Sediment and Stormwater Current Technical Practices

Maryland Department of Transportation State Highway Administration
June 7, 2018

This document details the current technical practices that are used to review Maryland Department of Transportation State Highway Administration (MDOT SHA) projects submitted to the MDOT SHA Plan Review Division (PRD). Some of these practices may be modified or supplemented when the MDOT SHA Sediment and Stormwater Technical Procedures are approved by the Maryland Department of the Environment (MDE).

Erosion & Sediment Control

The intent of this section is to provide a supplement to the "2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control" in support of design efforts for MDOT SHA projects. Future revisions and modifications to the Standards and Specifications may result in a conflict between this supplement and the current Standards and Specifications. The designer is reminded that the Standards and Specifications are the overriding design document and sound engineering judgment should be applied to all designs.

The supplemental information listed below is referenced by the section number in the Standards and Specifications that it refers to:

Add the following to Section A-5.I, Content of the Erosion and Sediment Control Plan:

Design Data on Plans

Some erosion and sediment control (ESC) measures (e.g. temporary gabion outlet structures, temporary stone outlet structures, traps, basins, etc.) require design data on the plans. For temporary stone outlet structures (TSOS) and temporary gabion outlet structures (TGOS), include: location and/or identification number (ID #), weir elevation, drainage area (DA) size, required storage, and actual storage. The ESC plan should include grading contours for sediment traps and basins. When excavation or additional grading is needed to achieve the required storage volume behind a TGOS or TSOS, show the temporary contours or provide enough information during plan review to demonstrate sufficient storage availability.

Standard Stabilization Note

All disturbed areas with slopes flatter than 2:1 must be stabilized with 4 inches of topsoil, seed, and mulch. For slopes 2:1 or steeper, refer to the "MDOT SHA Landscape Design Guide."

Same Day Stabilization:

Same Day Stabilization (SDS) is not a standard ESC measure. It should be limited to small areas where the ESC filtering practices provided in the "2011 Maryland Standards and Specifications for Soil Erosion and Sediment Control" are not feasible or practical. The SDS provision should also be limited to areas where the proposed work can be completed in a single working day, including application of the permanent stabilization. In some instances, temporary plastic sheeting may be used to protect multi-day SDS areas. Seed, straw, and/or SSM are not acceptable methods to temporary stabilize an SDS work area that will be disturbed the next day.

When a plan has an area that calls for same day stabilization, but the rest of the disturbance has ESC measures, the limits of SDS need to be clearly identified on the plans. This can be done with a bubble, shading, or hatching. If shading or hatching is used, the pattern should be identified in the legend.

MDOT SHA projects that include limited amounts of disturbances, such as sidewalk replacement or guard rail installation, often include a provision for same day stabilization in lieu of installation and removal of sediment control devices. A note detailing the requirements

should be provided on the plans and referred to in the Sequence of Construction (SOC). If the note allows for either same day stabilization or the installation of sediment control devices, then the sediment control devices should be shown on the plan.

Removal (pulling) and resetting of W-Beam post and panel that does not require grading or earth disturbance may be excluded from the Limit of Disturbance (LOD). Most end treatment installation includes safety grading and should be included within the LOD. New installation of guard rail and associated safety grading should be included within LOD. The LOD may be shown on a typical section or detail and included in the SOC. If a typical LOD detail is used, any LOD located within environmentally sensitive areas should still be shown individually on the plans.

Add the following after Section A-5.I, Content of the Erosion and Sediment Control Plan, Item H.6 (e):

(f) Details that deviate from the "2011 Maryland Standards and Specifications for Erosion and Sediment Control" must be shown on the plans.

Add the following to Section B-1:

Stabilized Construction Entrance

In certain situations, a stabilized construction entrance (SCE) may not be required. This special allowance is made for areas where it is either infeasible or inapplicable to provide an SCE. A typical example would be when the work area is smaller than the disturbance that would be created by an SCE. Where no SCE is provided, the contractor shall designate the construction equipment that shall be allowed within the LOD. This equipment shall be kept within the LOD until the proposed work is complete and shall have treads/tires cleaned prior to leaving the LOD. The method of cleaning shall be specified by the contractor. Washing of treads/tires requires an appropriate sediment filtering practice or capturing devise.

Rumble Pad

Pre-constructed rumble pads may be used instead of stabilized construction entrances provided they are installed according to manufacturer's recommendations and a sufficient number of pads are installed to allow a minimum of four tire revolutions while on the pad. More pads may be needed depending on site conditions. The plan shall specify that accumulated materials be cleaned from the pads daily (or more often if necessary) and an acceptable disposed method be specified on the plan or in the specification.

Add the following to Section B-4-4:

Temporary Stabilization

Disturbed areas that are to be paved shall be stabilized with graded aggregate base (GAB). All other areas shall be stabilized according to MDOT SHA specification section 704.

