

TRAINING MODULE 1

Delaware Urban Runoff Management Model

DURMM v2.5

Quick-Start Guide



Introduction

This Quick-Start Guide has been developed as an overview of the basic use of the 2nd version of the Delaware Urban Runoff Management Model (DURMM). It is not intended to serve as a detailed description of each cell in the spreadsheet or the algorithms used in those cells. The Quick-Start Guide first describes the general workflow and data input, then continues with two examples illustrating typical uses of the model to meet the requirements of the 2019 Delaware Sediment & Stormwater Regulations (DSSR). The final series of slides describes typical project set-up options.

Users should always make sure they're using the latest version of DURMM v2.5, which is available for download from the Sediment & Stormwater Program website. Contact the Sediment & Stormwater Program (DNREC.Stormwater@delaware.gov) for additional information.

The latest version of DURMM v2.5 can be found here: [Plan Review, Engineering, Construction and Maintenance Resources - DNREC Alpha \(delaware.gov\)](#)

Use the "Save-As" option to download the Microsoft Excel file.

NOTE: Designers proposing redevelopment projects in New Castle County will need to download the alternate version of DURMM for applicable projects.

Downloading DURMM v2.5

The following are resources from the [DNREC Sediment and Stormwater Program](#) for sediment and stormwater plan reviews, engineering design, construction activities and maintenance of best management practices.

[Plan Review](#) **Engineering** ¹ [Construction Review](#) [Maintenance](#)

Tutorials and Presentations
[Downstream Analysis Procedure to Show Cv and Fv Compliance](#)
[DURMM v2.5 Quick Start Guide](#)

Spreadsheets
 (Note: These are excel files and should be saved to your computer and used offline)
[Delaware Urban Runoff Management Model \(DURMM\) v2.51 Excel Spreadsheet](#)
[Delaware Urban Runoff Management Model \(DURMM\) v2.51 Excel Spreadsheet for Redevelopment in New Castle County](#) ²

[RPv Summary Table](#) ³
[BMP Design Worksheet](#) ⁴

References
[Pond Code 378 for Urban Stormwater Management Ponds](#)
[Delaware Regulatory Rainfall Amounts](#)
[DNREC Approved Stormwater Management Structures](#)
[DNREC Approved Software for Hydrologic & Hydraulic Modeling](#)
[Approved Biosoil-14 Suppliers](#)

DELAWARE DEPARTMENT OF NATURAL RESOURCES AND ENVIRONMENTAL CONTROL

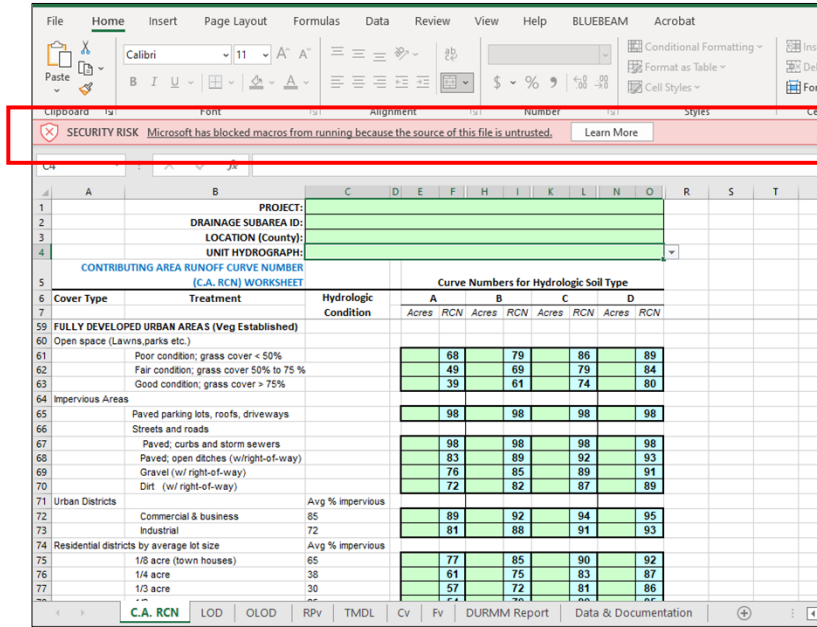
Users should always make sure they’re using the latest version of DURMM v2.5, which is available for download from the Sediment & Stormwater Program website. Contact the Sediment & Stormwater Program (DNREC.Stormwater@delaware.gov) for additional information.

The latest version of DURMM v2.5 can be found here: [Plan Review, Engineering, Construction and Maintenance Resources - DNREC Alpha \(delaware.gov\)](#)

1. Select the “Engineering” tab.
2. Two versions of the DURMM spreadsheets are available for projects
 - The first version depicted is utilized statewide.
 - The second version depicted is utilized for redevelopment projects within the jurisdiction of New Castle County Land Use. All other projects should utilize the first version of DURMM.
3. The RPv Summary Table is used to demonstrate compliance with the RPv requirements under the 2019 DSSR.
4. The BMP Design Worksheet is a spreadsheet used to assist in the design of Sheet Flow to Filter Strips (BMP 9.0), Traditional Constructed Wetlands (BMP 12.0), and Afforestation (BMP 17.0)

Use the “Save-As” option to download the Microsoft Excel file to be edited offline.

Security Settings



Upon opening a newly downloaded DURMM, you'll notice the "Security Risk" banner at the top. Current Microsoft settings default to disable macros.

For more information or for instructions to enable macros click "Learn More"

DURMM v2.5

Basic Workflow & Data Input



DURMM v.2 Layout

Layout

DURMM v.2.5 was developed using Microsoft’s Excel 2016 spreadsheet program. However, it should be compatible with any version back to Excel 97. There are several macros that allow clearing and resetting some of the user input cells, however these are not absolutely necessary for the model to function properly. Upon initial use of the model, the user will be prompted to allow the use of the macros. Enabling macros varies depending on the version of Excel being used.

The model itself consists of 8 worksheets. The general workflow proceeds from one worksheet to the next in a left-to-right direction. The cells within each worksheet are color-coded, as follows:

- Green Cells – cells intended for user input
- Cyan Cells – cells that contain either pre-set values or secondary output
- Magenta Cells - cells that contain calculated results for primary output
- Orange Cells – these cells are used to input data from upstream contributing areas as explained further on Page #5

DURMM v2.5

Explanation of Worksheets



The next series of slides describe each of the 8 worksheets included in the model and some of the important elements contained in that sheet.

“C.A. RCN” Worksheet

“C. A. RCN” Worksheet

The “C. A. RCN” worksheet is used to determine the weighted Runoff Curve Number (RCN) for the entire contributing area under analysis. Key elements of this worksheet include:

1. Project Data: Project name and subarea ID are entered in the green cells provided. The county location and unit hydrograph are then selected from their respective dropdown lists. This information will be carried over to other worksheets without the need for additional user input.
2. Land Cover Data: Acres of land cover by Hydrologic Soil Group (HSG) and hydrologic condition within the contributing area are entered in the green cells. The table is set up similar to the standard RCN tables in TR-55. The “User defined urban” cells can be used to enter RCN values not included in the standard table, with prior approval.
3. The default setting for this worksheet opens to the urban land cover data. However, the scroll button can be used to scroll up to other land cover descriptions as used in TR-55.
4. User Defined: The spreadsheet includes two (2) lines for user defined land cover, hydrologic condition, acreage and RCN. User defined values require concurrence by DNREC and/or Delegated Agency.
5. Upstream Contributing Areas: The ID, acreage and RCN for up to four (4) previously analyzed upstream areas within the total contributing area can be entered by the user. Data for these cells will be in the separate DURMM Report for those contributing areas.
6. Total acreage and weighted RCN of the total contributing area are computed and reported in their respective fields.
7. The “Clear Table” button can be used to clear all user supplied data from the worksheet and reset any user-defined values.

NOTES:

- Acreage values should be entered to no more than two (2) decimal places. A popup warning to this effect will appear if a user tries to enter values greater than 2 decimal places.
- Acreage values within the project Limit of Disturbance (LOD) for the subarea under analysis is assumed to be fully captured by the BMP(s) entered on the Rpv Sheet unless a Project Level Analysis is being performed in accordance with the procedures covered later in this module.

“LOD” Worksheet

The screenshot shows a spreadsheet titled "LIMIT OF DISTURBANCE (LOD) WORKSHEET". It is divided into four main sections:

- Step 1 - Subarea LOD Data:** Contains input fields for HSG Area Within LOD (ac), Pre-Developed Woods/Meadow Within LOD (ac), Pre-Developed Impervious Within LOD (ac), Post-Developed Imperviousness Within LOD (ac), and Post-Developed Imperviousness Within LOD, Option #2 (%).
- Step 2 - Subarea LOD Runoff Calculations:** Contains calculated values for RCN per HSG, Rpv per HSG (in.), Target RCN per HSG, Target Runoff per HSG (in.), Subarea LOD (ac), Subarea Weighted RCN, Subarea Weighted Rpv (in.), and Subarea Weighted Target Runoff (in.).
- Step 3 - Upstream LOD Areas (from previous DURMM report as applicable):** Contains input fields for Upstream Sub-Area ID, Upstream Contributing Area (ac), Target Runoff for Upstream Area (in.), Adjusted Cv after all reductions, Adjusted Rpv (in.), Adjusted Cv (in.), and Adjusted Fv (in.).
- Step 4 - Rpv Calculations for Combined LOD:** Contains calculated values for Combined LOD (ac), Weighted RCN, Weighted Rpv (in.), Weighted Target Runoff (in.), Estimated Annual Runoff (in.), Required Runoff to be Managed within LOD (in.), and Required Runoff to be Managed within LOD (%).

Red boxes and numbers 1-5 highlight specific features: 1 points to the HSG input cells; 2 points to the runoff calculation cells; 3 points to the upstream area input table; 4 points to the combined LOD calculation cells; and 5 points to a "RESET" button.

“LOD” Worksheet

This worksheet is used to determine the runoff reduction requirement within the proposed limit of disturbance of the drainage subarea. Since the DSSR only require management of disturbed areas, this may or may not coincide with the total contributing area that drains to the BMPs within that subarea. Key elements of this worksheet include:

1. Total LOD acreage by HSG is entered in the first row of green cells. Acreage of any pre-developed woods/meadow within the LOD is entered in the next row. Post-developed imperviousness is then entered as either an acreage or as a percentage in the respective cells provided. (NOTE: Entering imperviousness as a percentage will overwrite a formula in those cells. See #5 below.)
2. The subarea Rpv runoff and target runoff is calculated in this section.
3. Data from up to four (4) previously analyzed upstream subareas are entered in this section. Data is taken from the appropriate DURMM reports for those subareas.
4. A weighted runoff volume for the Resource Protection Event is calculated based on the data entered above along with an estimate of the annual runoff volume. The required runoff reduction is then calculated in watershed inches and percent reduction.
5. The “RESET” button clears any user input data and resets the formulas used in the imperviousness cells.

NOTE: Acreage values should be entered to no more than two (2) decimal places. A popup warning to this effect will appear if a user tries to enter values greater than 2 decimal places.

