigation, a computer model will be submitted per requirements in IDM Chapter 203
- If used for Water Quality only, equations can be used to calculate volume infiltrated and time to drain (provided in PCSM Guidance Document)
- Demonstrate the Water Quality Volume is infiltrated

Note: Don't forget to check for karst and wellhead protection areas!

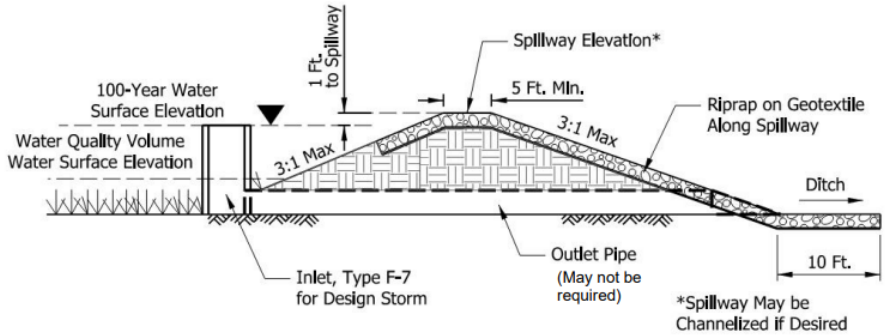
Infiltration Basin and Swale Details



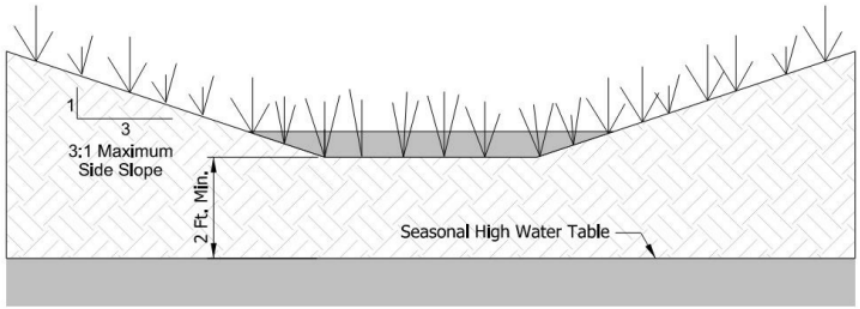
Plan View



Basin Berm Cross Section



Berm Cross Section



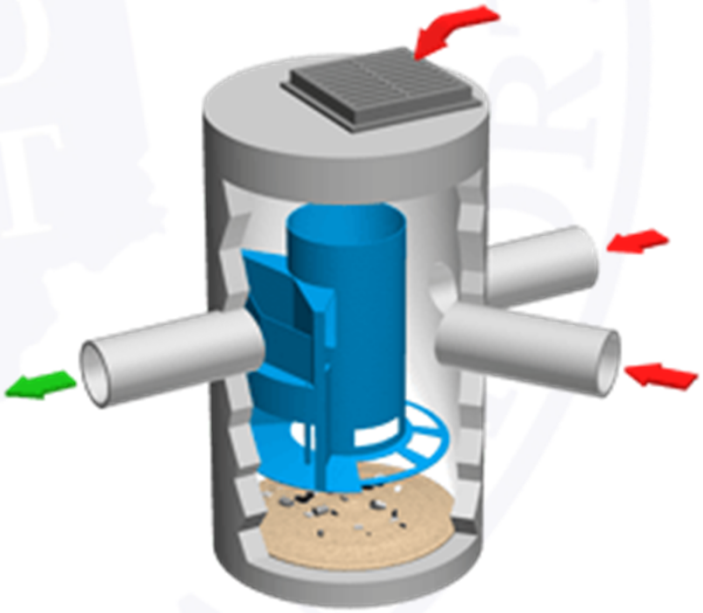
Cross Section View

Hydrodynamic Separators

- Proprietary PCBMP device
  - Many other types available, Hydrodynamic Separators only for INDOT projects at this time
- Flow-through device
- Use a swirl or vortex to remove solids and trash via gravity from run-off
- Relatively small footprint
- Maintenance is critical – frequent inspection and cleanout required

Don’t forget to consider inspection and maintenance access in the design!

- Design Criteria
  - 80% TSS Removal and Floatables
  - Treatment train may be required to achieve desired pollutant removal



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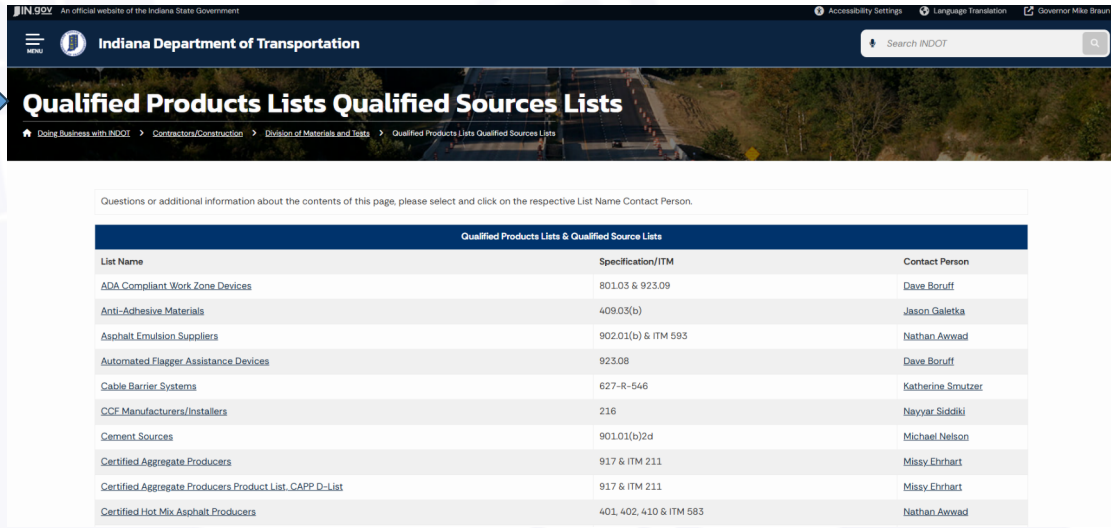
INDOT Qualified Products List (QPL)

- Stormwater Treatment Units QPL
  - https://www.in.gov/indot/doing-business-with-indot/files/apl71.pdf
  - ADS – Barracuda Max
  - Aquashield, Inc. – Aqua-swirl Xcelerator
  - Contech Engineered Solutions, LLC – Cascade Separator
  - Hydro International/Oldcastle Infrastructure – First Defense Optimum



March 25, 2024

STORMWATER TREATMENT UNITS

Specification Reference: USP

SM Material Code:
720M00100

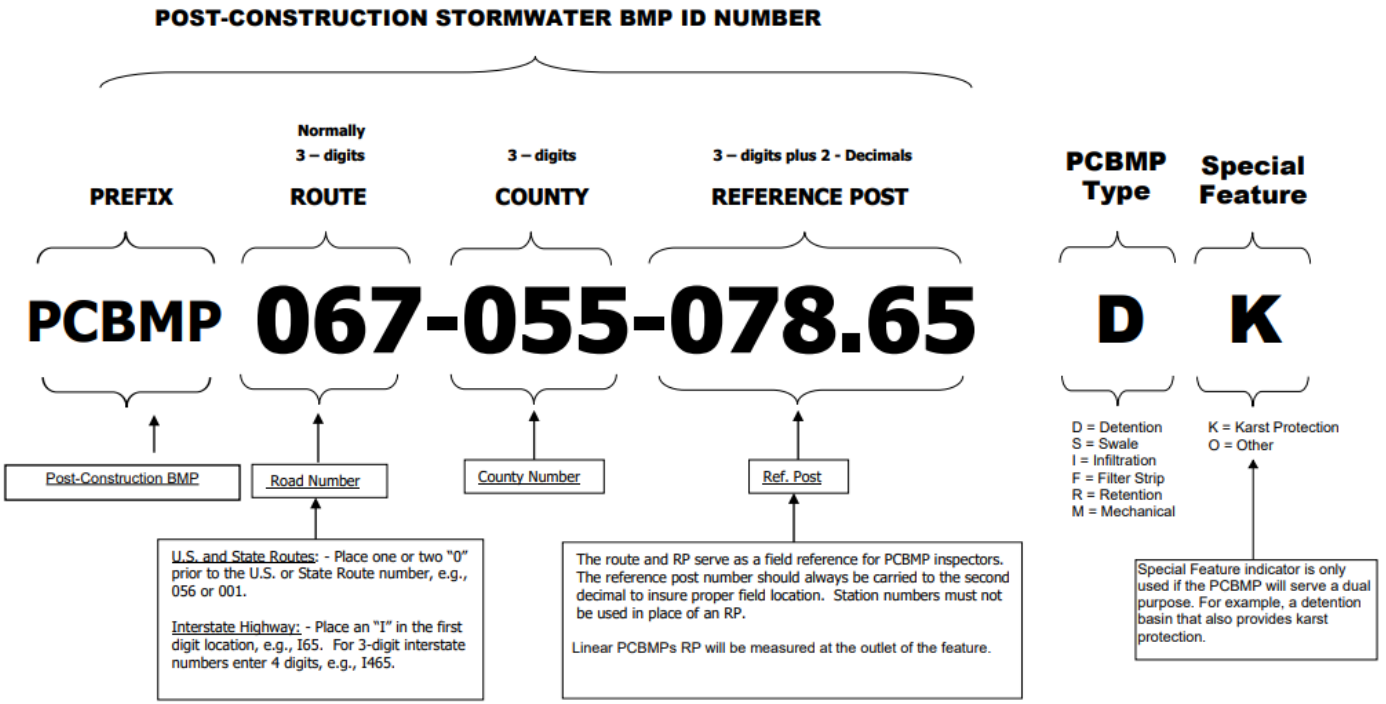
AWP Material Code:
720M00100

Source Code	Manufacturer Model	Approval Number	Comments
	HYDRODYNAMIC SEPARATORS		
8961	ADVANCED DRAINAGE SYSTEMS, INC. BEAVER DAM, KY BARRACUDA MAX	W247100	
8962	AQUASHIELD, INC. HIXSON, TX AQUA-SWIRL XCELERATOR	W247101	
8963	CONTECH ENGINEERED SOLUTIONS, LLC HARTFORD, KY CASCADE SEPARATOR	W247102	
8964	CONTECH ENGINEERED SOLUTIONS, LLC NORWALK, OH CASCADE SEPARATOR	W247104	
8965	HYDRO INTERNATIONAL/OLDCASTLE INFRASTRUCTURE ELGIN, IL FIRST DEFENSE OPTIMUM	W247103	
8966	HYDRO INTERNATIONAL/OLDCASTLE INFRASTRUCTURE KALAMAZOO, MI FIRST DEFENSE OPTIMUM	W247105	
8967	HYDRO INTERNATIONAL/OLDCASTLE INFRASTRUCTURE LEXINGTON, KY FIRST DEFENSE OPTIMUM	W247106	

Hydrodynamic Separator Design Process

- Calculate the water quality treatment rate
- Design diversion structure – requires an additional manhole
  - Water quality treatment rate flows to the separator
  - The remaining flow is bypassed
- For cost estimating, designer can contact a manufacturer representative from the INDOT QPL for Stormwater Treatment Units
- The unit must be sized based on the NJCAT verified flow rates (we are adding flow rates as an attachment to the QPL, can use Indianapolis flow rates)
- In the plans, call out a hydrodynamic separator and list the water quality treatment rate
  - Do not list the manufacturer or model – the contractor will choose the unit they will construct from the QPL

PCBMP Naming Convention

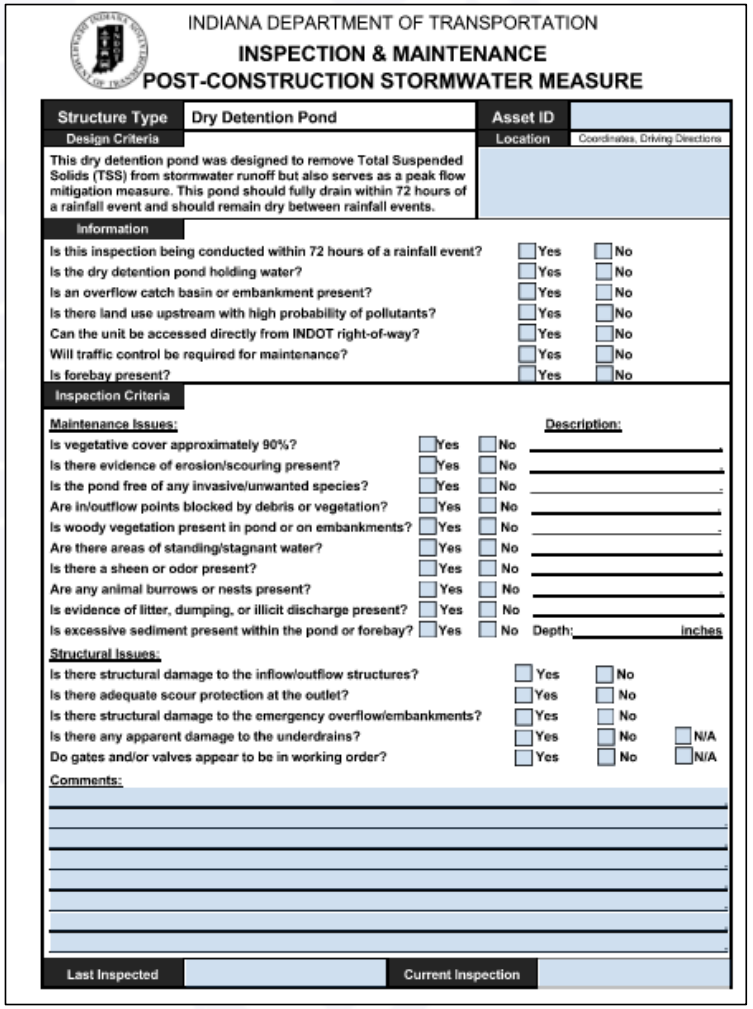


Contact PCSM@indot.IN.gov for questions regarding PCBMP asset ID numbers

POST-CONSTRUCTION STORMWATER MANAGEMENT NUMBERING SYSTEM

Inspection and Maintenance

- PCBMPs added to asset list during final construction review
- Given an asset ID number and added to inspection schedule
- Maintenance as needed based on inspection
- Editable maintenance plan templates
- Inspection frequency varies based on PCBMP type
- <u>Access for inspection and maintenance very important</u>



INDIANA DEPARTMENT OF TRANSPORTATION

INSPECTION & MAINTENANCE
POST-CONSTRUCTION STORMWATER MEASURE

Structure Type	Dry Detention Pond	Asset ID	
Design Criteria		Location	Coordinates, Driving Directions

This dry detention pond was designed to remove Total Suspended Solids (TSS) from stormwater runoff but also serves as a peak flow mitigation measure. This pond should fully drain within 72 hours of a rainfall event and should remain dry between rainfall events.

Information

Is this inspection being conducted within 72 hours of a rainfall event?	☐ Yes	☐ No
Is the dry detention pond holding water?	☐ Yes	☐ No
Is an overflow catch basin or embankment present?	☐ Yes	☐ No
Is there land use upstream with high probability of pollutants?	☐ Yes	☐ No
Can the unit be accessed directly from INDOT right-of-way?	☐ Yes	☐ No
Will traffic control be required for maintenance?	☐ Yes	☐ No
Is forebay present?	☐ Yes	☐ No

Inspection Criteria

Maintenance Issues:			Description:
Is vegetative cover approximately 90%?	☐ Yes	☐ No	
Is there evidence of erosion/scouring present?	☐ Yes	☐ No	
Is the pond free of any invasive/unwanted species?	☐ Yes	☐ No	
Are in/outflow points blocked by debris or vegetation?	☐ Yes	☐ No	
Is woody vegetation present in pond or on embankments?	☐ Yes	☐ No	
Are there areas of standing/stagnant water?	☐ Yes	☐ No	
Is there a sheen or odor present?	☐ Yes	☐ No	
Are any animal burrows or nests present?	☐ Yes	☐ No	
Is evidence of litter, dumping, or illicit discharge present?	☐ Yes	☐ No	
Is excessive sediment present within the pond or forebay?	☐ Yes	☐ No	Depth: _____ inches

Structural Issues:			
Is there structural damage to the inflow/outflow structures?	☐ Yes	☐ No	
Is there adequate scour protection at the outlet?	☐ Yes	☐ No	
Is there structural damage to the emergency overflow/embankments?	☐ Yes	☐ No	
Is there any apparent damage to the underdrains?	☐ Yes	☐ No	☐ N/A
Do gates and/or valves appear to be in working order?	☐ Yes	☐ No	☐ N/A

Comments:

Last Inspected		Current Inspection	

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Inspection and Maintenance Forms (1 of 2)

- Designer to fill out first portion of form

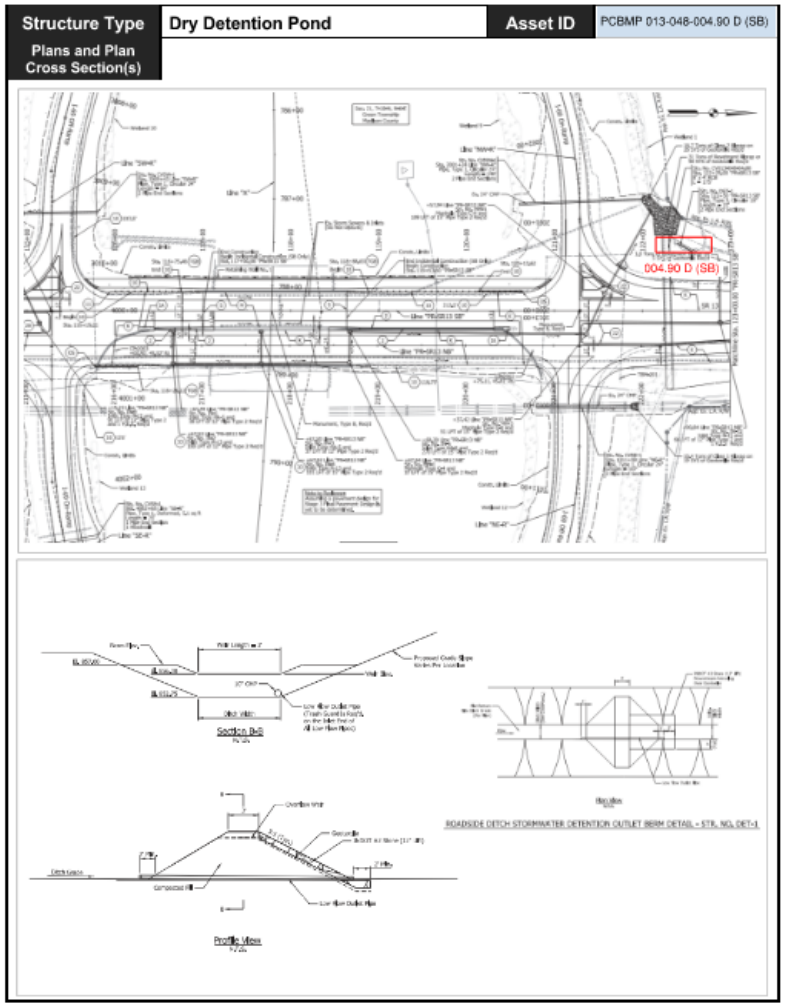
INDIANA DEPARTMENT OF TRANSPORTATION

INSPECTION & MAINTENANCE

POST-CONSTRUCTION STORMWATER MEASURE

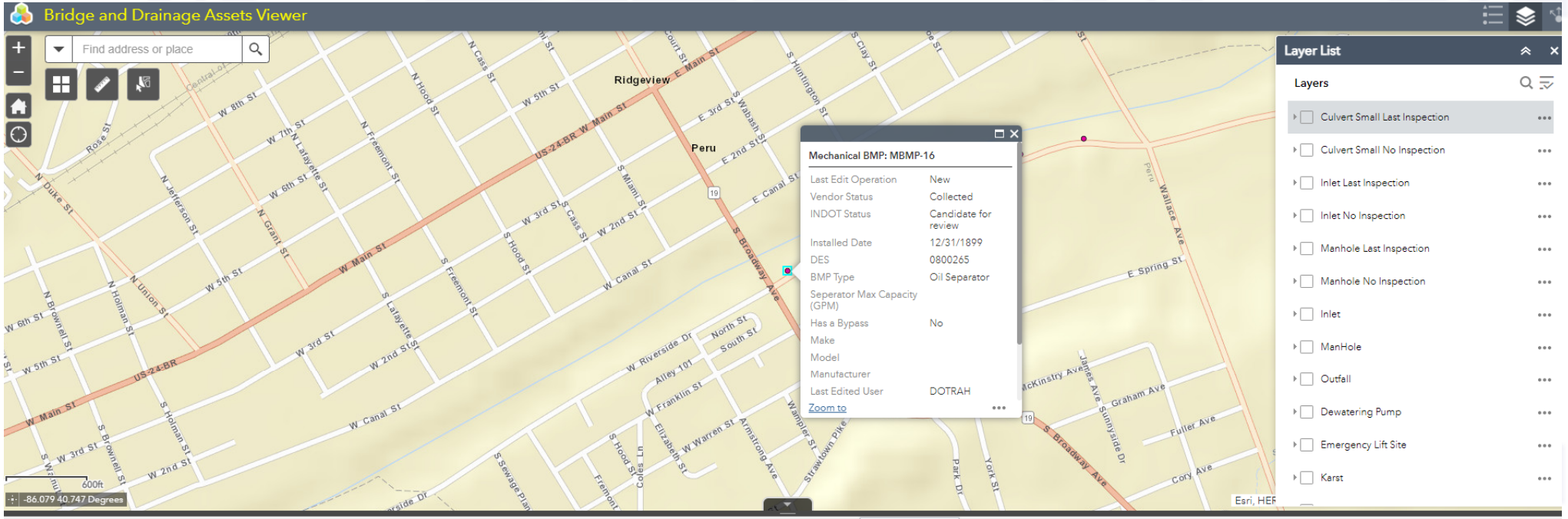
Structure Type	Dry Detention Pond	Asset ID	PCBMP 013-048-004.90 D (SB)
Design Criteria		Location	Coordinates, Driving Directions
This dry detention pond was designed to remove Total Suspended Solids (TSS) from stormwater runoff but also serves as a peak flow mitigation measure. This pond should fully drain within 72 hours of a rainfall event and should remain dry between rainfall events.		85.8434592°W 39.9953390°N On the west side of the SR-13 southbound travel lanes at the beginning of the on ramp to I-69	

Inspection and Maintenance Forms (2 of 2)



- Designer to add screenshots from plans to 3rd page of form
  - Plan view and profile view
  - Any other details in plans
  - Additional pages can be added
- PCBMP inspectors fill out the rest of the form during inspections

Bridge and Drainage Assets Viewer Updates



Culvert Small (flow direction) | Gravity Sewer (flow direction) | Small Culvert End Points & Inlets and Drains | County Bridge Point | Bridge Deck Represented as a Line | Pavement Sections | Mechanical BMP