“OLOD” Worksheet

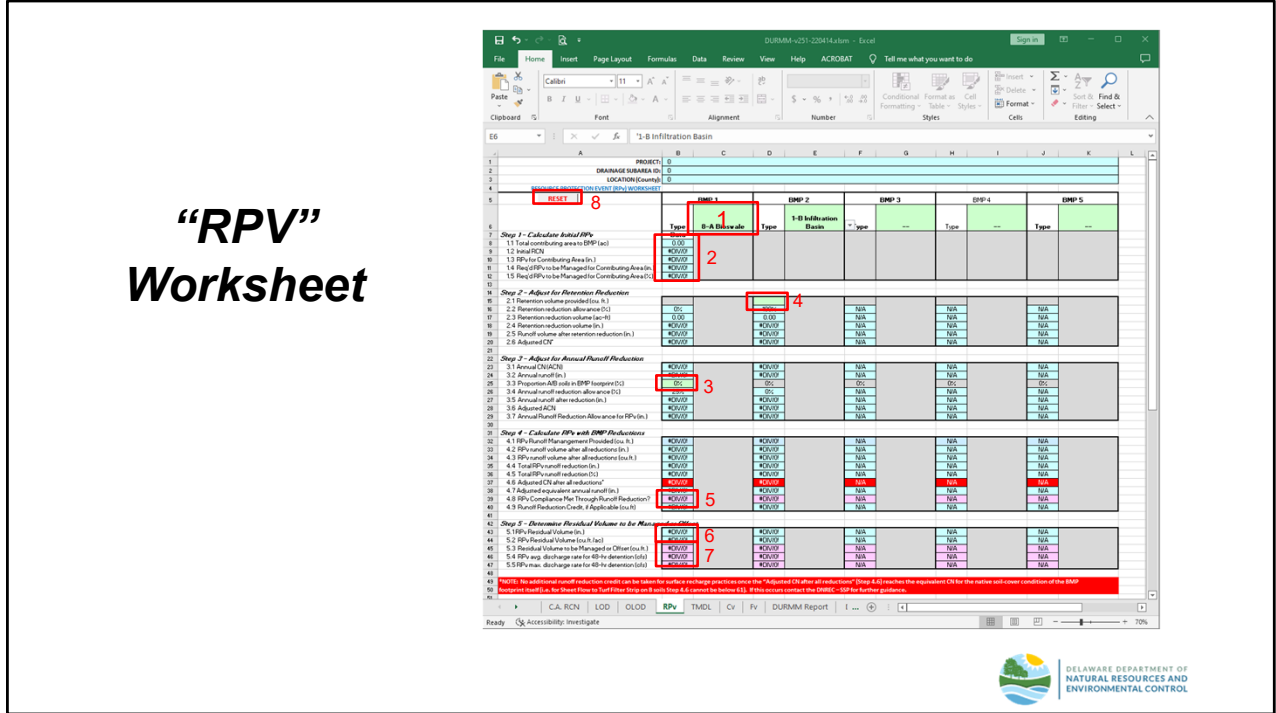
“OLOD” Worksheet

This worksheet is used to account for runoff that is outside the LOD, but within the total contributing area of the BMP drainage subarea. If the total contributing area and the LOD coincide, this worksheet may be skipped. Key elements on this sheet include:

1. Data entered previously for the “C.A. RCN” and “LOD” worksheets are used to calculate the area outside the LOD and the RCN for that area. If the total contributing drainage area and LOD coincide, the result will display “N/A” for these cells.
2. Data used to determine the time of concentration for the area outside the LOD is entered in the green cells. There are allowances for 3 sheet flow, 3 shallow concentrated flow and 5 open channel flow segments. (NOTE: The user must supply an estimated velocity for the open channel flow segments; it is not calculated within the model.) The total time of concentration for the area outside the LOD is calculated in the magenta cell.
3. The “Clear Tc” button can be used to clear any user input for the Time of Concentration calculation.
4. The peak discharge for the Conveyance Event and the Flooding Event are calculated in their respective magenta cells.

NOTE: The “OLOD” sheet provides a good way to check for errors previously entered on the “C.A. RCN” and “LOD” worksheets. Negative acreage values at Step 1.5 and/or RCN values exceeding 100 at Step 1.4 indicate such errors.

“RPV” Worksheet



“RPV” Worksheet

This worksheet is used to calculate the runoff reduction for the selected BMP suite and check for compliance for the Resource Protection Event. Key elements on this sheet include:

1. User selects a BMP from the dropdown list. BMP 1 would represent the most upstream BMP if a treatment train is proposed. Numbering then proceeds downstream for subsequent BMPs.
2. The model adjusts the runoff reduction requirement for the LOD to the total contributing area. It also checks to ensure any weighted adjustment is no less than the requirement for the LOD itself. The required reduction is calculated in both watershed inches and as a percentage.
3. If the BMP selected has an annual runoff reduction component (refer to “Data & Documentation” sheet, Page 14), the proportion of the BMP footprint in soils in HSG A/B is entered in the green cell and the appropriate runoff reduction value is entered by the model.
4. If the BMP selected has a retention storage component (refer to “Data & Documentation” sheet, Page 14), the available storage in cubic feet is entered in the green cell.
5. The model calculates the retention reduction and/or the annual runoff reduction and checks to see if the required reduction has been met.
6. If the required runoff reduction is not met, the model calculates the residual runoff volume that must be managed using detention or other means, such as an on-site credit or off-site offset.
7. If the residual volume will be managed using a detention practice, these cells contain the calculated average and maximum discharge rates to be used for design and compliance.
8. The “RESET” button can be used to clear user input data from the worksheet to model a different BMP suite.

“TMDL” Worksheet



“TMDL” Worksheet

This worksheet is used to calculate the Total Maximum Daily Load (TMDL). Although compliance is not currently based on specific TMDL targets, the Department is collecting this data to assess attainment of overall watershed TMDL goals. The BMP suite selected on the RPv worksheet is carried over to this sheet, precluding the need to input any BMP data. Key elements on this sheet include:

1. The user selects the appropriate TMDL watershed from the dropdown list.
2. The model calculates the total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) annual pollutant load in milligrams and pounds based on the runoff volume calculated previously and the Event Mean Concentrations (EMCs) provided in the model.
3. The adjusted runoff volume is carried over from the RPv worksheet.
4. Load reduction is calculated based on the input loads and adjusted runoff reduction. Additional adjustment is calculated for removal efficiency.
5. The model checks to determine if the pollutant reduction goal for the TMDL watershed has been met and calculates a final adjusted annual load for TN, TP and TSS for reporting purposes.

NOTE: There is currently no regulatory requirement under the 2019 DSSR to meet a specific TMDL target. However, DNREC requires the TMDL Worksheet to be completed for all projects in order to provide data for tracking TMDL progress.

“Cv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
6	Type: --	Type: --	Type: --	Type: --	Type: --
7	Data	Data	Data	Data	Data
8	0.00	0.00	0.00	0.00	0.00
9	NOVOT				
10	N/A				
11	N/A				
12					
13	Step 2 - Adjust for Retention Reduction				
14	N/A	N/A	N/A	N/A	N/A
15	N/A	N/A	N/A	N/A	N/A
16	N/A	N/A	N/A	N/A	N/A
17	N/A	N/A	N/A	N/A	N/A
18	N/A	N/A	N/A	N/A	N/A
19					
20	Step 3 - Adjust for Annual Runoff Reduction				
21	N/A	N/A	N/A	N/A	N/A
22	N/A	N/A	N/A	N/A	N/A
23	N/A	N/A	N/A	N/A	N/A
24	N/A	N/A	N/A	N/A	N/A
25					
26	Step 4 - Calculate Cv with BMP Reductions				
27	N/A	N/A	N/A	N/A	N/A
28	N/A	N/A	N/A	N/A	N/A
29	N/A	N/A	N/A	N/A	N/A
30					



“Cv” Worksheet

This worksheet calculates the effect of runoff reduction practices for the Conveyance (10-YR) Event. The BMP suite selected on the Rpv worksheet is carried over to this sheet, precluding the need to input any BMP data. All other cells are calculated based on data entry and results from previous worksheets. Reductions based on available storage are given full credit. However, the adjustments for runoff reduction BMPs are lower than those for the Resource Protection Event since they are less able to mitigate runoff from a storm of this magnitude.

“Fv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
6	Type: --	Type: --	Type: --	Type: --	Type: --
7	Data	Data	Data	Data	Data
8	1.1 Total contributing area to BMP (ac)	0.00	0.00	0.00	0.00
9	1.2 Initial RCU	0.00	0.00	0.00	0.00
10	1.3 100-Year Rainfall (in.)	N/A	N/A	N/A	N/A
11	1.4 Fv runoff volume (in.)	N/A	N/A	N/A	N/A
13	Step 2 - Adjust for Retention Reductions				
14	2.1 Storage volume (cu. ft.)	N/A	N/A	N/A	N/A
15	2.2 Storage volume (ac-ft)	N/A	N/A	N/A	N/A
16	2.3 Storage volume (in.)	N/A	N/A	N/A	N/A
17	2.4 Runoff volume after reduction (in.)	N/A	N/A	N/A	N/A
18	2.5 CIP	N/A	N/A	N/A	N/A
20	Step 3 - Adjust for Annual Runoff Reduction				
21	3.1 Runoff reduction efficiency (%)	N/A	N/A	N/A	N/A
22	3.2 Annual runoff after reduction (in.)	N/A	N/A	N/A	N/A
23	3.3 Adjusted RCU	N/A	N/A	N/A	N/A
24	3.4 Event-based runoff reduction (in.)	N/A	N/A	N/A	N/A
26	Step 4 - Calculate Fv with BMP Reductions				
27	4.1 Fv runoff volume after all reductions (in.)	N/A	N/A	N/A	N/A
28	4.2 Total Fv runoff reduction (%)	N/A	N/A	N/A	N/A
29	4.3 Adjusted RCU for inlet modeling	N/A	N/A	N/A	N/A



“Fv” Worksheet

This worksheet calculates the effect of runoff reduction practices for the Flooding (100-YR) Event. The BMP suite selected on the Rv worksheet is carried over to this sheet, precluding the need to input any BMP data. All other cells are calculated based on data entry and results from previous worksheets. Reductions based on available storage are given full credit. However, the adjustments for runoff reduction BMPs are even lower than those for the Conveyance Event since they have minimal ability to mitigate runoff from a storm of this magnitude.

“DURMM Report” Worksheet

Row	Field	Value
5	DURMM Version	DURMM v2.5.yymmdd
20	BMP Suite	BMP 1, BMP 2, BMP 3, BMP 4, BMP 5
26	RPV Residual Volume	BMP 1, BMP 2, BMP 3, BMP 4, BMP 5
42	RPV Annual Pollutant Load	BMP 1, BMP 2, BMP 3, BMP 4, BMP 5
45	RPV Annual Pollutant Load	BMP 1, BMP 2, BMP 3, BMP 4, BMP 5

“DURMM Report” Worksheet

This worksheet summarizes the results from the previous worksheets in a format suitable for submission with the project application package. Some key elements include:

1. DURMM version.
2. Summary of BMP suite selected.
3. Determination of compliance with runoff reduction requirements and any residual volume to be managed with detention or other means.
4. Determination of final annual pollutant loads.
5. Summary of results for the RPv event.

The remaining sections of the DURMM Report worksheet are continued on the Page 13.

NOTE: The DURMM version is shown in the header of the report using the format:

DURMM v2.5#.yymmdd

The most current version of DURMM v2.5 should always be used for submission.



“DURMM Report” Worksheet (cont.)

Row	Description	Value	Annotation
49	Cv runoff volume (in.)	#N/A	6
50	Adjusted RCN for rRt Modeling (CN*)	0.00	
53	Fv runoff volume (in.)	#N/A	7
54	Equivalent RCN for rRt Modeling (CN*)	0.00	
57	Subarea ID	0.00	8
58	Contributing Area (ac.)	0.00	
59	Weighted Target Runoff (in.)	#N/A	
60	Adjusted Ck after all reductions	0.00	
61	Adjusted RPr (in.)	0.00	
62	Adjusted Cv (in.)	0.00	
63	Adjusted Fv (in.)	0.00	
66	Contributing Area (ac.)	0.00	9
67	LOD Area (ac.)	0.00	
68	TN Pollutant Load (lb/yr)	0.00	
69	TP Pollutant Load (lb/yr)	0.00	
70	TSS Pollutant Load (lb/yr)	0	
71	Percent Impervious Cover	#N/A	
74	Subarea ID	0.00	10
75	Contributing Area (ac.)	0.00	
76	RPr Residual Volume (cu ft)	0	
77	Adjusted Ck after all reductions	0.00	
78	Cv RCN for rRt Modeling	0.00	
79	Fv RCN for rRt Modeling	0.00	
80	TN Pollutant Load (lb/yr)	0.00	
81	TP Pollutant Load (lb/yr)	0.00	
82	TSS Pollutant Load (lb/yr)	0	



“DURMM Report” Worksheet (cont.)

The information in the remaining sections is largely self-explanatory. However, some key elements include:

6. Results for Conveyance Event (Cv).
7. Results for Flooding Event (Fv).
8. Data to be used for downstream DURMM modeling.
9. Data to be used with the DNREC Nutrient Protocol model.
10. Data to be used for external quantity and/or quality modeling.

The report allows a reviewer to quickly determine if the runoff reduction requirements have been met and the calculated pollutant reductions. If these requirements could not be satisfied due to site constraints or other justifiable technical reasons, the site would be subject to the offset provisions of the DSSR.

“Data & Documentation” Worksheet

The screenshot displays an Excel spreadsheet with the following columns: A (ID), B (BMP Category), C (BMP System), D (TA Reduction), E (TP Reduction), F (SP Reduction), G (TS Reduction), H (Retention Allowance), I (Annual Runoff Reduction, %), J (Annual Runoff Reduction, CFS), and K (Annual Runoff Reduction, Acre-Feet). The table lists various BMPs such as 'Annual Runoff Reduction Practice 1', 'Retention Practice 5-A', 'Annual Runoff Reduction Practice 36', etc., with corresponding numerical values for each category.

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“Data & Documentation” Worksheet

This worksheet summarizes the runoff reduction values used in calculations on the “RPV” sheet for all available Best Management Practices (BMPs). These values are derived from the appropriate Standards & Specifications for those BMPs. They are categorized as either “Retention Allowance” or “Annual Runoff Reduction” depending on the type of BMP. Reductions for Cv and Fv are also included where applicable.