Options | Filter by map extent | Zoom to | Clear selection | Refresh

Last Edit Operation	Vendor Status	INDOT Status	Installed Date	DES	BMP Type	Seperator Max Capacity (GPM)	Has a Bypass	Make	Model	Manufacturer	Last Edited User	Last Edited Date
New	Collected	Candidate for review	12/31/1899	0800265	Oil Separator		No				DOTRAH	3/4/2020
New	Collected	Candidate for review	12/31/1899	0800265	Oil Separator		No				DOTRAH	3/4/2020
New	Collected	Candidate for review	12/31/1899	0800265	Oil Separator		No				DOTRAH	3/4/2020
New	Collected	Candidate for review	12/31/1899	0800265	Oil Separator		No				DOTRAH	3/4/2020
New	Collected	Candidate for review	12/31/1899	0800265	Oil Separator		No				DOTRAH	3/4/2020

PCSM Submittal Requirements

- See submittal guidance located here:

https://www.in.gov/indot/engineering/files/PCSM-Submittal-Requirements-7-8-2024.pdf

- Updates to IDM Chapter 14 have been drafted, waiting to be released, matches requirements at link above
- Common mistakes
  - Wrong naming convention for PCBMPs in plans
  - Not labeling added pavement values at each outfall
  - Not calling out PCBMPs in plan sheets or construction detail sheets
  - Not including detail sheets
  - Turning in PCSM Report after Stage 3 submittal or not resubmitting PCSM Report in time to make updates to final plans

INDIANA DEPARTMENT OF TRANSPORTATION

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Indianapolis, Indiana 46204

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Eric Holcomb, Governor
Michael Smith, Commissioner

Post-Construction Stormwater Management (PCSM) - Submittal Requirements as of 9-25-2024

With Stage 1 Review Submission (25% Design):

- Stormwater Outfalls (locations where stormwater leaves INDOT right-of-way) identified in plan sheets with approximate added pavement values listed (acres or square feet)
- Preliminary locations of proposed Post-Construction Stormwater Best Management Practices (PCBMPs) identified and labeled in plan sheets.
  - Use naming convention provided on Environmental Services Division Stormwater webpage
  - List type of PCBMP (for example: PCBMP 067-055-078.65 – Dry Turf Grass Swale)
- PCBMPs included in cost estimate
- Design calculations for PCBMPs are not required with Stage 1 Submittal

With Stage 2 Review Submission (55% Design):

- Stormwater Outfalls identified in plans with approximate added pavement values listed (acres or square feet)
- Preliminary locations of proposed PCBMPs identified and labeled in plan sheets and construction detail sheets
  - Use naming convention provided on Environmental Services Division Stormwater webpage
  - List type of PCBMP (for example PCBMP 067-055-078.65 – Dry Turf Grass Swale)
- PCBMP detail sheets for all PCBMPs. Must include beginning and ending station and offset (if linear) and all dimensions and details needed for construction.
- PCBMPs included in cost estimate
- Design calculations for PCBMPs are not required with Stage 2 Submittal

90 Days After Stage 2 Review Submission (approval required before Stage 3 Submission):

- Post-construction Stormwater Management Design Report including:
  - Narrative
  - Project Location Map
  - Outfall Locations Map
  - Existing and proposed drainage area delineations for each outfall
    - Must include existing contours with labels and proposed contours with labels, respectively
  - NRCS Soils information
    - Percolation testing results if using infiltration measure(s)
  - Water Quality Volume calculations for each outfall
  - Water Quality Treatment rate calculations or model output for flow through PCBMP sizing
  - All supporting calculations for proposed PCBMPs, including computer models
  - Signed and sealed by a professional engineer licensed in Indiana

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- PCBMP detail sheets for all PCBMPs. Must include beginning and ending station and offset (if linear) and all dimensions and details needed for construction.
- Completed maintenance plans (see templates on Environmental Services Division Stormwater webpage). Submit as separate pdfs in a zipped file. Fill out preliminary information and add screenshots from plans (plan, profile, and cross-section views).
- Shapefiles of outlines of PCBMPs (points for HDS units) in a separate zipped file.

With Stage 3 Review Submission (95% Design) and/or Final Tracings Submission (100% Design):

- All items required with Stage 2 Review Submission in addition to the following:
  - PCSM Unique Special Provisions (USP) or PCSM Recurring Special Provisions (RSP)
  - Completed maintenance plans (see templates on Environmental Services Division Stormwater webpage) if updated since PCSM Report submittal
  - PCSM Approval Memo

With SWP3 (as an Appendix):

- Approved Final Tracings plans
- PCSM Approval Memo

For PCSM Report Submittal, there are currently two options:

- Email report to PCSM@indot.IN.gov
  - Send an external link to files for downloading if file size exceeds 20M

or

- Request ERMS Application "PCSM Reports"
  - After uploading, email PCSM@indot.IN.gov to verify report was received

How to Submit

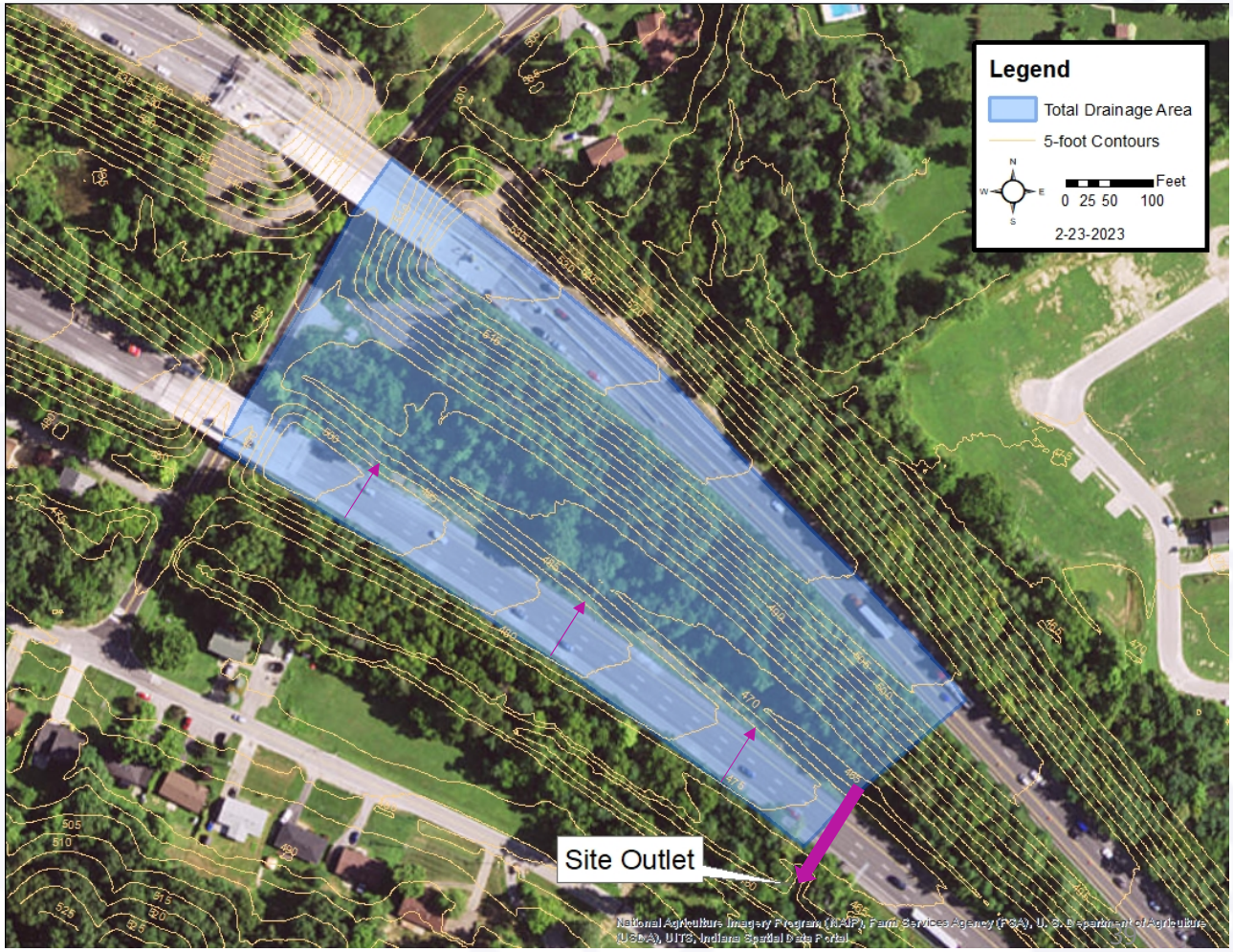
- Typical ERMS Uploads for Plans Submittals
  - For Stage 2, 3, and Final Tracings, notify us at PCSM@indot.IN.gov when a submittal is made (that includes PCBMPs). State in transmittal letter PCBMPs are included.
- PCSM Reports can be submitted to ERMS or PCSM@indot.IN.gov
  - Request access to PCSM Reports application
  - If it does not give you a drop down for PCSM Report, contact PCSM team at address above. Do not upload as a design file or we will not be automatically notified of the submittal through ERMS.
- PCSM Naming Convention
  - Report – PCSM Report DES XXXXXXX (Date) XX-XX-XXXX
    - For example: PCSM Report DES 1900162 2-23-2023
  - Models – PCSM (Model Name) DES XXXXXXX (Date) XX-XX-XXXX
    - For example: PCSM WinTR-55 DES 1900162 2-23-2023
  - Use this basic naming convention for other file types

Review Process

- Comment Form will be sent to designer via email as needed
  - INDOT PM will be cc'd, along with INDOT Stormwater Specialists
- Approval Memo will be sent once design is approved
- Coordination meetings may be required
  - Designers are encouraged to ask questions ahead of submittals and request meetings if needed
- PCSM Reports will not be scored at this time; however, INDOT PMs will be aware of number of resubmittals
  - INDOT Roadway Engineering has indicated they do plan to score the plans based on PCBMPs once updates to Chapter 14 are released regarding PCBMPs

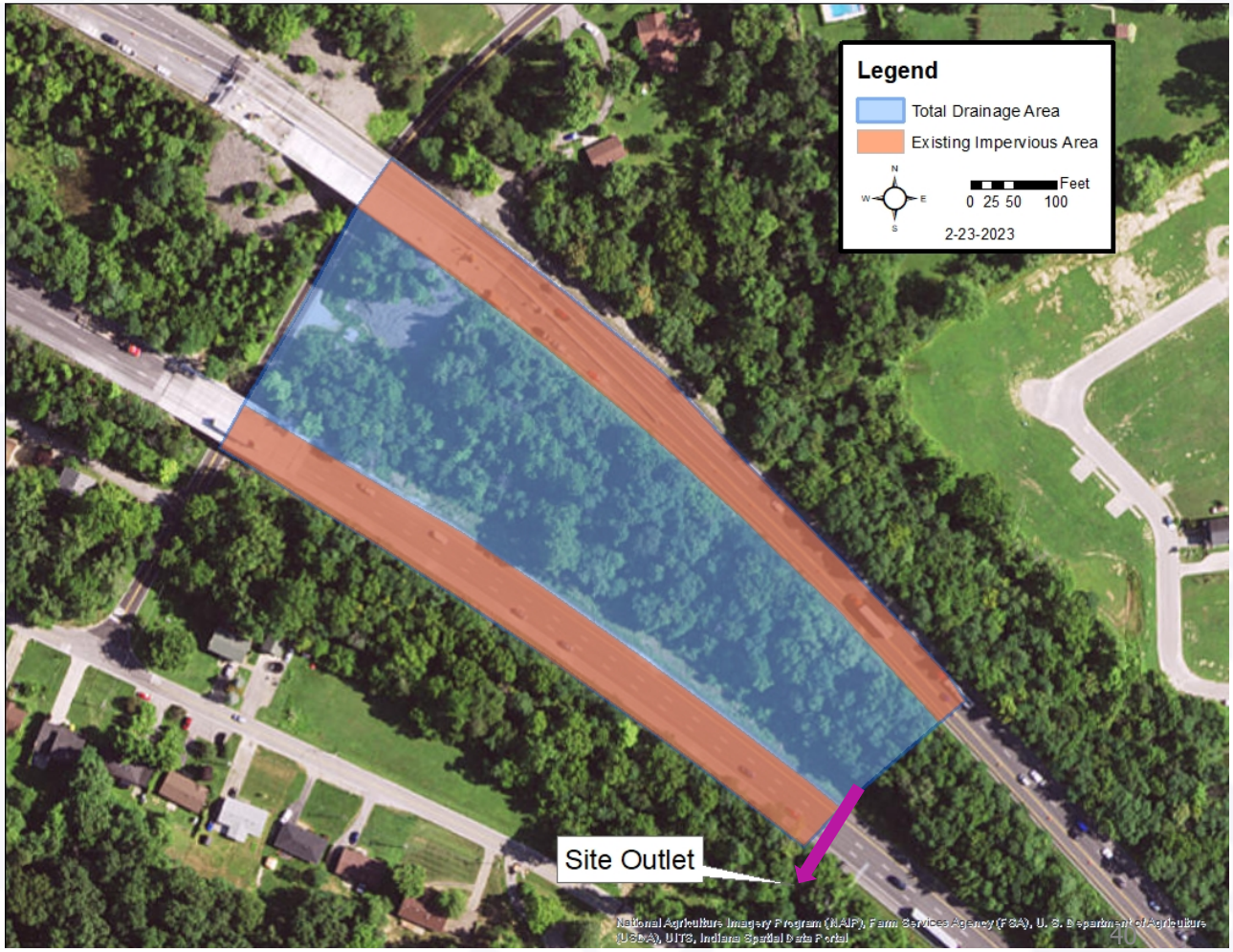
Water Quality Volume Example (1 of 4)

- Determine site outlet
- Delineate drainage area (acres)
  - Use LiDAR for offsite area and survey data for onsite area
  - Account for existing drainage features such as storm sewer



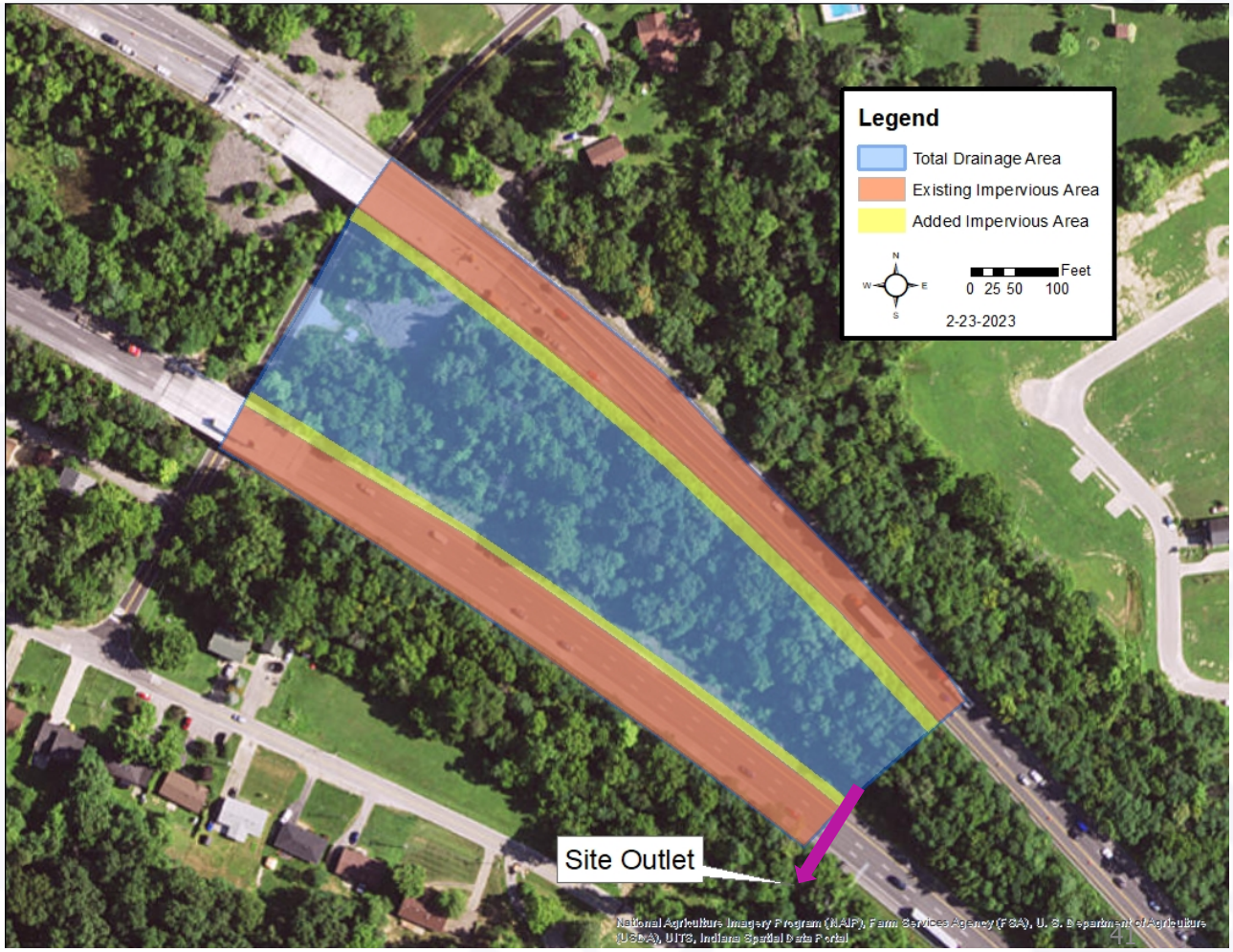
Water Quality Volume Example (2 of 4)

- Determine existing onsite impervious area
  - Include all surfaces, not just the roadway



Water Quality Volume Example (3 of 4)

- Determine proposed onsite impervious area
  - Include all surfaces, not just the roadway



Water Quality Volume (4 of 4)

Water Quality Volume Calculation Template

Cells shaded in grey will auto-populate, designer is responsible for checking results.

$$WQ_v = \frac{(P * R_v * A)}{12}$$

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

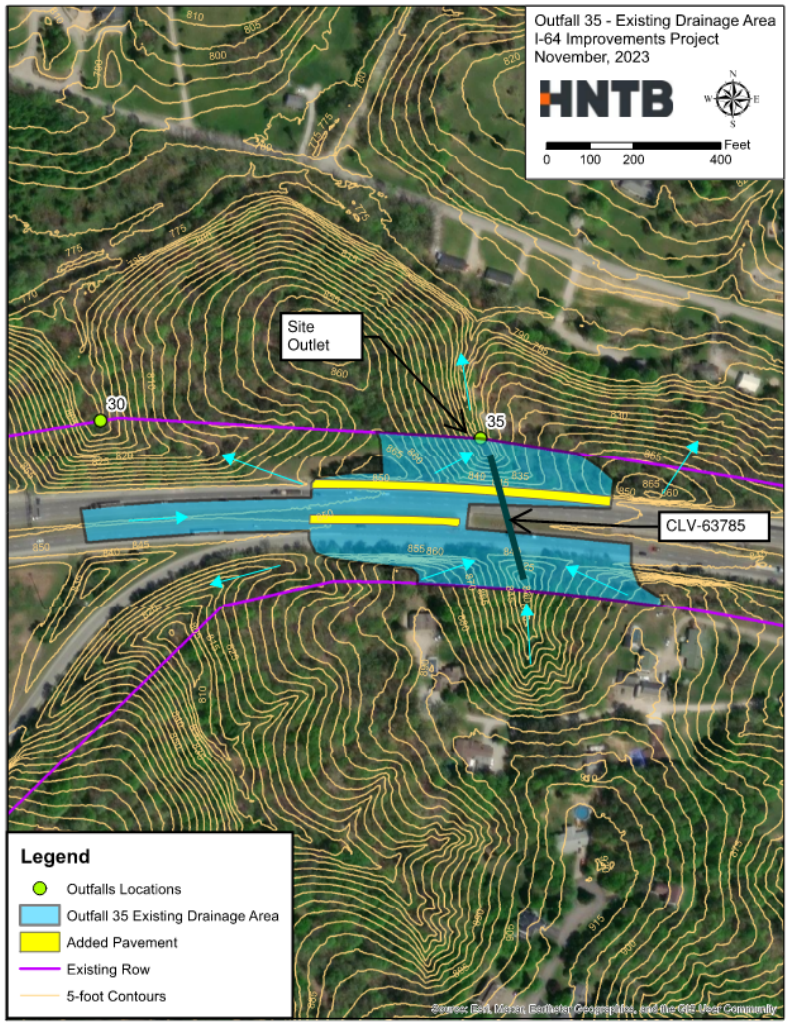
$$I = \frac{P_{ia} - E_{ia}}{A} * 100$$

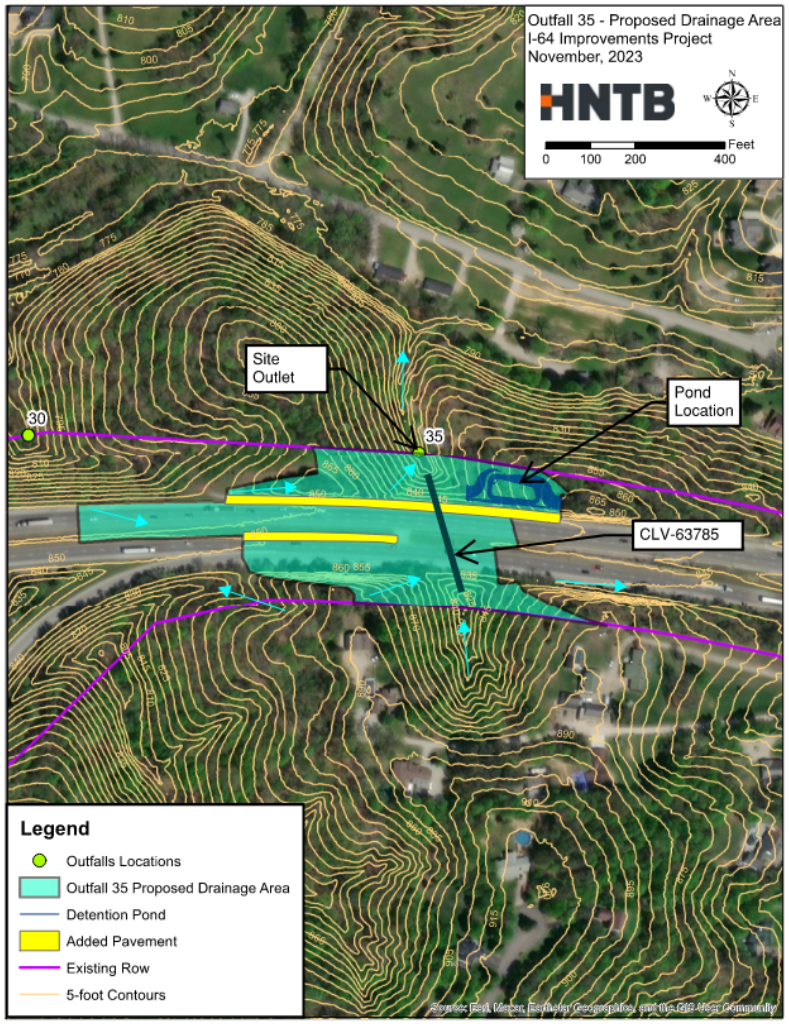
P_{ia}	2.8	Proposed Onsite Impervious Area, acres
E_{ia}	2.3	Existing Onsite Impervious Area, acres
A	6.6	Total Proposed Onsite Drainage Area, acres
I	8.5	Percent New Impervious Cover, %
R_v	0.1	Volumetric Run-off Coefficient
WQ_v	0.07	Water Quality Volume, acre-ft
WQ_v	3020	Water Quality Volume, ft³