DURMM v2.5

“Broadkill Estates” Example Site Ex. #1: Concept Level Analysis



Example #1: Concept Level Analysis

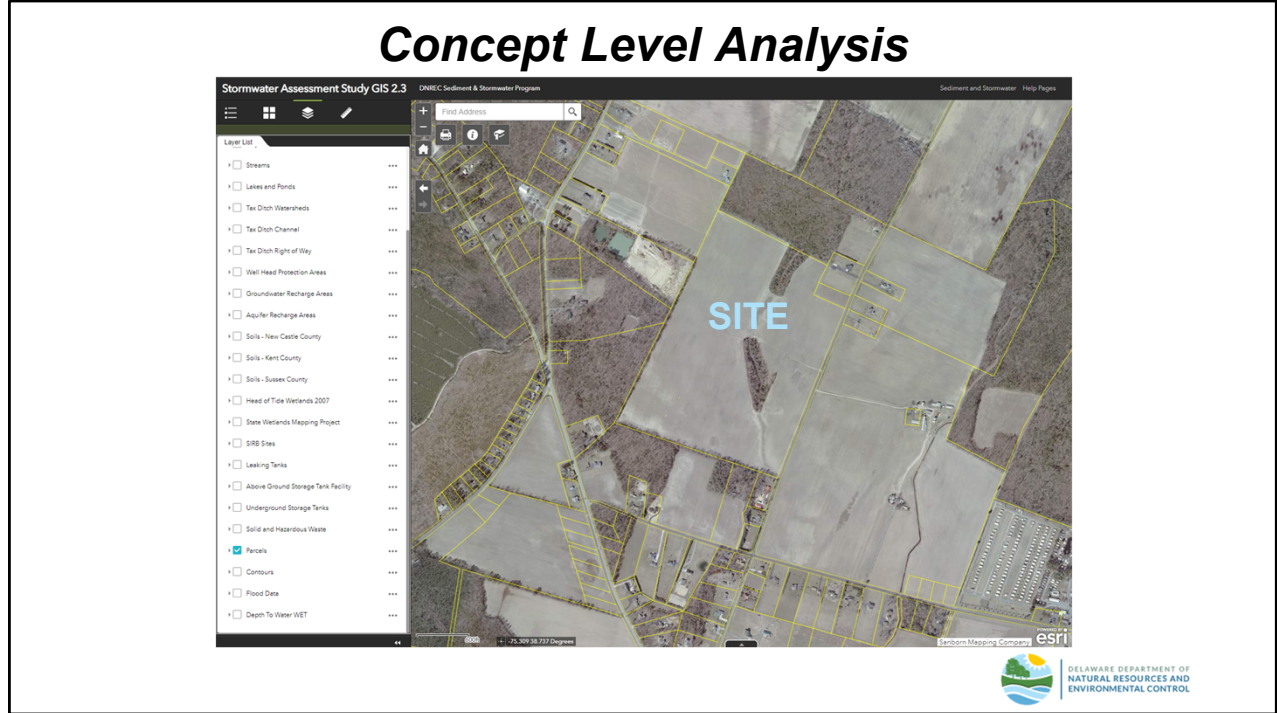
The procedures outlined in the previous section will now be used to perform a typical concept level analysis for a fictional land development project named “Broadkill Estates”. For the purposes of this example, a concept level analysis assumes an artificial watershed boundary that coincides with the parcel boundary.

Concept Level Analysis



Data Sources

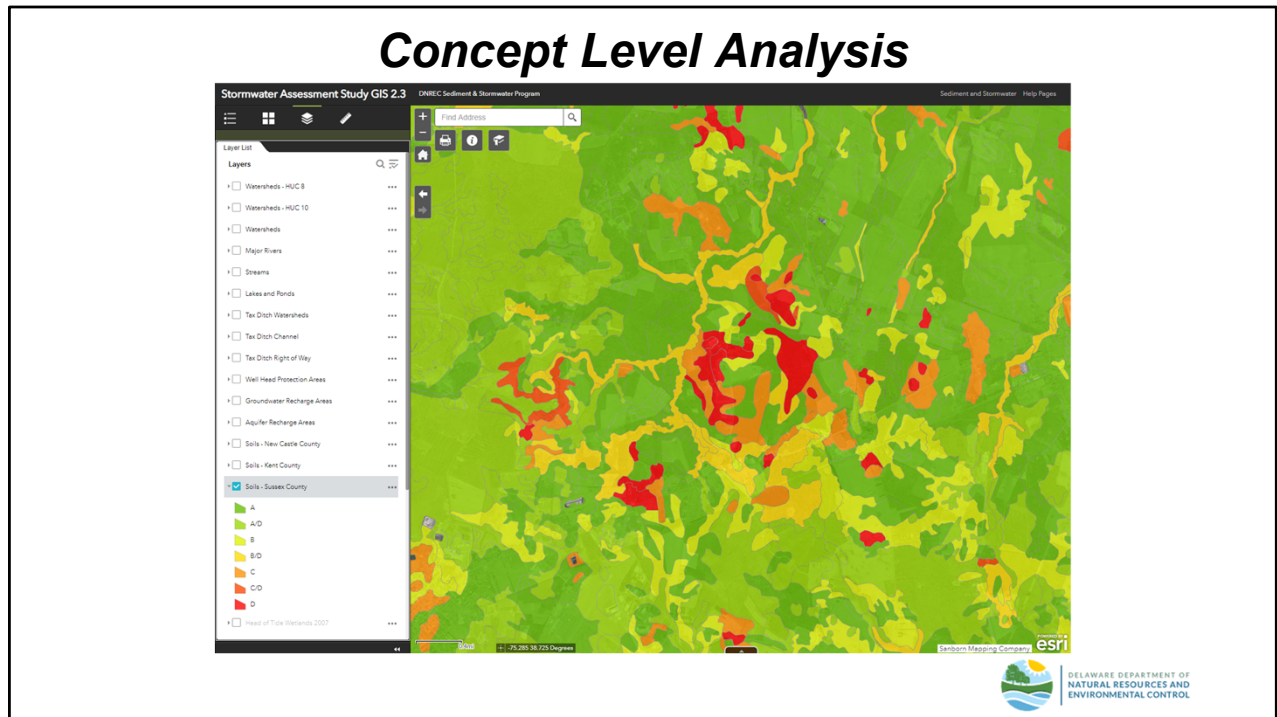
The information compiled for the Stormwater Assessment Study (SAS) will provide the necessary data inputs for the analysis.



Site GIS Data

The Stormwater Assessment Study GIS App is an on-line GIS tool that can be used for collecting data necessary to perform the DURMM analysis. The SAS GIS App is available at the following link:

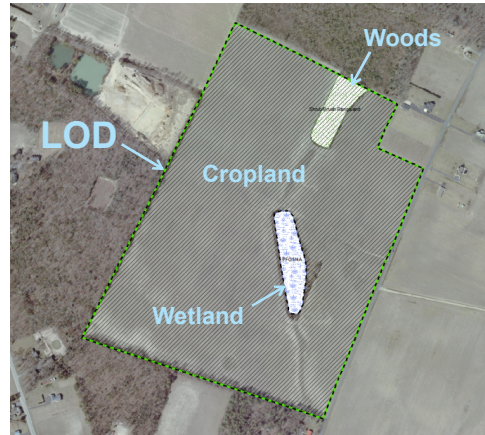
<https://firstmap.delaware.gov/sasgis>



Soils Data

The Soils layer contains information on Hydrologic Soil Group (HSG) of the various soils on the site that is used by the model to determine runoff volume.

Concept Level Analysis



Proposed LU: Residential, 1 ac. lots



Existing and Proposed Conditions

The majority of the site consists of existing cropland. A small tributary bisects the site into two major drainage subareas. Although the tributary has been partially piped to facilitate cultivation, a small wetland area is located near the center of the site. There is also a small area of scrub/shrub forest at the downstream discharge point of the site.

“Broadkill Estates” has been proposed as a single-family residential site with an average lot size of 1 acre. For purposes of the concept level analysis, the Limit of Disturbance (LOD) has been assumed to coincide with the parcel boundary, except for the wetland area which will remain undisturbed.

Concept Level Analysis Site Data



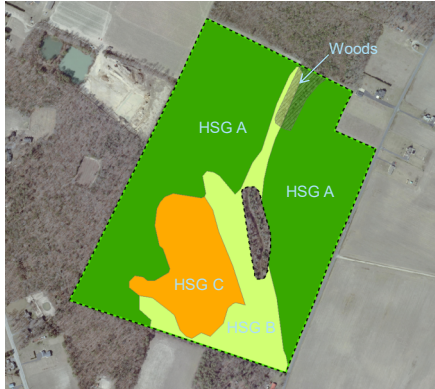
- C.A. RCN Tab
 - Residential, 1-ac. (20% imperv.)
 - HSG A: 70.07 ac.
 - HSG B: 17.10 ac.
 - HSG C: 15.56 ac.



Data Inputs – “C.A. RCN” Worksheet

The slide above summarizes the data that will be input to the “C.A. RCN” worksheet. The colored soil mapping areas are considered the total LOD for the Conceptual Level Analysis. The unshaded area is a delineated wetland that will remain undisturbed.

Concept Level Analysis Site Data



- LOD Tab
 - HSG A
 - LOD Area: 70.07 ac.
 - Pre-Dev. Woods: 1.55 ac.
 - Post-Dev. Impervious: 20%
 - HSG B
 - LOD area: 17.10 ac.
 - Pre-Dev. Woods: 0.80 ac.
 - Post-Dev. Impervious: 20%
 - HSG C
 - LOD Area: 15.56 ac.
 - Pre-Dev. Woods: 0 ac.
 - Post-Dev. Impervious: 20%



Data Inputs – “LOD” Worksheet

The slide above summarizes the data that will be input to the “LOD” worksheet. Since the analysis assumes an artificial watershed boundary that coincides with the parcel boundary and LOD, the “OLOD” worksheet is not needed for the Concept Level Analysis.

“C.A. RCN” Worksheet

“C.A. RCN” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. Acreage values should be entered to no more than two (2) decimal places, otherwise a popup error message will appear. The model has calculated the following results:

- Total Acreage: 103
- Weighted RCN: 58

In keeping with NRCS tradition, results for the RCN are reported in rounded whole numbers on this worksheet even though the internal calculations are performed at the standard level of precision used in Excel.



“LOD” Worksheet

LIMIT OF DISTURBANCE (LOD) WORKSHEET				
Step 1 - Subarea LOD Data				
1.1 HSG Area Within LOD (ac)	HSG A	HSG B	HSG C	HSG D
1.2 Pre-Developed Wood/Meadow Within LOD (ac)	70.07	17.11	15.56	
1.3 Pre-Developed Impervious Within LOD (ac)	1.95	7.9		
1.4 a Post-Developed Imperviousness Within LOD, Option #1 (ac) (60%)				
1.4 b Post-Developed Imperviousness Within LOD, Option #2 (%)	20%	20%	20%	0%
Step 2 - Subarea LOD Runoff Calculations				
2.1 RCN per HSG	50.80	68.40	78.90	0.00
2.2 RPV per HSG (in.)	0.21	0.64	0.98	0.00
2.3 Target RCN per HSG	38.80	60.72	74.00	0.00
2.4 Target Runoff per HSG (in.)	0.21	0.64	0.98	0.00
2.5 Subarea LOD (ac)	102.73			
2.6 Subarea Weighted RCN	57.97			
2.7 Subarea Weighted RPV (in.)	0.57			
2.8 Subarea Weighted Target Runoff (in.)	0.43			
Step 3 - Upstream LOD Areas (Imperviousness EXCLUDED Report as split)				
	Area 1	Area 2	Area 3	Area 4
3.1 Upstream Sub-Area ID				
3.2 Upstream Contributing Area (ac)				
3.3 Target Runoff for Upstream Area (in.)				
3.4 Adjusted CV after all reductions				
3.5 Adjusted RPV (in.)				
3.6 Adjusted Cv (in.)				
3.7 Adjusted Pv (in.)				
Step 4 - RPV Calculations for Combined LOD				
4.1 Combined LOD (ac)	102.73			
4.2 Weighted RCN	57.97			
4.3 Weighted RPV (in.)	0.57			
4.4 Weighted Target Runoff (in.)	0.43			
4.5 Estimated Annual Runoff (in.)	5.93			
4.6 Req'd Runoff to be Managed within LOD (in.)	0.16			
4.7 Req'd Runoff to be Managed within LOD (%)	29%			

“LOD” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. Again, acreage values should be entered to no more than two (2) decimal places to avoid a popup error message. The model has calculated the following results:

- Total LOD Area: 102.73
- Weighted LOD RCN: 57.97
- Weighted RPV runoff volume: 0.57”
- Estimated annual runoff: 5.93”
- Required runoff reduction: 0.16” (29%)

The results on this sheet are carried out to 2 decimal places. In some cases, the user may detect a slight discrepancy between the computed RCN on the “LOD” worksheet and the previous “C.A. RCN” worksheet if the typical TR-55 land use descriptions were used on the “C.A. RCN” worksheet. This is the result of rounding of impervious area when the typical land use descriptions are used. If the user wishes better agreement between these worksheets, impervious and pervious (open space) acreages should be entered directly on the “C.A. RCN” worksheet. In either case, the results from the “LOD” worksheet are used for all subsequent worksheet calculations.

“RPV” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Step 1 - Calculate Initial RPV					
11 Total contributing area of BMP (ac)	0.57				
12 Local RCN	0.07				
13 RPV (in) Contributing Area (in)	34,664				
14 Prop(RPV) to be Managed for Contributing Area (in)	0.07				
15 Prop(RPV) to be Managed for Contributing Area (in)	0.07				
Step 2 - Adjust for Retention Reduction					
21 Retention volume provided (cu. ft.)	30,688				
22 Retention reduction allowance (in)	0.00				
23 Retention reduction volume (ac-ft)	0.00				
24 Retention reduction volume (in)	0.00				
25 Runoff volume after retention reduction (in)	0.41				
26 Adjusted RPV	0.16				
Step 3 - Adjust for Annual Runoff Reduction					
31 Annual CH (in)	0.37				
32 Annual runoff (in)	0.37				
33 Proportion All soils in BMP (ac-ft)	0.00				
34 Annual runoff reduction allowance (in)	0.00				
35 Annual runoff after reduction (in)	0.37				
36 Adjusted RPV	0.16				
37 Annual Runoff Reduction Allowance for RPV (in)	0.00				
Step 4 - Calculate RPV with BMP Reductions					
41 RPV runoff (Management Practices) (in)	0.07				
42 RPV runoff volume after all reductions (in)	0.41				
43 RPV runoff volume after all reductions (in)	0.41				
44 Total RPV runoff reduction (in)	0.00				
45 Adjusted RPV after all reductions	0.16				
46 Adjusted equivalent annual runoff (in)	0.41				
47 RPV Compliance Met Through Runoff Reduction?	NO				
48 Runoff Reduction Credit (Equivalent in)	0.00				
Step 5 - Determine Residual Volume to be Managed for Offsets					
51 SFBV Residual Volume (in)	0.00				
52 SFBV Residual Volume (in)	0.00				
53 Residual Volume to be Managed or Offset (in)	0.00				
54 SFBV req. discharge rate for 10% detention (in)	0.00				
55 SFBV req. discharge rate for 60% detention (in)	0.00				

“RPV” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. The designer has selected a BMP treatment train consisting of grassed channels for all rooftops and roadways draining to infiltrating bioretention. It is estimated approximately 75% of the grass channels will be located in soils with Hydrologic Soil Group (HSG) A or B. The model has calculated the following results:

- RPV for total contributing area: 0.57”
- Reduction after BMP 1: 0.07” (12%)
- Residual volume to be managed after BMP 1: 34,664 cu. ft.
- Reduction after BMP 2: 0.16” (29%)

Annualized runoff reductions are used for BMPs that do not have a storage component, such as the grassed channels used in this example. Since infiltration BMPs will store and retain all the captured runoff, their reduction values are based on their storage capacity. A “NO” in the magenta cells of Step 4 indicate additional runoff reduction is required in order to comply with the RPv. A “YES” in the magenta cells indicates the required reduction has been met. In this case, the residual volume to be managed after BMP 1 was used to estimate the storage provided for BMP 2. The reduction allowances for the BMP suite should be considered representative of the subarea as a whole rather than a strict hydraulic routing from one BMP to the next. This will need to be verified by the Design Level Analysis. Any residual runoff subject to additional management or an offset for the RPv is calculated in Step 5 and shown in the magenta cells. Since this example was able to meet the required runoff reduction with two BMPs, the residual volume to be managed after BMP 2 is reported as “N/A”.

“TMDL” Worksheet

PROJECT: Broadkill Estates												
DRAINAGE SUBAREA ID: Site - Concept Level Analysis												
TMDL WATERSHED: Broadkill River												
TOTAL MAXIMUM DAILY LOAD (TMDL) WORKSHEET												
BMP 1				BMP 2				BMP 3				BMP 4
8-B Grassed Channel				2-A Traditional Bio-retention - infiltration								
Type:	TN	TP	TSS	Type:	TN	TP	TSS	Type:	TN	TP	TSS	Type:
1.1 Total contributing area to BMP (ac)	102.73											
1.2 Initial RCN	58											
1.3 Annual runoff volume (in.)	5.93											
1.4 Annual runoff volume (liters)	6.27E+07											
Step 2 - Calculate Annual Pollutant Load												
2.1 EMC (mg/L)	2.80	0.49	90	2.80	0.49	90	N/A	N/A	N/A	N/A	N/A	N/A
2.2 Load (mg/yr)	1.75E+08	3.07E+07	5.64E+09	1.45E+08	2.53E+07	4.65E+09	N/A	N/A	N/A	N/A	N/A	N/A
2.3 Stormwater Load (lb/ac/yr)	3.77	0.66	121	3.11	0.54	100	N/A	N/A	N/A	N/A	N/A	N/A
Step 3 - Adjust for Pollutant Reduction												
3.1 BMP annual runoff reduction (%)	18%			25%			N/A				N/A	
3.2 Adjusted annual runoff volume (in.)	4.89			3.67			N/A				N/A	
3.3 Adjusted annual runoff volume (liters)	5.17E+07			3.87E+07			N/A				N/A	
3.4 Adjusted load from annual reductions (lb/ac/yr)	3.11	0.54	99.85	2.33	0.41	74.80	N/A	N/A	N/A	N/A	N/A	N/A
3.5 BMP removal efficiency (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.6 BMP effluent concentration (mg/L)	2.80	0.49	90.00	2.80	0.49	90.00	N/A	N/A	N/A	N/A	N/A	N/A
3.7 Final Adjusted Load (lb/ac/yr)	3.11	0.54	100	2.33	0.41	75	N/A	N/A	N/A	N/A	N/A	N/A
Step 4 - Pollutant Reduction Met? (For Informational Purposes)												
4.1 TMDL (lb/ac/yr)	11.90	0.50	N/A									
4.2 Reduction met?	YES	NO	N/A	YES	YES	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)	319.11	55.85	10237	239.06	41.84	7684	N/A	N/A	N/A	N/A	N/A	N/A

“TMDL” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. Once the user selects the appropriate TMDL watershed from the dropdown list, the model calculates the total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) loads, as well as the reductions from the BMP suite selected on the “RPv” worksheet. The model has calculated the following results:

- Pollutant Load: 3.77 lb/ac/yr-TN; 0.66 lb/ac/yr-TP; 121 lb/ac/yr-TSS
- Pollutant load after BMP 1: 3.11 lb/ac/yr-TN; 0.54 lb/ac/yr-TP; 100 lb/ac/yr-TSS
- Pollutant load after BMP 2: 2.33 lb/ac/yr-TN; 0.41 lb/ac/yr-TP; 75 lb/ac/yr-TSS

Pollutant load is calculated using the RPv runoff volume and the Event Mean Concentration (EMC) values for the various pollutants that are integrated into the model. The model checks to determine whether the required pollutant reduction has been met. Since the Broadkill River does not have a regulatory TMDL for TSS, these cells are shown as “N/A”. A “YES” in the magenta cells indicates that the load reduction has been met. In this example, the TN load reduction has been met as a result of meeting the RPv runoff reduction attributed to BMP 1. The TP reduction was only met with the addition of BMP 2. There is currently no regulatory requirement under the 2019 DSSR to meet a specific TMDL target. However, DNREC requires the TMDL Worksheet to be completed for all projects in order to provide data for tracking TMDL progress.

“Cv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Step 1 - Calculate Initial Cv					
1.1 Total contributing area to BMP (ac)	109.73	109.73	109.73	109.73	109.73
1.2 Initial RCN	57.87				
1.3 10-year rainfall (in.)	5.8				
1.4 Cv runoff volume (in.)	1.34				
Step 2 - Adjust for Retention Reduction					
2.1 Storage volume (cu. ft.)	0.00	34665.00	N/A	N/A	N/A
2.2 Storage volume (ac-ft)	0.00	0.80	N/A	N/A	N/A
2.3 Storage volume (in.)	0.00	0.09	N/A	N/A	N/A
2.4 Runoff volume after reduction (in.)	1.34	1.24	N/A	N/A	N/A
2.5 CV*	57.87	56.59	N/A	N/A	N/A
Step 3 - Adjust for Annual Runoff Reduction					
3.1 Runoff reduction allowance (%)	0%	0%	N/A	N/A	N/A
3.2 Annual runoff after reduction (in.)	1.33	1.33	N/A	N/A	N/A
3.3 Adjusted ACN	57.83	57.83	N/A	N/A	N/A
3.4 Event-based runoff reduction (in.)	0.00	0.00	N/A	N/A	N/A
Step 4 - Calculate Cv with BMP Reductions					
4.1 Cv runoff volume after all reductions (in.)	1.33	1.24	N/A	N/A	N/A
4.2 Total Cv runoff reduction (%)	0%	7%	N/A	N/A	N/A
4.3 Adjusted RCN for h&h modeling	57.83	56.59	N/A	N/A	N/A

“Cv” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. There are no user-input cells on the “Cv” worksheet. The model has calculated the following results:

- Cv runoff volume: 1.34”
- Cv runoff volume after BMP 1: 1.33” (0% reduction)
- Cv runoff volume after BMP 2: 1.24” (7% reduction)

The runoff reduction values for the Cv event are adjusted downward, as discussed in the Cv Worksheet overview section.



“Fv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Step 1 - Calculate Initial Fv					
1.1 Total contributing area to BMP (ac)	100.73	100.73	100.73	100.73	100.73
1.2 Initial RCN	57.97				
1.3 100-Year Rainfall (in.)	3.6				
1.4 Fv runoff volume (in.)	4.00				
Step 2 - Adjust for Retention Reduction					
2.1 Storage volume (cu. ft.)	0.00	34665.00	N/A	N/A	N/A
2.2 Storage volume (ac-ft)	0.00	0.80	N/A	N/A	N/A
2.3 Storage volume (in.)	0.00	0.09	N/A	N/A	N/A
2.4 Runoff volume after reduction (in.)	4.00	3.91	N/A	N/A	N/A
2.5 CN*	57.97	57.23	N/A	N/A	N/A
Step 3 - Adjust for Annual Runoff Reduction					
3.1 Runoff reduction allowance (%)	0%	0%	N/A	N/A	N/A
3.2 Annual runoff after reduction (in.)	4.00	4.00	N/A	N/A	N/A
3.3 Adjusted ACN	57.97	57.97	N/A	N/A	N/A
3.4 Event-based runoff reduction (in.)	0.00	0.00	N/A	N/A	N/A
Step 4 - Calculate Fv with BMP Reductions					
4.1 Fv runoff volume after all reductions (in.)	4.00	3.91	N/A	N/A	N/A
4.2 Total Fv runoff reduction (%)	0%	2%	N/A	N/A	N/A
4.3 Adjusted RCN for h&h modeling	57.97	57.23	N/A	N/A	N/A



“Fv” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. There are no user-input cells on the “Fv” worksheet. The model has calculated the following results:

- Fv runoff volume: 4.00”
- Fv runoff volume after BMP 1: 4.00” (0% reduction)
- Fv runoff volume after BMP 2: 3.91” (2% reduction)

The runoff reduction values for the Fv event are adjusted downward, as discussed in the Fv Worksheet overview section.

“DURMM Report” Worksheet

BMP-1	BMP-2	BMP-3	BMP-4	BMP-5
0.50	0.41	N/A	N/A	N/A
0.50	0.41	N/A	N/A	N/A
0.50	0.41	N/A	N/A	N/A
0.50	0.41	N/A	N/A	N/A
0.50	0.41	N/A	N/A	N/A



“DURMM Report” Worksheet

The “DURMM Report” worksheet summarizes the results from the other worksheets. Information is filled into the cells automatically as the user progresses from worksheet to worksheet. The report includes the runoff volumes for the R_{Pv}, C_v and F_v, as well as the reductions for the various BMPs selected to manage the subarea. It also summarizes whether the site meets the required runoff reduction for the R_{Pv} and the required TMDL pollutant load reductions.