Dry Detention Example (1 of 5)

- Assumes detention is required and model was created per typical INDOT procedure
- Calculate Water Quality Volume
- Size outlet structure such that the WQv is detained and released over a 24-hour period (use hydrograph)
- If outlet structure is ≤6” use a stone trench and perforated pipe
  - Set up the model to ignore the stone trench and perforated pipe – use the actual elevation of the low flow pipe in the model
  - Use Elevation-Area method with an elevation at the bottom of the trench/outlet pipe invert with zero storage and another elevation at the flowline with zero storage
  - May require multiple openings in outlet structure
- Sometimes this method will not work and the dry detention feature will have to be modeled as a swale

Dry Detention Example (2 of 5)





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Dry Detention Example (3 of 5)

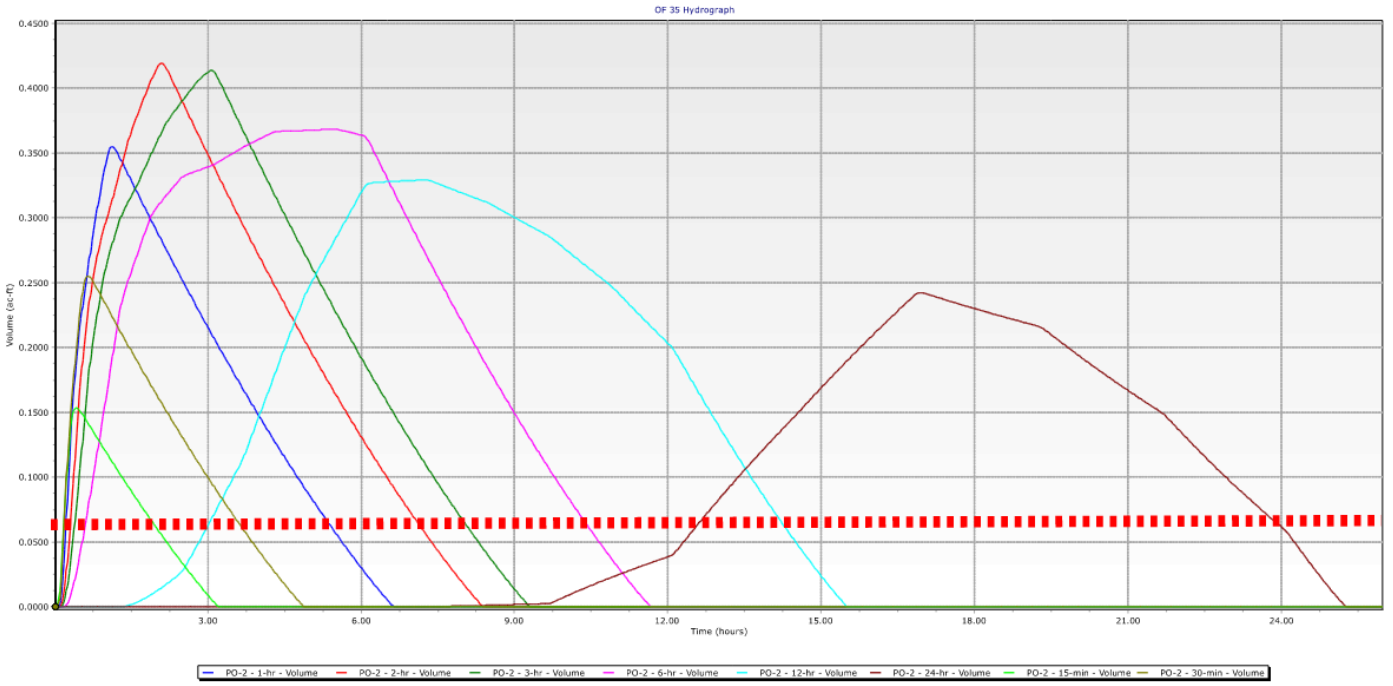
Water Quality Volume Calculation - Outfall 35

$$WQ_v = \frac{(P * R_v * A)}{12}$$

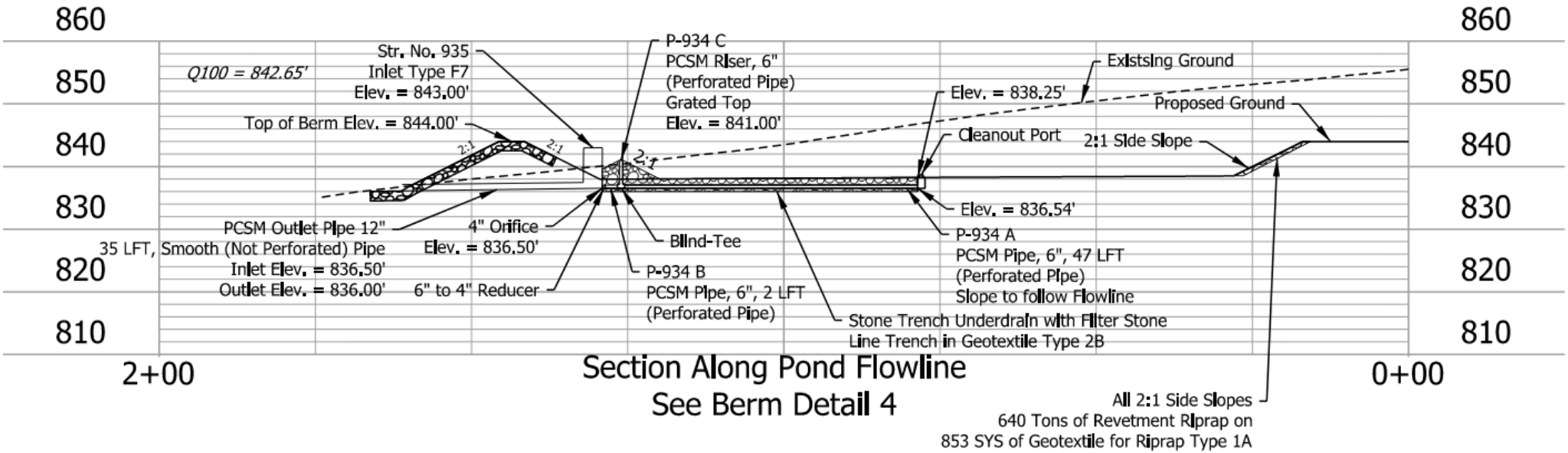
$$R_v = 0.05 + (0.009 * I)$$

$$I = \frac{P_{ia} - E_{ia}}{A} * 100$$

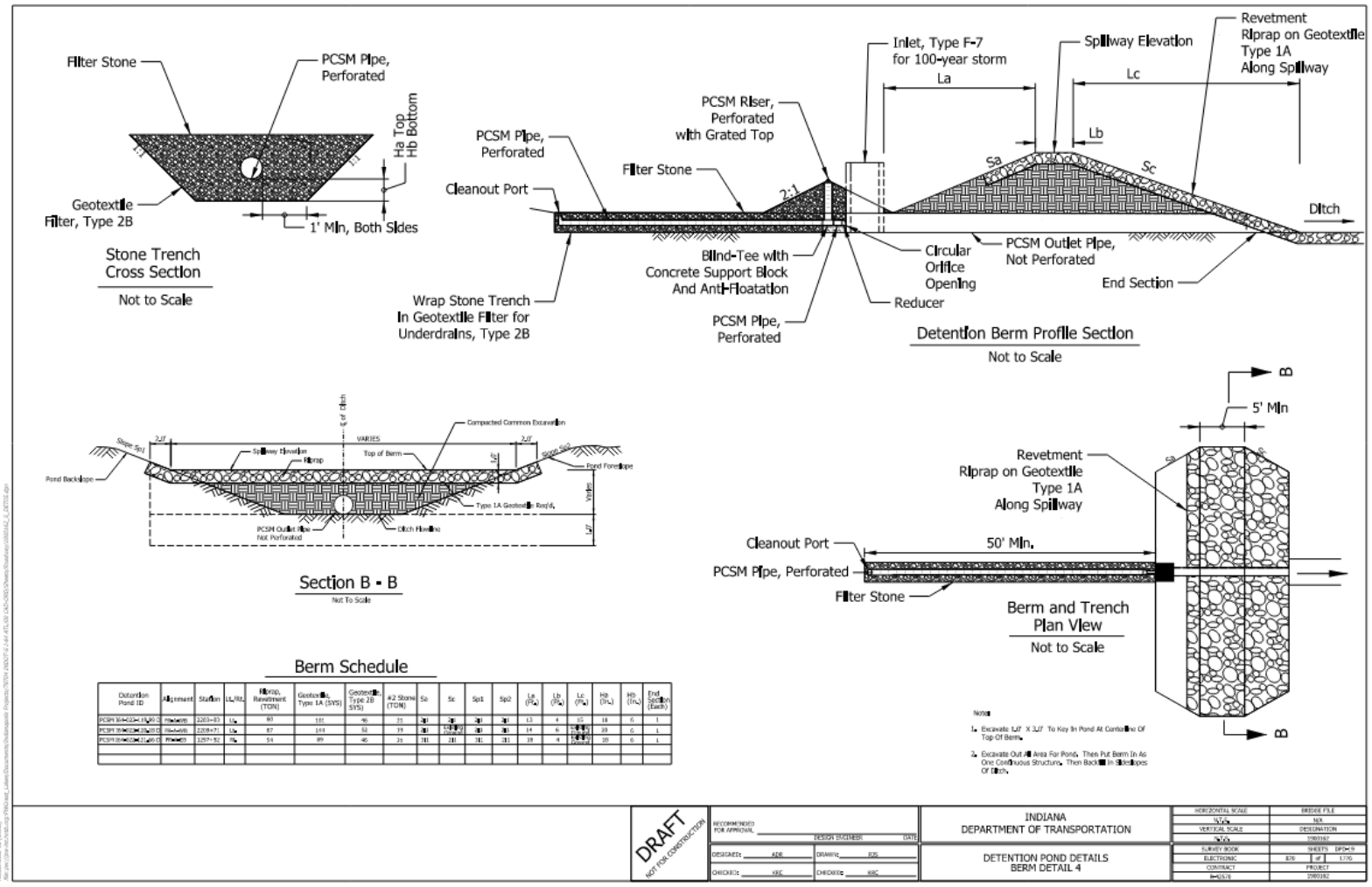
P_{ia}	2.78	Proposed Onsite Impervious Area, acres
E_{ia}	2.22	Existing Onsite Impervious Area, acres
A	5.19	Total Proposed Onsite Drainage Area, acres
I	10.79	Percent New Impervious Cover, %
R_v	0.15	Volumetric Run-off Coefficient
WQ_v	0.06	Water Quality Volume, acre-ft
WQ_v	2771	Ft^3
Added Pavement	0.56	acres
Treated Pavement	1.81	acres



Dry Detention Example (4 of 5)