The next section of the report summarizes the adjustments to the RCN for the C_v and F_v that can be used for more detailed hydrologic and hydraulic modeling in more complex situations. These adjustments account for the equivalent lower RCN that results from using runoff reduction techniques.

In this example, the designer was able to show at the concept level that the use of runoff reduction practices could meet both the runoff reduction requirements of the 2019 DSSR and the TMDL goals in the watershed. The results of the Concept Level Analysis will need to be verified through the more detailed Design Level Analysis to show the site complies with the requirements of the 2019 DSSR.

DURMM v2.5

“Broadkill Estates” Example Site Ex. #2: Design Level Analysis



Example #2: Design Level Analysis

The procedures outlined in the previous section will now be used to perform a more detailed design level analysis for the fictional land development project “Broadkill Estates”.

NOTE: This approach can also be used for a Total Site Analysis as noted later in this Quick-Start Guide.

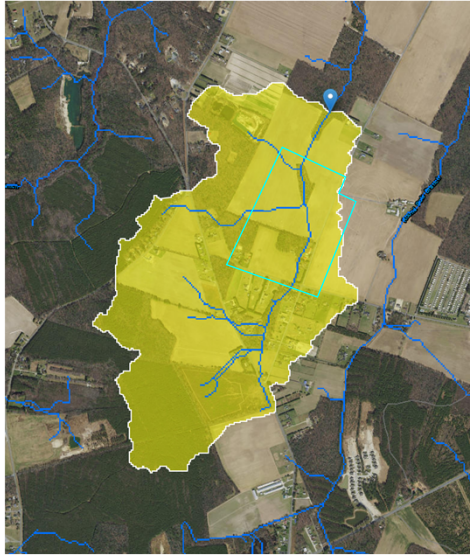
Design Level Analysis



Site Layout

At the design level, the lot and road layout have typically been determined, as well as the general proposed grading and drainage patterns.

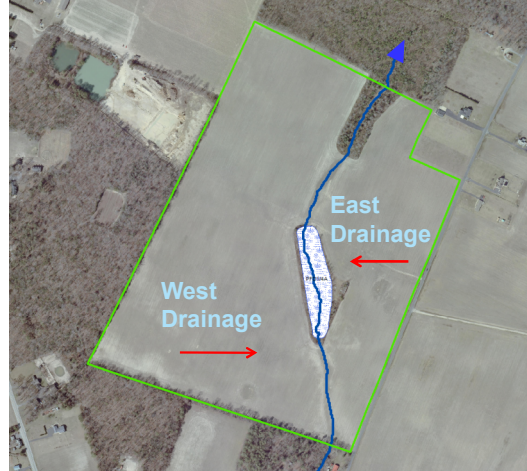
Design Level Analysis



Hydrologic Analysis

The concept level analysis assumed an artificial drainage boundary that coincided with the parcel boundary. This is rarely the case in practice. The more typical situation is illustrated by the “Broadkill Estates” example site in which significant offsite areas drain through the site. In addition, there are incidental areas which drain onto the site around the site boundary. Both these situations must ultimately be considered in the final design. For the purposes of this example, it will be assumed that the larger upstream area will be allowed to pass through the site relatively unmanaged. This will require that the site runoff be managed prior to discharge into the tributary stream. Although incidental offsite areas that would be captured by the selected BMP suite do not need to be managed to the same level as the area within the site LOD, they will still need to be accounted for in the design of the BMPs. The following pages illustrate how DURMM v2.5 is used to perform the analysis and check for compliance with the requirements of the DSSR.

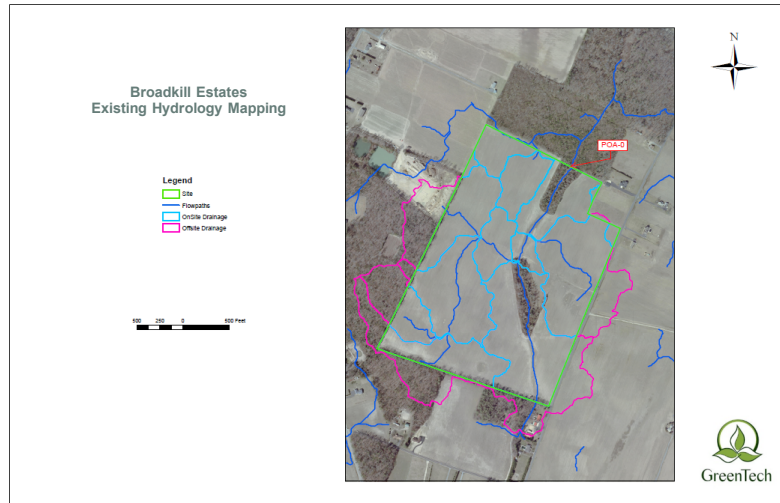
Design Level Analysis



Onsite Drainage

As described in the concept level analysis, the site is bisected by a tributary stream that runs from south to north. This site drainage is therefore characterized by a west drainage subarea and an east drainage subarea.

Design Level Analysis



Offsite Drainage

The “Existing Drainage” map included in the Project Application Package is helpful to determine any offsite drainage areas that must be accounted for in the final BMP design for the site.

Design Level Analysis



Site Design

For the purposes of this example, the proposed lot and road layout for the east drainage subarea will be analyzed. The area outside the lots will be designated as common open space.

NOTE: For a Total Site Analysis, both the East and West subareas would need to be combined into a single subarea.

Design Level Analysis



LOD vs. OLOD

The 2019 DSSR require that only those areas that are disturbed during the construction of the project must be managed. When designing BMPs to manage those areas, however, it is likely that undisturbed areas may contribute drainage to them. These undisturbed areas which are outside the limit of disturbance may be either onsite or offsite. DURMM v2.5 can account for this situation by calculating a weighted R_{Pv} runoff volume that reflects the LOD runoff as well as the OLOD runoff. The runoff reduction requirement for the LOD is then adjusted for the total contributing area.

For the purposes of this example, the LOD for the east drainage subarea is bounded by the tributary stream and parcel boundary, excluding the wetland area. The OLOD consists of an area to the east of the property boundary that is currently in cropland.

Design Level Analysis



Soils Data - LOD

The LOD area consists mainly of soils in HSG A, with a small area of soils in HSG B adjacent to the stream.

Design Level Analysis



Soils Data – OLOD

The area outside the LOD consists entirely of soils in HSG A.

Design Level Analysis



OLOD – Time of Concentration

DURMM v2.5 is capable of determining a peak discharge for OLOD areas if they will be managed by BMPs that are discharge-based, such as grassed channels and bioswales. This requires the user to enter an estimate of the time of concentration (T_c) for the area outside the LOD. Since the OLOD areas are often irregular in shape, it is adequate for the user to designate a single representative T_c path for the entire OLOD area for any particular subarea under analysis. The T_c path should be carried through to the final onsite stormwater management BMP in the flow path.

Design Level Analysis Site Data



- C.A. RCN Tab
 - Row Crops, SR + Crop Residue
 - HSG A: 9.68 ac.
 - Open space
 - HSG A: 8.06 ac.
 - HSG B: 2.26 ac
 - 1-ac. residential (20 % imperv.)
 - HSG A: 21.16 ac.
 - HSG B: 0.73 ac



Data Inputs – “C.A. RCN” Worksheet

The slide above summarizes the data that will be input to the “C.A. RCN” worksheet. It includes both LOD and OLOD areas.

Design Level Analysis Site Data (cont.)



- LOD Tab
 - HSG A
 - LOD area: 29.22 ac.
 - Pre-Dev. Woods: 1.55 ac.
 - Post-Dev. Impervious: 4.23 ac.
 - HSG B
 - LOD area: 2.99 ac.
 - Pre-Dev. Woods: 0 ac.
 - Post-Dev. Impervious: 0.15 ac.
- OLOD Tab
 - Sheet Flow, 100 ft, 0.001 ft/ft, “d”
 - Shallow Conc., 300 ft, 0.002 ft/ft, “u”
 - Channel Flow, 1000 ft, 0.01 ft/ft, 1 fps



Data Inputs – “LOD” and “OLOD” Worksheets

The slide above summarizes the data that will be input to the “LOD” and “OLOD” worksheets.

**“C.A. RCN”
Worksheet**

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type			
			A	B	C	D
CULTIVATED AGRICULTURAL LANDS						
1	Barren	poor	77	86	91	94
2	Crop residue (C)	poor	76	85	90	93
3	Crop residue (D)	good	74	83	88	91
4	Row Crops	poor	72	81	86	89
5	Row Crops	good	67	76	81	84
6	SP - Crop residue	poor	71	80	85	88
7	SP - Crop residue	good	64	73	78	81
8	Contoured (C)	poor	75	79	84	88
9	Contoured (C)	good	65	70	75	79
10	C - Crop residue	poor	69	78	83	87
11	C - Crop residue	good	64	74	79	83
12	Cont & terrace (C)	poor	66	74	80	84
13	Cont & terrace (C)	good	62	71	76	80
14	CSI - Crop residue	poor	65	73	79	83
15	CSI - Crop residue	good	61	69	74	78
16	Small Grain	poor	65	76	81	85
17	Small Grain	good	61	71	76	80
18	SP - Crop residue	poor	64	75	80	84
19	SP - Crop residue	good	60	70	75	79
20	Contoured (C)	poor	63	74	80	84
21	Contoured (C)	good	61	71	76	80
22	C - Crop residue	poor	69	73	80	84
23	C - Crop residue	good	65	72	80	83
24	Cont & terrace (C)	poor	67	72	79	83
25	Cont & terrace (C)	good	63	71	78	81
26	CSI - Crop residue	poor	66	73	80	83
27	CSI - Crop residue	good	62	70	77	80
28	or broadcast	poor	58	72	81	85
29	or broadcast	good	54	70	80	84
30	Contoured	poor	64	75	83	86
31	Contoured	good	55	69	76	80
32	meadow	poor	63	73	80	83
33	Cont & terrace	poor	53	67	76	80
34	Cont & terrace	good	43	55	64	68
35	Pasture, grazed or range	poor	49	59	66	70
36	Pasture, grazed or range	good	39	51	59	63
37	Meadow (cont. grass (non-grass))	poor	30	38	44	47
38	Meadow (cont. grass (non-grass))	good	46	57	63	66
39	Bush - low, wood, grass (sh)	poor	35	46	52	55
40	Bush - low, wood, grass (sh)	good	30	41	47	50
41	Woods - grass combination	poor	57	73	82	86
42	Woods - grass combination	good	43	55	64	68



“C.A. RCN” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above for the OLOD area. Note that the user must scroll up to the input cells associated with agricultural land uses. RCN data for the urban land uses within the LOD area are shown on the next page.

**“C.A. RCN”
Worksheet
(cont.)**

Cover Type	Treatment	Hydrologic Condition	Curve Numbers for Hydrologic Soil Type			
			A	B	C	D
FULLY DEVELOPED URBAN AREAS (Imp. Establishments)						
Open space (lawns, etc.)			60	70	80	85
Paved condition, grass cover < 50%			60	70	75	80
Flat condition, grass cover 50% to 75%			45	55	61	64
Good condition, grass cover > 75%			30	35	41	43
Impervious Areas						
Paved parking lots, roads, driveways			50	50	50	50
Roofs and gutters			50	50	50	50
Paved open lots (light or no imp.)			70	80	85	91
Gravel (light or no imp.)			70	80	85	91
Oil (light or no imp.)			70	80	85	91
Urban Districts						
Commercial business		Imp. % Impervious	60	70	74	78
Industrial			60	70	74	78
Residential districts (single family use)						
Imp. % Impervious						
W/ area (new houses)			77	85	90	92
W/ area			60	70	74	78
W/ area			57	72	81	86
W/ area			54	70	80	85
W/ area			51	67	73	78
W/ area			45	65	71	75
DEVELOPING URBAN AREA (Imp. Preparation)						
Hard graded area (paved or imp.)			77	86	91	94
USER DEFINED						
Subarea Contributing Area per Soil Type (ac)						
			38.9	2.90	0	0
			21.89			
			53			
UPSTREAM CONTRIBUTING AREAS						
Upstream Contributing Area 1						
Upstream Contributing Area 2						
Upstream Contributing Area 3						
Upstream Contributing Area 4						
Total Contributing Area v. Upstream Areas (ac)			41.9			
Weighted Runoff Curve Number (RCN)			53			

“C.A. RCN” Worksheet (cont.)