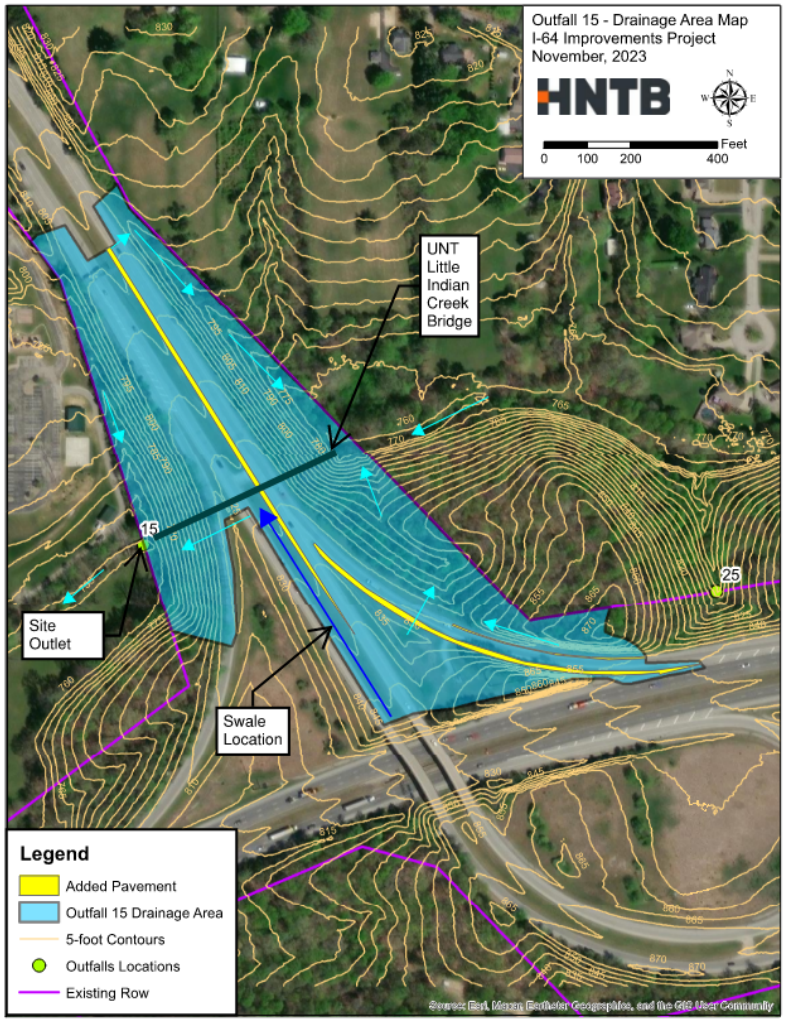
Dry Detention Example (5 of 5)

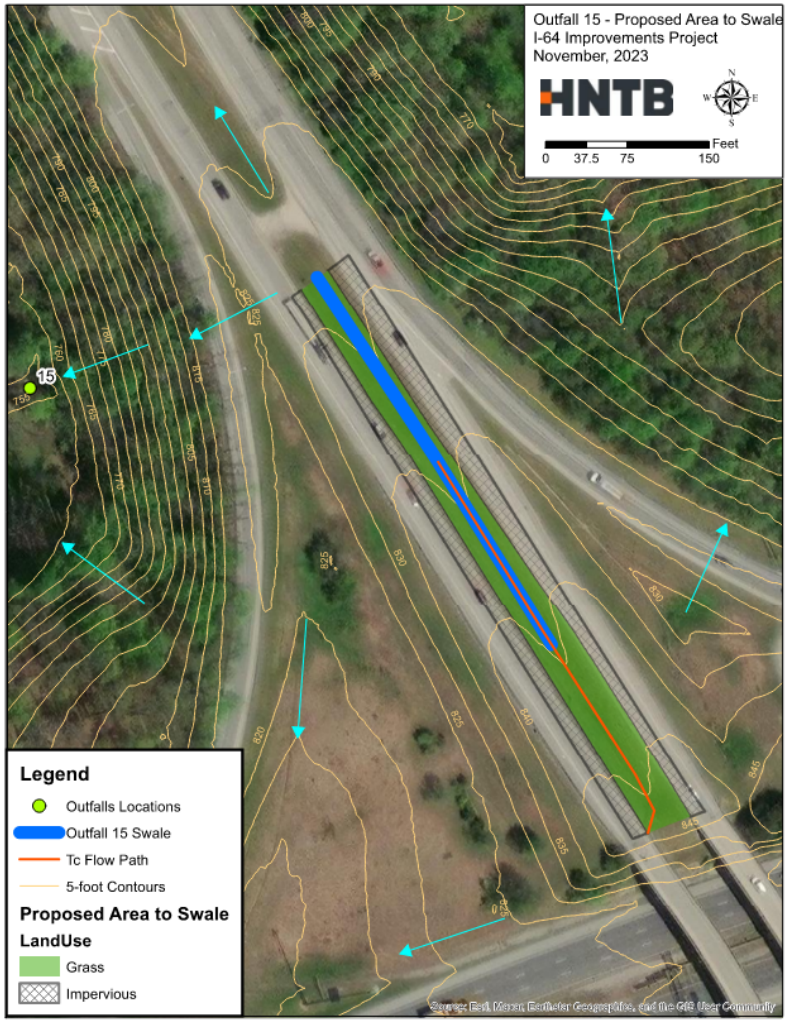


Dry Swale Example (1 of 8)

- Calculate Water Quality Volume
  - Can use Excel Template https://www.in.gov/indot/engineering/environmental-services/storm-water/
- Calculate Water Quality Treatment Rate
  - Can use Win TR-55
- Determine preliminary longitudinal slope
- Determine preliminary swale geometry
- Determine preliminary vegetation type (native or turf)
- Analyze swale using Manning's Equations
  - Can use Bentley FlowMaster https://www.in.gov/indot/engineering/environmental-services/storm-water/
- Determine Hydraulic Residence Time
  - Can use Excel Template
  - Target – 9 minutes for 80% TSS Removal

Dry Swale Example (2 of 8)





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Dry Swale Example (3 of 8)

OF15 PCSM Time of Concentration

Sheet Flow (Applicable to Tc only)	Segment ID	1		
1. Surface description (Figure 202-2B)		short grass		
2. Manning's roughness coefficient for sheet flow, n (Figure 202-2B)		0.15		
3. Flow Length, L (total L <= 100 ft)	ft	100		
4. Two year 24-hour rainfall, P2 (NOAA Table)	in	3.072		
5. Land slope, s	ft/ft	0.0460		sub total
6. Tt = [0.007 (n L)$^{0.8}$]/[p$_2$$^{0.5}$ s$^{0.4}$]	hr	0.119		0.119
Shallow Concentrated Flow	Segment ID	2		
7. Surface Description (paved or unpaved)		unpaved		
8. Flow Length, L	ft	99		
9. Watercourse slope, s	ft/ft	0.032		
10. Average Velocity, V (Figure 202-2D)	ft/s	2.9		sub total
11. Tt = L/(3600 V)	hr	0.010		0.010
Channel Flow	Segment ID	3		
12. Width of ditch bottom	ft	0.5		
13. Ratio of Horizontal to Vertical of left ditch side slope (XH:1V)		3		
14. Ratio of Horizontal to Vertical of right ditch side slope (XH:1V)		3		
15. Bankfull depth of flow:	ft	3		
16. Cross sectional flow area, a	ft2	28.5		
17. Wetted Perimeter, p_w	ft2	19.5		
18. Hydraulic radius, r=a/p_w	ft2	1.5		
19. Channel slope, s	ft/ft	0.030		
20. Manning's roughness coeff. for channel flow, n (Figure 202-2C)		0.05		
21. V=[1.49 r$^{0.67}$ s$^{0.5}$] /n	ft/s	6.66		
22. Flow Length, L	ft	200		sub total
23. Tt = L/ (3600 V)	hr	0.008		0.008
24. Total Time of Concentration or Travel Time			**Watershed Tc (hours)**	**0.137**
			Watershed Tc (minutes)	**8**

Water Quality Volume Calculation - Outfall 15

$$WQ_v = \frac{(P * R_v * A)}{12}$$

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

$$I = \frac{P_{ia} - E_{ia}}{A} * 100$$

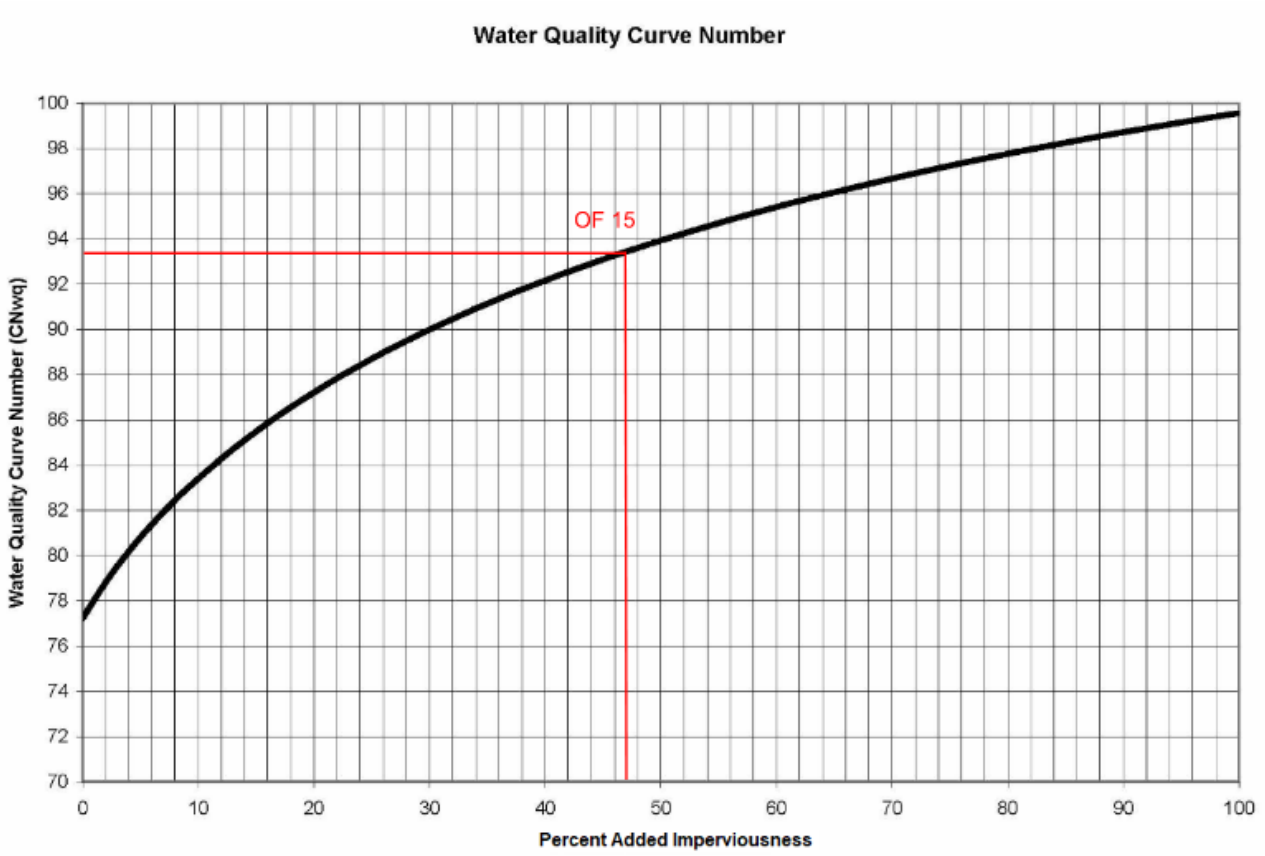
P_{ia}	3.44	Proposed Onsite Impervious Area, acres
E_{ia}	2.95	Existing Onsite Impervious Area, acres
A	13.50	Total Proposed Onsite Drainage Area, acres
I	3.63	Percent New Impervious Cover, %
R_v	0.08	Volumetric Run-off Coefficient
WQ_v	0.09	Water Quality Volume, acre-ft

Water Quality Curve Number - To Swale

Grass	0.49	acres
Pavement	0.43	acres
Total	0.92	acres
% Impervious Cover	0.47	To Swale
CNwq from Graph	93	Use in Win-TR 55
Added Pavement	0.49	acres
Treated Pavement	0.43	acres

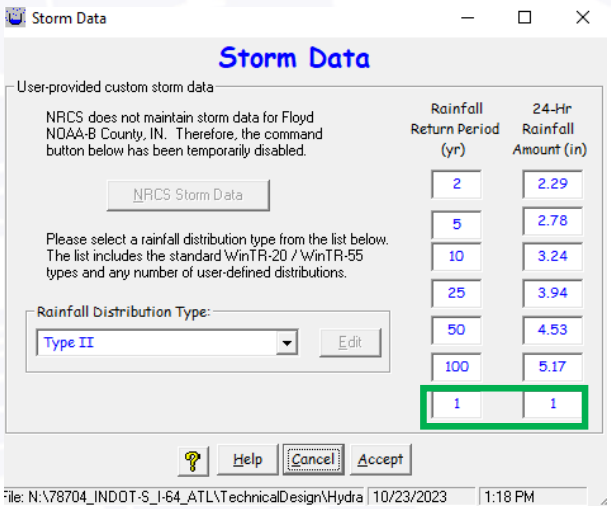
Remaining pavement will be treated in proposed detention pond.

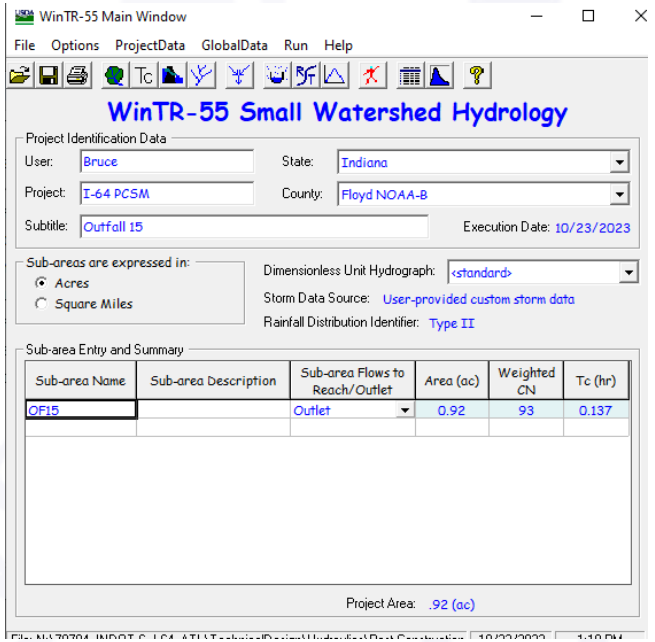
Dry Swale Example (4 of 8)



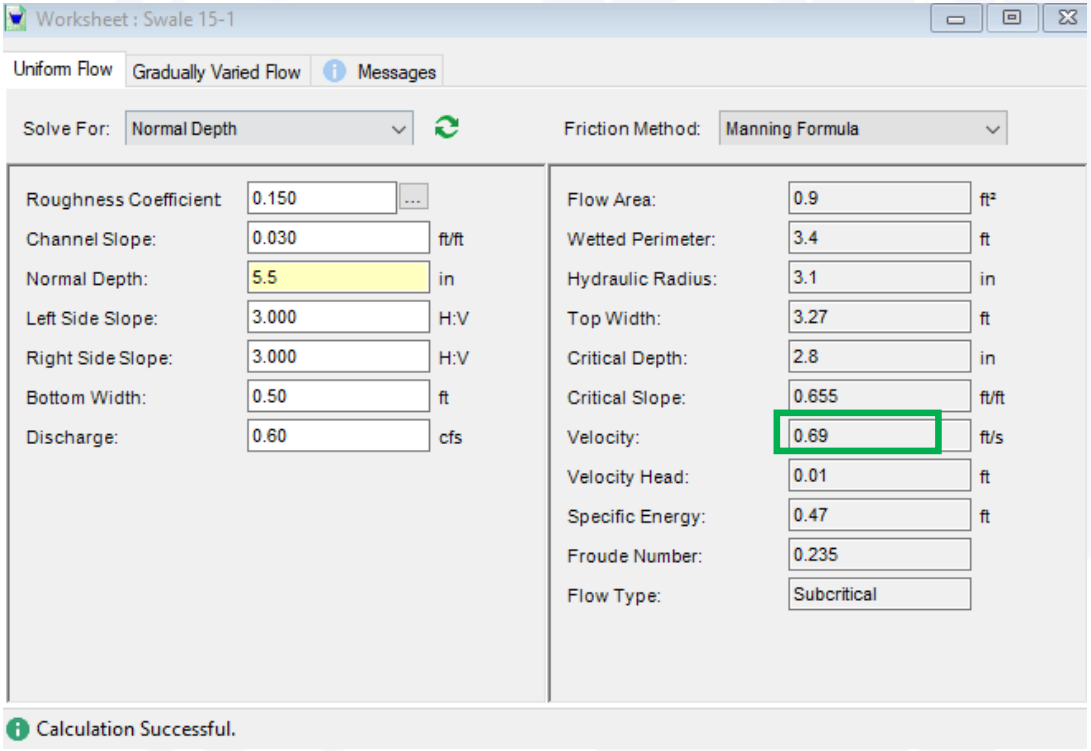
Dry Swale Example (5 of 8)

- CNwq = 93
- Tc = 0.14 hours (obtained using TR-55 Methodology)
- Area draining to swale = 0.92 acres
- NRCS Type II rainfall distribution
  - Depth of rainfall = 1 inch
- NRCS Methodology
- <u>Qwq = 0.6 cfs</u>





Dry Swale Example (6 of 8)



- Qwq = 0.6 cfs
- Length of Swale = 400 feet
- Longitudinal Slope = 0.03 ft/ft
- Bottom Width = 0.5 feet
- Slide Slopes = 3:1
- Manning's n = 0.15
- Depth of flow in channel = 5.5" (less than 6" ->ok)
  - Vegetation = Turf Grass
- Vwq = 0.69 ft/s

Dry Swale Example (7 of 8)

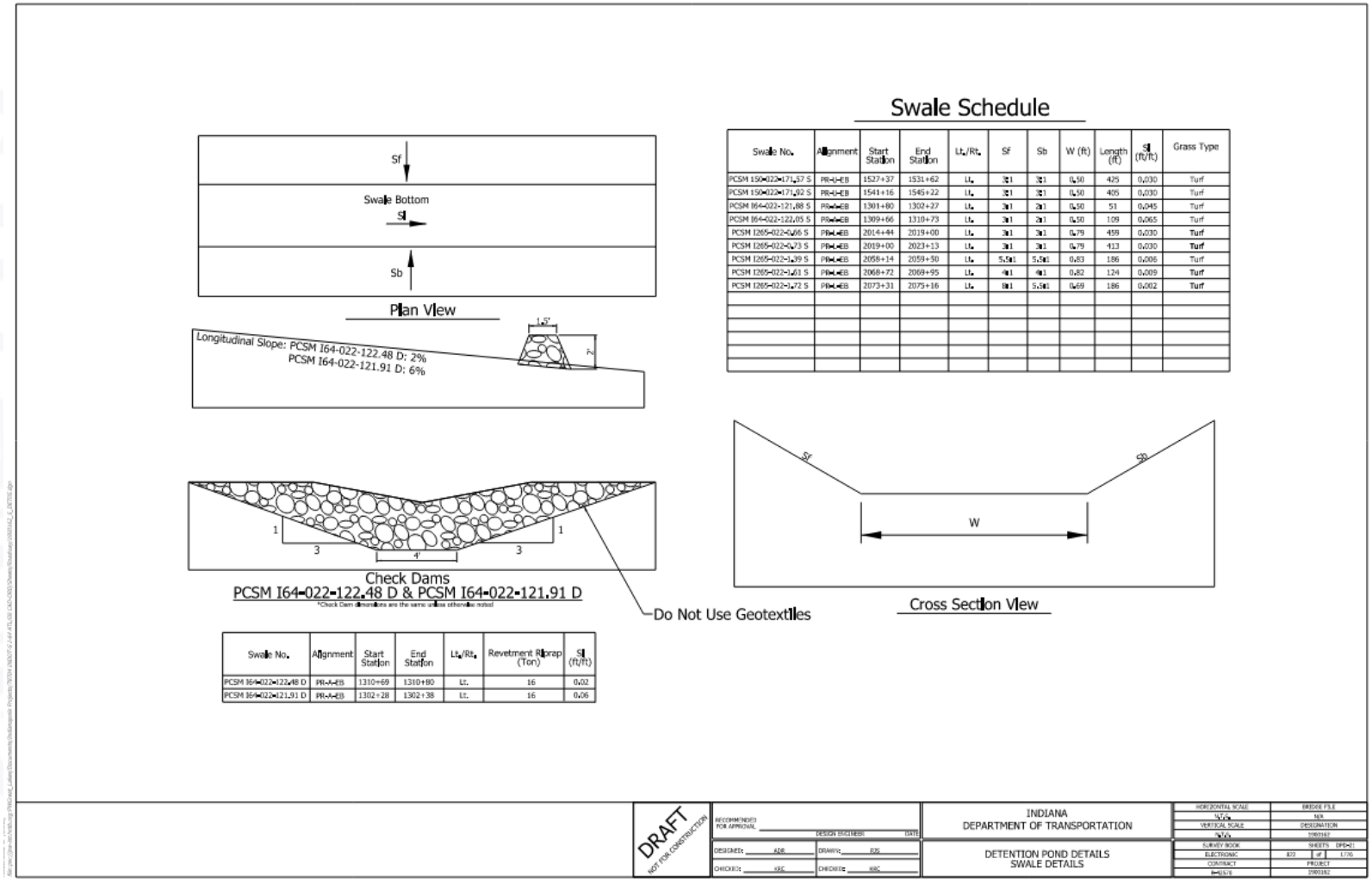
Hydraulic Residence Time Outfall 15

$$T_{ahr} = \frac{(L_{swale}/v_{wq})}{60}$$

L_{swale}	400	Length of swale, feet
v_{wq}	0.69	Peak flow velocity at water quality event, ft/s
T_{ahr}	9.7	Hydraulic residence time, minutes

≥ 9 minutes = 80% TSS Removal -> OK

Dry Swale Example (8 of 8)



Swale Schedule

Swale No.	Alignment	Start Station	End Station	Lt./Rt.	Sf	Sb	W (ft)	Length (ft)	Sl (ft/ft)	Grass Type
PCSM I64-022-171.57 S	PR-A-EB	1527+37	1531+62	Lt.	3:1	3:1	0.50	425	0.030	Turf
PCSM I64-022-171.92 S	PR-A-EB	1541+16	1545+22	Lt.	3:1	3:1	0.50	406	0.030	Turf
PCSM I64-022-121.88 S	PR-A-EB	1301+80	1302+27	Lt.	3:1	3:1	0.50	51	0.045	Turf
PCSM I64-022-122.05 S	PR-A-EB	1309+66	1310+73	Lt.	3:1	3:1	0.50	109	0.065	Turf
PCSM I265-022-0.66 S	PR-A-EB	2014+44	2019+00	Lt.	3:1	3:1	0.79	459	0.030	Turf
PCSM I265-022-0.73 S	PR-A-EB	2019+00	2023+13	Lt.	3:1	3:1	0.79	413	0.030	Turf
PCSM I265-022-1.39 S	PR-A-EB	2058+14	2059+50	Lt.	5.5:1	5.5:1	0.83	186	0.006	Turf
PCSM I265-022-1.61 S	PR-A-EB	2068+72	2069+95	Lt.	4:1	4:1	0.82	124	0.009	Turf
PCSM I265-022-1.72 S	PR-A-EB	2073+31	2075+16	Lt.	8:1	5.5:1	0.69	186	0.002	Turf