The remaining data inputs/outputs for this worksheet are illustrated in the slide above. The model has calculated the following results:

- Total Acreage: 41.9
- Weighted RCN: 53



“LOD” Worksheet

The screenshot shows an Excel spreadsheet with the following data:

LIMIT OF DISTURBANCE (LOD) WORKSHEET		HSG A	HSG B	HSG C	HSG D	
6. Step 1 - Subarea LOD Data						RESET
7. 1.1 HSG Area Within LOD (ac)		29.21	2.99			
8. 1.2 Pre-Developed Woods/Meadow Within LOD (ac)		1.50				
9. 1.3 Pre-Developed Impervious Within LOD (ac)						
10. 1.4 Pre-Developed Imperviousness Within LOD, Option #1 (H/L) (ac)		0.20	0.15			
11. 1.4.b Post-Developed Imperviousness Within LOD, Option #2 (%)		14%	5%	0%	0%	
12. Step 2 - Subarea LOD Runoff Calculations						
14. 2.1 RCN per HSG		47.54	62.86	0.00	0.00	
15. 2.2 RPV per HSG (in.)		6.55	6.70	0.00	0.00	
16. 2.3 Target RCN per HSG		39.32	63.00	0.00	0.00	
17. 2.4 Target Runoff per HSG (in.)		0.20	0.65	0.00	0.00	
18.						
19. 2.5 Subarea LOD (ac)		32.21				
20. 2.6 Subarea Weighted RCN		48.96				
21. 2.7 Subarea Weighted RPV (in.)		0.38				
22. 2.8 Subarea Weighted Target Runoff (in.)		0.24				
23.						
24. Step 3 - Upstream LOD Areas (Non-impervious OR RPV) Report as applicable		Area 1	Area 2	Area 3	Area 4	
25. 3.1 Upstream Sub-Area ID						
26. 3.2 Upstream Contributing Area (ac)						
27. 3.3 Target Runoff for Upstream Area (in.)						
28. 3.4 Adjusted Cv after all reductions						
29. 3.5 Adjusted RPV (in.)						
30. 3.6 Adjusted Cv (in.)						
31. 3.7 Adjusted Cv (in.)						
32.						
33. Step 4 - RPV Calculations for Combined LOD						
34. 4.1 Combined LOD (ac)		32.21				
35. 4.2 Weighted RCN		48.96				
36. 4.3 Weighted RPV (in.)		0.38				
37. 4.4 Weighted Target Runoff (in.)		0.24				
38. 4.5 Estimated Annual Runoff (in.)		3.29				
39. 4.6 Req'd Runoff to be Managed within LOD (in.)		0.14				
40. 4.7 Req'd Runoff to be Managed within LOD (%)		36%				
41.						
42.						



“LOD” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. The model has calculated the following results:

- Total LOD Acreage: 32.21
- Weighted LOD RCN: 48.96
- Weighted RPV runoff volume: 0.38”
- Weighted RPV target runoff volume: 0.24”
- Estimated annual runoff: 3.29”
- Required runoff reduction: 0.14” (36%)

“OLOD” Worksheet

The screenshot shows an Excel spreadsheet with the following data sections:

Step 1 - Site Data	Value
1.1 Contributing Area (ac)	41.00
1.2 C.A. RCN	64
1.3 LOD (feet)	32.00
1.4 LOD RCN	60
1.5 Outside LOD Area (ac)	6.68
1.6 Outside LOD RCN	60

Step 2 - Time of Concentration	2.1	2.2	2.3	2.4	2.5	2.6
LENGTH	SLOPE	SURFACE	ROUGHNESS	VELOCITY	TRAVEL	TIME (hr)
Shoal	100	0.005	4	0.37	N/A	0.00
Shoal Concentrated	300	0.002	4	N/A	0	0.00
Open Channel	1000	0.01	N/A	N/A	10	0.20

2.7 Time of Concentration (Ttc) = 0.98

Step 3 - Peak Discharge	Value
3.1 Unit Hydrograph Type	GMV
3.2 Frequency (yr)	10
3.3 24-hr (10-year) (in.)	3.25
3.4 Total Aberration (in.)	1.00
3.5 1-day rain (in.)	2.25
3.6 1-day Peak Discharge (cfs/acre)	191
3.7 Peak (cfs)	191
3.8 Peak Discharge (cfs)	5.38
3.9 Peak unit peak discharge (cfs/ac)	0.56

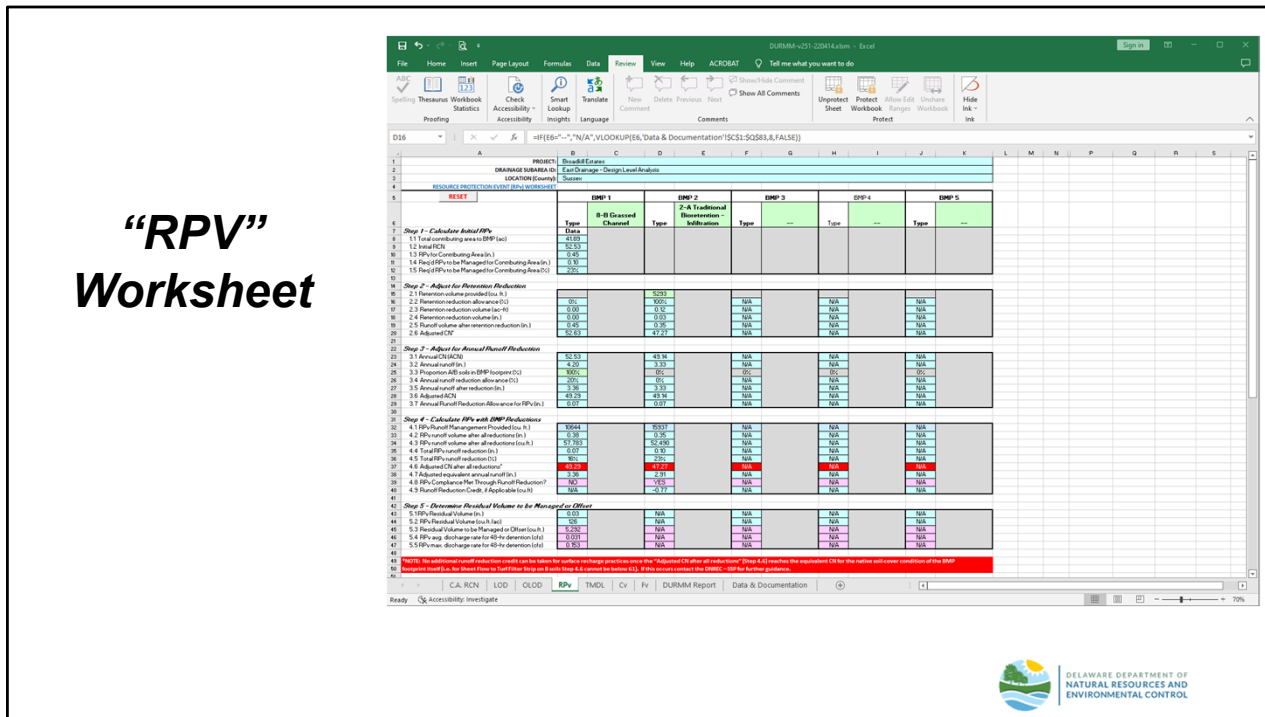
“OLOD” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. The model has calculated the following results:

- OLOD Acreage: 9.68
- OLOD RCN: 64
- OLOD Tc: 0.98 hrs
- OLOD Peak Discharge (Cv): 5.38 cfs
- OLOD Equiv. Unit Discharge (Cv): 0.56 cfs/ac
- OLOD Peak Discharge (Fv): 15.77 cfs
- OLOD Equiv. Unit Discharge (Fv): 1.63 cfs/ac



“RPV” Worksheet



“RPV” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. The same BMP treatment train consisting of grassed channels for the road drainage and infiltrating bioretention as used in the concept level analysis will be used. For the East Drainage, the grassed channels are completely within HSG A soils. The infiltrating bioretention facility will be sized to store any residual runoff required to be managed after the reduction from the grassed channels. The model has calculated the following results:

- R_{Pv} for total contributing area: 0.45”
- Reduction after BMP 1: 0.07” (16%)
- Reduction after BMP 2: 0.10” (23%)

Note that the required reduction of 0.14” for the 32.21 acre LOD as determined on the “LOD” worksheet has been adjusted to 0.10” for the total contributing area of 41.89 acres. Similarly, the required 36% reduction requirement has been adjusted to 23% based on the combined LOD and OLOD areas. As with the conceptual design, grassed channels and an infiltrating bioretention facility are adequate to meet the runoff reduction requirements for the R_{Pv}, thus the residual volume to be managed or offset is “N/A”.

NOTE: Select the “No BMP” option if performing a Total Site Analysis. The “R_{Pv} Residual Volume” calculated at Step 5.3 is the total runoff volume in cubic feet that is required to be managed for R_{Pv} compliance for the entire site. Only those subareas with BMPs then need to be further analyzed in DURMM.

“TMDL” Worksheet

	BMP 1			BMP 2			BMP 3			BMP 4		
	TN	TP	TSS	TN	TP	TSS	TN	TP	TSS	TN	TP	TSS
1.1 Total contributing area to BMP (ac)	41.89											
1.2 Initial RCN	53											
1.3 Annual runoff volume (in.)	4.20											
1.4 Annual runoff volume (liters)	1.81E+07											
2.1 EMC (mg/L)	2.80	0.49	90	2.80	0.49	90	N/A	N/A	N/A	N/A	N/A	N/A
2.2 Load (mg/yr)	5.07E+07	8.87E+06	1.63E+09	4.05E+07	7.10E+06	1.30E+09	N/A	N/A	N/A	N/A	N/A	N/A
2.3 Stormwater Load (lb/ac/yr)	2.67	0.47	86	2.13	0.37	69	N/A	N/A	N/A	N/A	N/A	N/A
3.1 BMP annual runoff reduction (%)	20%			13%			N/A			N/A		
3.2 Adjusted annual runoff volume (in)	3.36			2.91			N/A			N/A		
3.3 Adjusted annual runoff volume (liters)	1.45E+07			1.25E+07			N/A			N/A		
3.4 Adjusted load from annual reductions (lb/ac/yr)	2.13	0.37	69.60	1.84	0.32	59.27	N/A	N/A	N/A	N/A	N/A	N/A
3.5 BMP removal efficiency (%)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
3.6 BMP effluent concentration (mg/L)	2.80	0.49	90.00	2.80	0.49	90.00	N/A	N/A	N/A	N/A	N/A	N/A
3.7 Final Adjusted Load (lb/ac/yr)	2.13	0.37	69	1.84	0.32	59	N/A	N/A	N/A	N/A	N/A	N/A
4.1 TMDL (lb/ac/yr)	11.90	0.50	N/A	YES	YES	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.2 Reduction met?	YES	YES	N/A	YES	YES	N/A	N/A	N/A	N/A	N/A	N/A	N/A
4.3 Final Adjusted Load (lb/yr)	89.40	15.65	2874	77.24	13.52	2483	N/A	N/A	N/A	N/A	N/A	N/A

“TMDL” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. The model has calculated the following results:

- Pollutant Load:
 - 2.67 lb/ac/yr-TN
 - 0.47 lbac/yr-TP
 - 86 lb/ac/yr-TSS
- Pollutant load after BMP 1:
 - 2.13 lb/ac/yr-TN
 - 0.37 lb/ac/yr-TP
 - 69 lb/ac/yr-TSS
- Pollutant load after BMP 2:
 - 1.84 lb/ac/yr-TN
 - 0.32 lb/ac/yr-TP
 - 59 lb/ac/yr-TSS

The pollutant loads and reductions are likewise adjusted to account for the total contributing area to the BMPs. For the East Drainage, the grassed channels were adequate to meet both the TN and TP goals for the watershed.

“Cv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Step 1 - Calculate Initial Cv	Type: B & B Grassed Channel	Type: P & A Traditional	Type: --	Type: --	Type: --
8 1.1 Total contributing area to BMP (ac)	42.89	42.89	42.89	42.89	42.89
9 1.2 Initial RCN	52.53				
10 1.3 10-year rainfall (in.)	3.8				
11 1.4 Cv runoff volume (in.)	0.97				
Step 2 - Adjust for Retention Reduction					
14 2.1 Storage volume (cu. ft.)	0.00	\$293.00	N/A	N/A	N/A
15 2.2 Storage volume (ac-ft)	0.00	0.12	N/A	N/A	N/A
16 2.3 Storage volume (in.)	0.00	0.03	N/A	N/A	N/A
17 2.4 Runoff volume after reduction (in.)	0.97	0.94	N/A	N/A	N/A
18 2.5 CV*	52.53	51.94	N/A	N/A	N/A
Step 3 - Adjust for Annual Runoff Reduction					
21 3.1 Runoff reduction allowance (%)	0%	0%	N/A	N/A	N/A
22 3.2 Annual runoff after reduction (in.)	0.97	0.97	N/A	N/A	N/A
23 3.3 Adjusted ACN	52.50	52.50	N/A	N/A	N/A
24 3.4 Event-based runoff reduction (in.)	0.00	0.00	N/A	N/A	N/A
Step 4 - Calculate Cv with BMP Reductions					
27 4.1 Cv runoff volume after all reductions (in.)	0.97	0.94	N/A	N/A	N/A
28 4.2 Total Cv runoff reduction (%)	0%	4%	N/A	N/A	N/A
29 4.3 Adjusted RCN for H&H modeling	52.50	51.94	N/A	N/A	N/A

“Cv” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. There are no user-input cells on the “Cv” worksheet. The model has calculated the following results:

- Cv runoff volume: 0.97”
- Cv runoff volume after BMP 1: 0.97” (0% reduction)
- Cv runoff volume after BMP 2: 0.94” (4% reduction)

When the total contributing area consists of both an LOD and an OLOD, the model calculates an adjusted RCN for the combined LOD and OLOD that can be used as input to another DURMM analysis for a downstream subarea or for additional H&H modeling using an external program such as HydroCAD.