Swale No.	Alignment	Start Station	End Station	Lt./Rt.	Revetment Riprap (Ton)	Sl (ft/ft)
PCSM I64-022-122.48 D	PR-A-EB	1310+69	1310+80	Lt.	16	0.02
PCSM I64-022-121.91 D	PR-A-EB	1302+28	1302+38	Lt.	16	0.06

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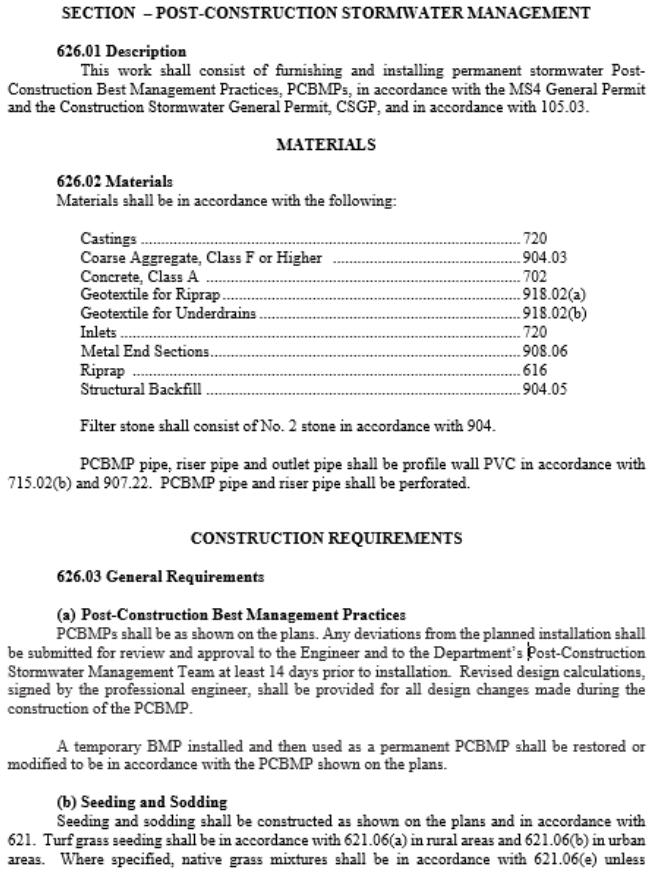
DETENTION POND DETAILS
SWALE DETAILS

NextLevel INDIANA

PCBMP Construction

- PCSM Recurring Special Provisions (RSP) in review by INDOT
- Effective for September Lettings
  - New Pay Items for PCBMP Outlet Pipe and Risers
  - New Standard Drawings
  - After March until September (2025), will use approved RSP as a USP



SECTION – POST-CONSTRUCTION STORMWATER MANAGEMENT

626.01 Description

This work shall consist of furnishing and installing permanent stormwater Post-Construction Best Management Practices, PCBMPs, in accordance with the MS4 General Permit and the Construction Stormwater General Permit, CSGP, and in accordance with 105.03.

MATERIALS

626.02 Materials

Materials shall be in accordance with the following:

Castings	720
Coarse Aggregate, Class F or Higher	904.03
Concrete, Class A	702
Geotextile for Riprap	918.02(a)
Geotextile for Underdrains	918.02(b)
Inlets	720
Metal End Sections	908.06
Riprap	616
Structural Backfill	904.05

Filter stone shall consist of No. 2 stone in accordance with 904.

PCBMP pipe, riser pipe and outlet pipe shall be profile wall PVC in accordance with 715.02(b) and 907.22. PCBMP pipe and riser pipe shall be perforated.

CONSTRUCTION REQUIREMENTS

626.03 General Requirements

(a) Post-Construction Best Management Practices

PCBMPs shall be as shown on the plans. Any deviations from the planned installation shall be submitted for review and approval to the Engineer and to the Department's Post-Construction Stormwater Management Team at least 14 days prior to installation. Revised design calculations, signed by the professional engineer, shall be provided for all design changes made during the construction of the PCBMP.

A temporary BMP installed and then used as a permanent PCBMP shall be restored or modified to be in accordance with the PCBMP shown on the plans.

(b) Seeding and Sodding

Seeding and sodding shall be constructed as shown on the plans and in accordance with 621. Turf grass seeding shall be in accordance with 621.06(a) in rural areas and 621.06(b) in urban areas. Where specified, native grass mixtures shall be in accordance with 621.06(e) unless

Temporary BMP to PCBMP

- If also used as a PCBMP, must be labeled and designated as such
- RSP states requirement for PCBMPs to be restored to condition as shown in the plans
- Cannot construct stone trench with underdrain for use as a temporary BMP

Temporary sediment basins can be converted to PCBMPs with modifications and proper asset designation

Sediment Basin

Available Resources

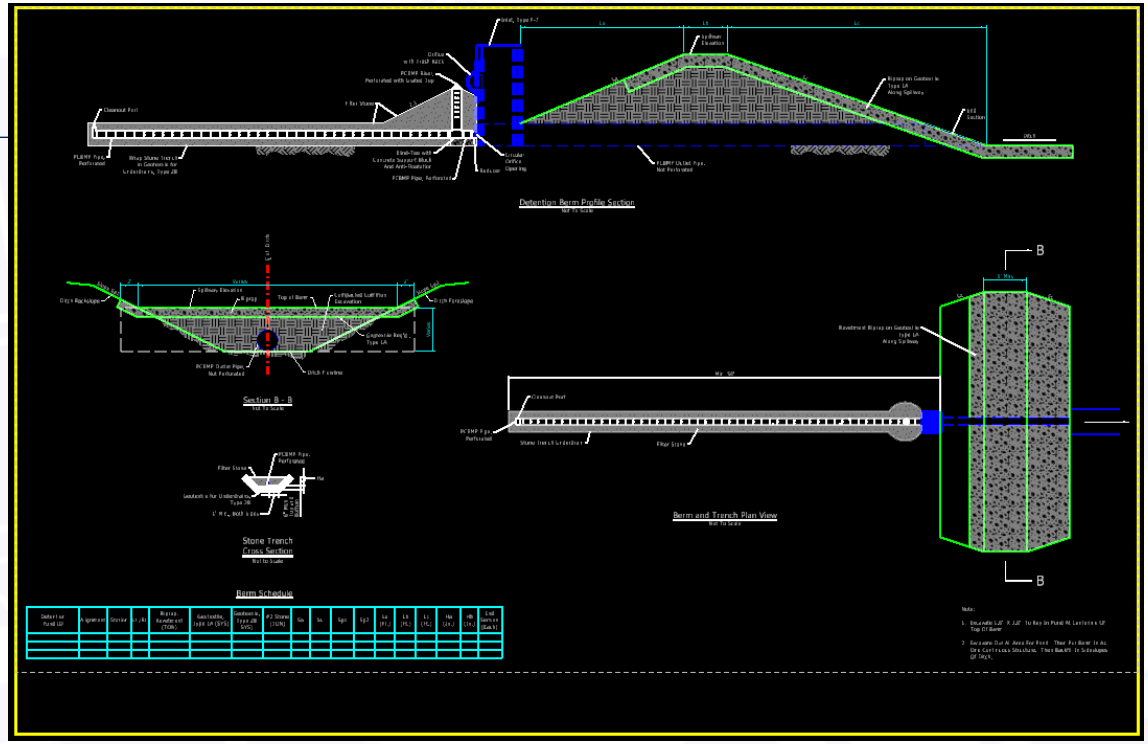
- See Stormwater Webpage
  https://www.in.gov/indot/engineering/environmental-services/storm-water/
- Design Memorandum 22-22
- Post-Construction Stormwater Management Guidance
- Submittal Guidance
- PCBMP Naming Guidance
- Hydraulic Residence Time Calculation Template
- Water Quality Volume Calculation Template
- Maintenance Plan Templates
- CADD Templates for Detention Outlets and Swales

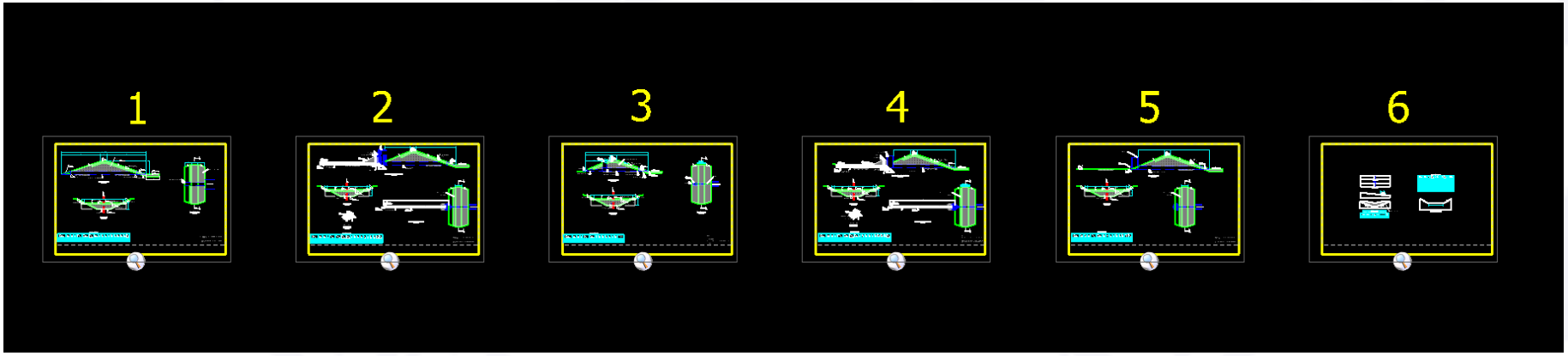
CADD Templates

- Templates available here:

https://www.in.gov/indot/engineering/environmental-services/storm-water/

- Includes 5 detention outlet structure templates and 1 template for swales
- INDOT QPL for trash racks to be released soon





Frequently Asked Questions

- When determining the value for net added impervious surface, do cross overs or other temporary pavements count?
  - ✓No, only permanent impervious surface is included in the calculation.
- According to Table 1 in DM 22-22, my project does require PCBMPs. Please provide more guidance for what should be done to credit PCBMPs already included in the design through supporting calculations and how do we designate as a PCBMP?
  - ✓Credit PCBMPs already included in the design means if there are detention, infiltration, or grass swales already included in the design, perform calculations to show they provide water quality treatment. Even if the full 80% TSS target removal cannot be achieved, perform the calculations to show some removal is achieved.
  - ✓To designate as a PCBMP, include each PCBMP in the plans per the Submittal Requirements Document https://www.in.gov/indot/engineering/files/PCSM-Submittal-Requirements-9-2024.pdf
  - ✓All PCBMPs require a report (one per project). See the PCSM Submittal Requirements document listed above.

Frequently Asked Questions

- If I'm already designing a detention basin for the job, does that automatically qualify as a PCBMP or do I have to specifically design one?
  - ✓ Calculations have to be developed per the PCSM Guidance Document and submitted with the PCSM Report for a detention facility to count for water quality requirements.
- How do I determine what county number to use for naming PCBMPs?
  - ✓ https://www.in.gov/fssa/dfr/files/Indiana_county_numbers_names.pdf
- How do I find the reference post numbers to use for naming PCBMPs?
  - ✓ https://www.indianamap.org/datasets/indot-reference-posts/about
- I have two projects with two DES numbers but under one INDOT contract. They both require a CSGP; however, their combined net added impervious surface is just over an acre. Do we consider them one project or two for determining how much net added impervious surface there is (and therefore if PCBMPs are required)?
  - ✓ The net added impervious surface for the two DES numbers should be combined when the following conditions are met:
    - ✓ The projects are less than or equal to 0.25 miles of the closest point of each other.
    - ✓ The projects outlet to the same perennial stream based on the 1:24,000 USGS Topo Quad solid blue line streams.

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Questions