“Fv” Worksheet

	BMP 1	BMP 2	BMP 3	BMP 4	BMP 5
Step 1 - Calculate Initial Fv	Type: B & B Grassed Channel	Type: P & A Traditional Bio-retention	Type: --	Type: --	Type: --
7 1.1 Total contributing area to BMP (ac)	42.89	42.89	42.89	42.89	42.89
9 1.2 Initial RCN	52.53				
10 1.3 100-Year Rainfall (in.)	9.2				
11 1.4 Fv runoff volume (in.)	3.33				
Step 2 - Adjust for Retention Reduction					
14 2.1 Storage volume (cu. ft.)	0.00	\$293.00	N/A	N/A	N/A
15 2.2 Storage volume (ac-ft)	0.00	0.12	N/A	N/A	N/A
16 2.3 Storage volume (in.)	0.00	0.03	N/A	N/A	N/A
17 2.4 Runoff volume after reduction (in.)	3.33	3.29	N/A	N/A	N/A
18 2.5 CN*	52.53	52.25	N/A	N/A	N/A
Step 3 - Adjust for Annual Runoff Reduction					
21 3.1 Runoff reduction allowance (%)	0%	0%	N/A	N/A	N/A
22 3.2 Annual runoff after reduction (in.)	3.33	3.33	N/A	N/A	N/A
23 3.3 Adjusted ACN	52.53	52.53	N/A	N/A	N/A
24 3.4 Event-based runoff reduction (in.)	0.00	0.00	N/A	N/A	N/A
Step 4 - Calculate Fv with BMP Reductions					
27 4.1 Fv runoff volume after all reductions (in.)	3.33	3.29	N/A	N/A	N/A
28 4.2 Total Fv runoff reduction (%)	0%	1%	N/A	N/A	N/A
29 4.3 Adjusted RCN for H&H modeling	52.53	52.25	N/A	N/A	N/A



“Fv” Worksheet

The data inputs/outputs for this worksheet are illustrated in the slide above. There are no user-input cells on the “Cv” worksheet. The model has calculated the following results:

- Fv runoff volume: 3.33”
- Fv runoff volume after BMP 1: 3.33” (0% reduction)
- Fv runoff volume after BMP 2: 3.29” (1% reduction)

As with the Cv, the model calculates an adjusted RCN for the combined LOD and OLOD that can be used as input to another DURMM analysis for a downstream subarea or for additional H&H modeling using an external program such as HydroCAD.

“DURMM
Report”
Worksheet

“DURMM Report” Worksheet

In this example, the designer was able to show that the use of runoff reduction practices complies with the requirements of the 2019 DSSR and TMDL pollutant reduction goals for the watershed. Since DURMM v2.5 does not include a BMP design module, the designer must next use an appropriate methodology to ensure the BMPs selected for analysis are designed in accordance with the Post Construction Stormwater BMP Standards & Specifications in accordance with the 2019 DSSR.

Once BMP design has been completed, the user will need to complete the Summary Table for Rpv Compliance as shown in the next series of slides.



DURMM v2.5

“Broadkill Estates” Example Site Summary Table for RPV Compliance



Summary Table for RPv Compliance

The Summary Table for RPv Compliance is used to demonstrate compliance with the RPv requirements under the 2019 DSSR.

Summary Table for R_{Pv} Compliance Sheet 1

The screenshot shows an Excel spreadsheet with the following structure:

- Section I - Complete this section for total site LOD management requirement:**
 - Row 6: Total Site LOD (0.0)
- Section II - Complete this section for BMPs provided for partial LOD management OR sub-area by sub-area management:**
 - Rows 7-28: Individual sub-areas with columns for Sub-Area ID, Contributing Area, Runoff, Rpv Runoff Management (Required/Provided), and Pollutant Loads (TN, TP, TSS).
- Totals:**
 - Row 29: Rpv Runoff Reduction Goal Met (0.00)
 - Row 30: Total Credit (Shortfall) (0.00)
- Notes:**
 - 1. All subareas must be within the same MUC watershed.
 - 2. Only the most downstream sub-area information should be entered for a series of sub-areas that drain to each other or for a treatment train.
 - 3. From DURMM v2.5 Report, Line 7 OR Approved Hydrologic Software Report
 - 4. From DURMM v2.5 Report, Line 35 OR Approved Hydrologic Software Report
 - 5. From DURMM v2.5 Report, Line 39 OR Approved Hydrologic Software Report
 - 6. From DURMM v2.5 Report, Line 40 OR Approved Hydrologic Software Report
 - 7. From DURMM v2.5 Report, Lines 44-48 OR Complete Sheet 2

Sheet 1

The cell coloring scheme used in the Summary Table for R_{Pv} Compliance is the same as that used in DURMM v2.5:

- Green Cells – cells intended for user input
- Cyan Cells – cells that contain either pre-set values or secondary output
- Magenta Cells - cells that contain calculated results for primary output

Input data for the Summary Table is taken from the DURMM Report worksheet or from an approved hydrologic model. If DURMM v2.5 was used for the BMP analysis, the data from the DURMM Report is entered in the appropriate columns on the Summary Table. A key is included at the bottom of Sheet 1 identifying what cell from the DURMM Report should be entered in which column.

Data entry and results are further coded in accordance with the following coloring scheme:

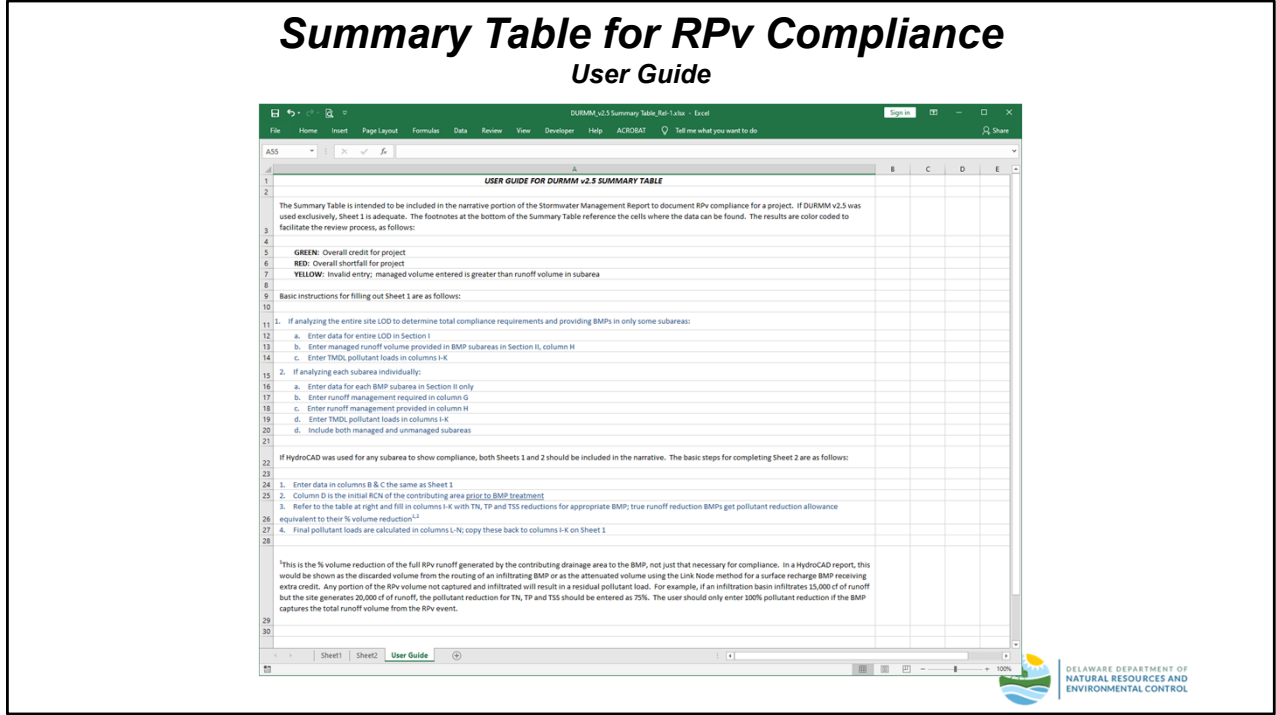
- Yellow – invalid entry; managed volume entered is greater than runoff volume generated in the subarea
- Dk. Green – the site has an overall credit
- Red – the site has an overall shortfall

Summary Table for R_Pv Compliance Sheet 2

Subarea	Area (ac)	Initial	BMP Pollutant Reduction (%)			Final Pollutant Load (lb/yr)			BMP Type	BMP Pollutant Reduction Abundance*		
ID		BCN	TN	TP	TSS	TN	TP	TSS		TN	TP	TSS
0-Total Site 100						0.00	0.00	0	0-No BMP	0%	0%	0%
1						0.00	0.00	0	1-A Extensive Vegetated Rafts	0%	0%	0%
2						0.00	0.00	0	2-B Intensive Vegetated Rafts	0%	0%	0%
3						0.00	0.00	0	3-C Full Roof Top Disconnection - HSG A	98%	98%	98%
4						0.00	0.00	0	4-D Full Roof Top Disconnection - HSG B	81%	81%	81%
5						0.00	0.00	0	5-E Full Roof Top Disconnection - HSG C	63%	63%	63%
6						0.00	0.00	0	6-F Full Roof Top Disconnection - HSG D	51%	51%	51%
7						0.00	0.00	0	7-G Bioswale, HSG A/B/Compost C	50%	50%	50%
8						0.00	0.00	0	8-H Grassed Channel, HSG C/D	20%	20%	20%
9						0.00	0.00	0	9-I Sheet Flow to Grassed FS, HSG A/B/Compost C	23%	23%	23%
10						0.00	0.00	0	10-J Sheet Flow to Forest FS, HSG A/B/Compost C	40%	40%	40%
11						0.00	0.00	0	11-K Sheet Flow to Forest FS, HSG C/D	20%	20%	20%
12						0.00	0.00	0	12-L Sheet Flow to Forest OS, HSG A/B/Compost C	60%	60%	60%
13						0.00	0.00	0	13-M Sheet Flow to Forest OS, HSG C/D	30%	30%	30%
14						0.00	0.00	0	14-N Dry Detention Pond	5%	10%	10%
15						0.00	0.00	0	15-O Dry Extended Detention (ED) Basin	20%	20%	20%
16						0.00	0.00	0	16-P Underground Detention Facilities	20%	20%	60%
17						0.00	0.00	0	17-Q Non-Structural Sand Filter	40%	60%	80%
18						0.00	0.00	0	18-R Surface Sand Filter	40%	60%	80%
19						0.00	0.00	0	19-S 3-Chamber Underground Sand Filter	40%	60%	80%
20						0.00	0.00	0	20-T Perimeter Sand Filter (DE Sand Filter)	40%	60%	80%
21						0.00	0.00	0	21-U Traditional Constructed Wetlands	30%	40%	80%
22						0.00	0.00	0	22-V Wetland Scales	20%	30%	60%
23						0.00	0.00	0	23-W Ephemeral Constructed Wetlands	20%	30%	60%
24						0.00	0.00	0	24-X Submerged Gravel Wetlands	30%	40%	80%
25						0.00	0.00	0	25-Y Wet Quantity Management Pond	0%	0%	0%
26						0.00	0.00	0	26-Z Wet Extended Detention (ED) Pond	30%	50%	60%

Sheet 2

Sheet 2 is only used in those cases where the design-level analysis was done using an external model, such as HydroCAD. Since these external models do not typically model water quality, Sheet 2 is used to determine the pollutant reductions based on the proposed BMPs for the project. The results are then transferred to the appropriate columns on Sheet 1.



User Guide

The third worksheet in the Summary Table workbook is a basic user guide for completing Sheet 1 and Sheet 2.

Summary Table for R_Pv Compliance Sheet 1 for Broadkill Estates Example

Ref. #	Sub-Area ID ¹⁾	Contributing Area ²⁾ (a)	Runoff ³⁾ (b)	Runoff ⁴⁾ (c)	R _P v Runoff Management (d)		TN Pollutant Load ⁵⁾ (lb/yr)	TP Pollutant Load ⁶⁾ (lb/yr)	TSS Pollutant Load ⁷⁾ (lb/yr)	
					Required ⁸⁾	Provided ⁹⁾				
Section I - Complete this section for total site LOD management requirement										
0	Total Site LOD								0.0	
Section II - Complete this section for BMPs provided for partial LOD management OR sub-area by sub-area management										
1	East Drainage	41.89	0.45	68427.3	15936	15937	77.24	13.52	2483	
2				0.0						
3				0.0						
4				0.0						
5				0.0						
6				0.0						
7				0.0						
8				0.0						
9				0.0						
10				0.0						
11				0.0						
12				0.0						
13				0.0						
14				0.0						
15				0.0						
16				0.0						
17				0.0						
18				0.0						
19				0.0						
20				0.0						
21				0.0						
22				0.0						
23				0.0						
24				0.0						
25				0.0						
26				0.0						
27				0.0						
28				0.0						
29				0.0						
30				0.0						
30	Totals					15936 cf	15937 cf	77.24 lb/yr	13.52 lb/yr	2483 lb/yr
30	R _P v Runoff Reduction Goal Met?				YES					
31	Total Credits/Shortfall				1 cf	Credits				

Notes:
 1. All subareas must be within the same HUC 8 watershed.
 2. Only the most downstream sub-area information should be entered for a series of sub-areas that drain to each other or for a treatment train.
 3. From DURMM v2.5 Report, Line 7 OR Approved Hydrologic Software Report
 4. From DURMM v2.5 Report, Line 35 OR Approved Hydrologic Software Report
 5. From DURMM v2.5 Report, Line 39 OR Approved Hydrologic Software Report
 6. From (N) DURMM v2.5 Report, Line 40 OR Approved Hydrologic Software Report

Sheet 1 for Broadkill Estates Example

This slide shows the data for the east drainage from the DURMM v2.5 Report Worksheet for the Broadkill Estates example as it should be entered into Section II of the Summary Table for R_Pv Compliance. A similar design level analysis would need to be completed for the west drainage and the resulting data also entered into Section II of this Summary Table to show R_Pv compliance for each sub-area within the total site. All subareas, including any unmanaged areas, must be entered in Section II when using this approach in order to ensure any shortfall is mitigated by BMPs in the managed subareas.

For a Total Site Analysis, the East and West drainage areas would be combined into a single sub-area and results using the “No BMP” option would be entered into Section I of the Summary Table for R_Pv compliance. Only those subareas that contain BMPs then need to be entered in Section II. DURMM will automatically calculate any shortfall based on the “No BMP” values from Section I. Additional examples of completing the “Summary Table for R_Pv Compliance” are included in Module 3.

The DURMM v2.5 worksheets would be included with the other H&H computations in the SWM Report.

Include the Summary Table for R_Pv Compliance in the narrative summary portion of the SWM Report.

DURMM v2.5

Project Setup Options



There is more than one way to use DURMMv2.5 to demonstrate Rpv compliance.

Project Setup Options

- ***Total Site Analysis***
 - *aka Project Level DURMM, or PLD, Method*
- ***BMP Drainage Area Analysis***
 - *Single BMP*
 - *BMPs in Series / Treatment Train*



DURMM v2.5 may be used to analyze the entire site LOD to determine the total site R_{Pv} volume to be managed, which is often referred to as a Project Level DURMM (PLD).

Alternately, DURMM may be set up to have separate DURMM workbooks for the drainage area of each BMP or BMP treatment train.

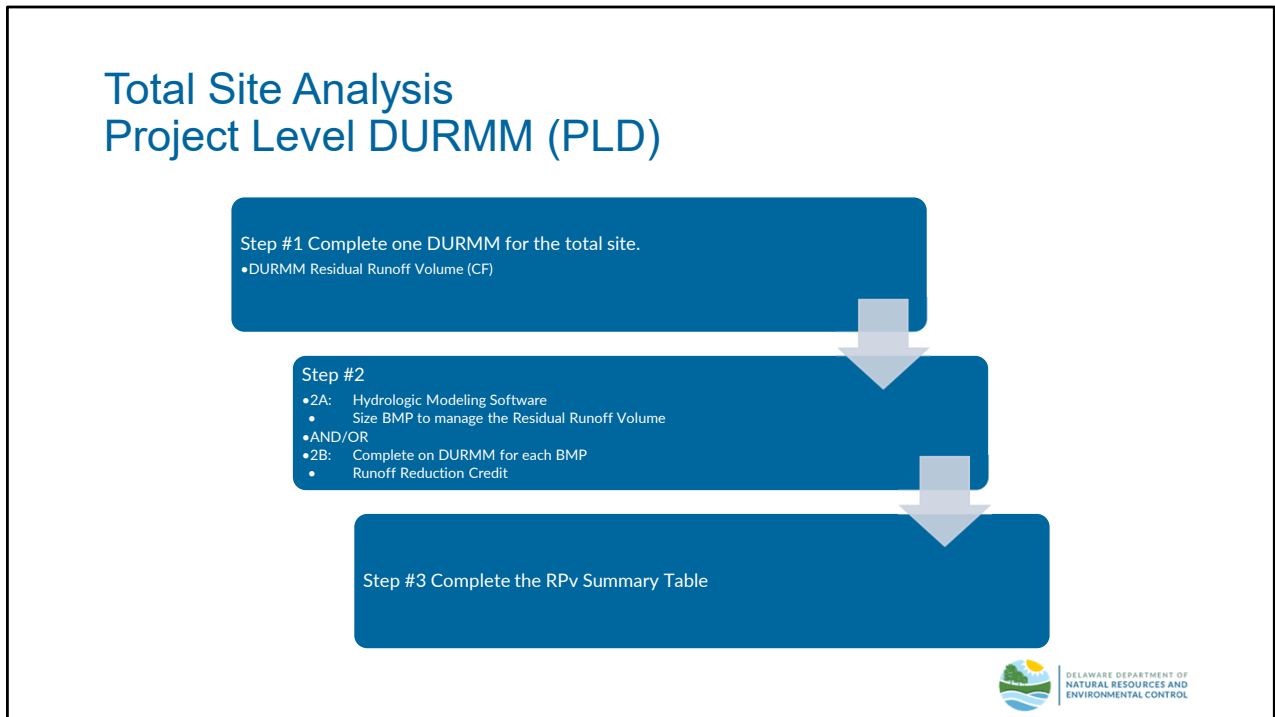
Both options require the use of the Summary Table for Site R_{Pv} Compliance when the site LOD contains more than one subarea.

DURMM v2.5

Project Setup – Total Site Analysis (aka PLD Method)



When utilizing DURMM v2.5 at the total site analysis level, all the proposed Land Cover Data (in acres) within the project LOD is entered into the RCN tab of one DURMM workbook. With the remainder of the workbook completed, the BMP 1 selection in cell B6 of the Rpv Tab should be set to “No BMP”. The resulting residual runoff volume in Step 5.3 of the Rpv tab is the total runoff volume that must be managed in BMPs or otherwise offset to meet Rpv compliance.



First, complete one DURMM workbook for the total site LOD. If Step 5.3 of the Rpv tab results in “N/A” and Step 4.8 indicates “yes” no further analysis is necessary. Rpv compliance is met based on the land use changes.

Otherwise, once the total site residual runoff volume has been calculated, separate DURMMs are created for each BMP, and/or the BMPs sized using hydrologic modeling software to manage the Rpv volume.

Information from the Project Level DURMM is entered into the Rpv Summary Table spreadsheet in Section I. Information from the hydrologic modeling of BMPs and/or the BMP DURMM information is entered in Section II. The Rpv Summary Table spreadsheet calculates the total Rpv credit/shortfall. To comply with DSSR 5.2 or 5.6, the project must show a net Rpv credit.

DURMM v2.5

Project Setup – BMP Drainage Area



When utilizing DURMM v2.5 at the BMP drainage area level, each BMP or BMP treatment train drainage area has an individual DURMM workbook. Areas within the LOD that do not discharge to a BMP will have a “No BMP” DURMM workbook for the unmanaged areas. Some of the DURMM workbooks, including the “No BMP” workbooks, may show an R_{Pv} shortfall and some DURMM workbooks may demonstrate an R_{Pv} credit.

BMP Drainage Area DURMM

Step #1 Complete DURMM Workbooks for each BMP or BMP Treatment Train

- Drainage areas with BMPs should select one or more BMPs in the R Pv tab
- Drainage areas without BMPs should select "No BMP" and will show a shortfall volume in Step 5.3 of the R Pv tab.

Step #2 Hydrologic Modeling Software

- Size BMP to manage or overmanage the Residual Runoff Volume

Step #3 Complete the R Pv Summary Table



Once completed, some of the DURMM workbooks will show a shortfall and some will show credits.

During the design process drainage areas with proposed BMPs may select "No BMP" in the R Pv tab to calculate the shortfall in residual runoff volume (Step 5.3), thereby assisting in the sizing of a given BMP. This "No BMP" selection should then be modified to a specific BMP type to calculate the partial or extra R Pv credit.

Information from the BMP Drainage Area DURMM workbooks are entered into the R Pv Summary Table spreadsheet in Section II. The R Pv Summary Table spreadsheet will calculate the total credit or shortfall for the site. To comply with DSSR 5.2 or 5.6, the project must show a net credit.

DURMM v2.5

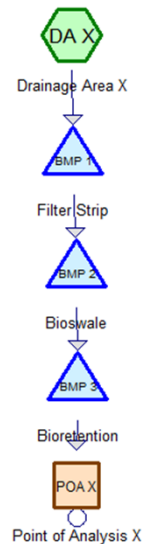
Project Setup – BMPs in Series (Treatment Train)



BMPs in Series

Single Drainage Area

- One DURMM with multiple BMPs in the Rpv tab



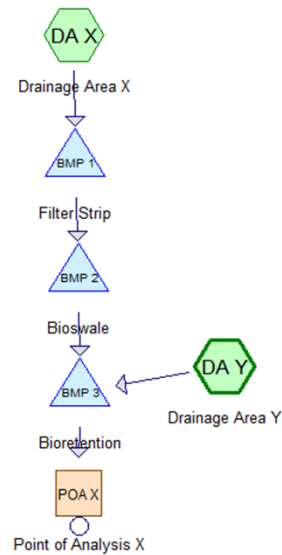
Multiple BMPs in series (Treatment Train):

When a series of BMPs are receiving the same flow conditions with no other drainage area being discharged to the downstream BMPs, multiple BMPs may be entered within the same DURMM. For example, in the scenario pictured, all of drainage area X is routed first through a filter strip, then to a bioswale, and finally to a bioretention basin. No additional drainage area is discharging to BMPs 2 or 3. The DURMM model for drainage area X would include the filter strip as BMP 1 in the Rpv tab, the bioswale as BMP 2 and the bioretention as BMP 3. Refer to Example 2, page 45, in this Module for an example of BMP treatment train set-up in DURMM.

BMPs in Series

Multiple Drainage Areas

- One DURMM for each distinct drainage area
- Data for upstream DURMMs will be incorporated into the next DURMM downstream
- Drainage areas unique to a BMP should be included in the RCN tab of the BMP's DURMM



Multiple BMPs in series (Treatment Train):

When a series of BMPs are not all receiving the same flow conditions, a DURMM model should be created for each BMP drainage area. Information from an upstream DURMM workbook upstream will be entered into the next downstream DURMM model and so forth. Any new drainage areas unique to a given BMP will be incorporated into that given model. Refer to Example 2D in training Module 2.

In the scenario depicted in the slide above, all of drainage area X is routed through a filter strip, bioswale, and bioretention basin, but drainage area Y is also being managed by the bioretention basin. In this case a DURMM model (DURMM DA-X) for drainage area X would include the filter strip as BMP 1 in the Rpv tab, the bioswale as BMP 2.

A separate DURMM model (DURMM DA-Y) would be developed for the bioretention basin, BMP 3. The upstream contributing drainage area from DURMM DA-X will be entered on the CA-RCN and LOD tabs of DURMM DA-Y, reducing in the inlet runoff flows into the bioretention basin from DA-X to account for the upstream management. Only the bioretention BMP is entered into the Rpv sheet as BMP1 for DURMM DA-Y.

Results from each DURMM model should be entered into the Rpv Summary Table.

(THIS CONCLUDES THE DURMM V2.5 QUICK-START GUIDE. FOR ADDITIONAL INFORMATION CONTACT THE DELAWARE SEDIMENT & STORMWATER PROGRAM.)