Add the following to Section B-4-8:

Staging, storage and stockpile areas

Staging, storage and stockpile areas are typically identified and located by the contractor, but in some cases, may be shown on the plans. The contractor is responsible for obtaining approvals for off-site borrow or waste sites. Off-site borrow or waste sites require local, county, and Soil Conservation District approvals if they are located on private property, PRD approval if on MDOT SHA property, or MDE approval if on federal property or other State property.

Add the following to Section D-4, Conditions Where Practice Applies:

The exit slope must be flat. If the slope exceeds 0%, then use "NRCS Design Guide MD #6 Riprap Design Methods" on riprap channel design and Isbasch equation.

http://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_025594.pdf

Other Supplemental Information:

Notice of Intent (NOI)

For projects with an earth disturbance of 1.0 acre or greater, a National Pollutant Discharge Elimination System (NPDES) Individual Application or a Notice of Intent (NOI) to comply with General Permit to Discharge Stormwater Associated with Construction Activities must be completed online and approved by MDE prior to any earth disturbance.

Notice of Termination (NOT)

The online Notice of Termination must be completed by MDOT SHA Compliance personnel or MDOT SHA responsible construction personnel before a project can be closed out. Stormwater facility as-builts should be accepted by the Highway Hydraulics Division and the Plan Review Division prior to the project closeout.

Material Removal by Pressure Washing

If a high-pressure water jet is to be used to remove concrete from existing structures, the plans or specifications should direct the contractor to submit a plan for effluent collection, removal, and off-site treatment. This activity may require an Industrial Discharge Permit from MDE.

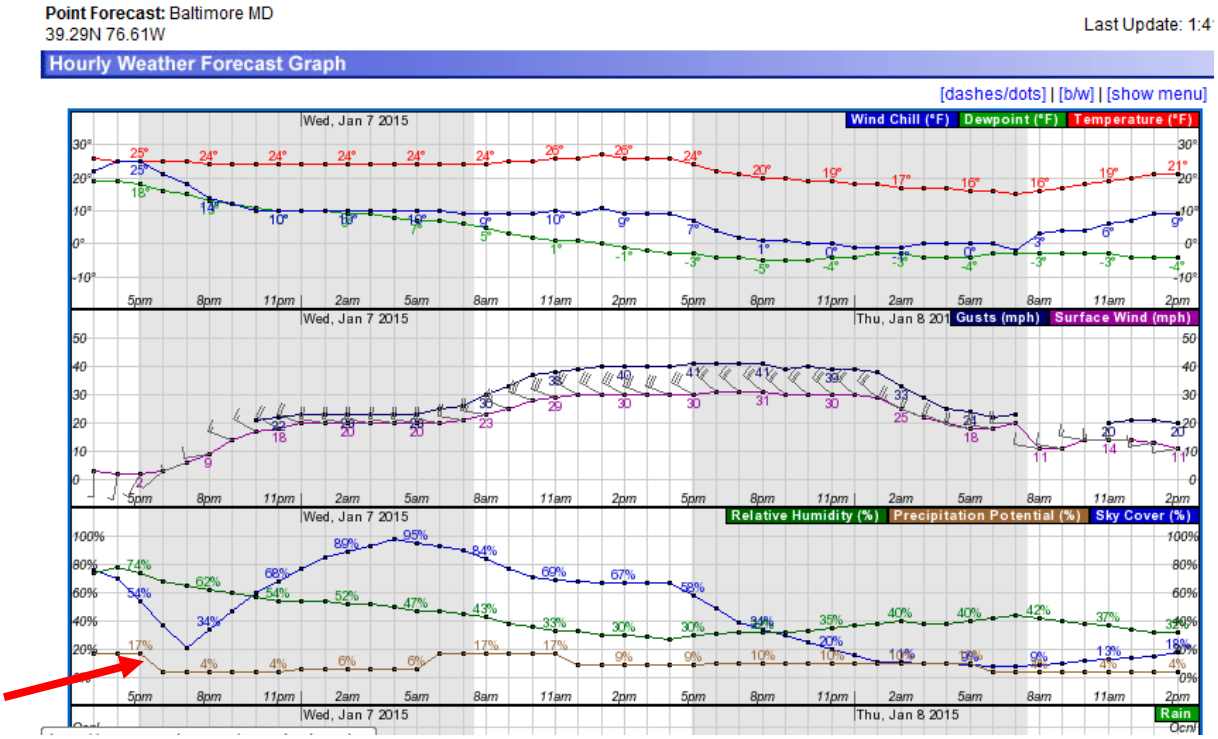
Scarifying Soils

Existing in-situ soils should be scarified below stormwater management best management practices (BMPs). Suggested language for this note to the contractor is as follows: "Scarify the soil surface with a backhoe, skid-steer, or tractor with ripping teeth, cultivator, disk harrow, or other agricultural machinery. Scarify to a depth that will result in soil that is easy to dig for at least the top 12". Do not scarify within the drip line of existing trees to prevent damage to surface feeder roots."

Three Day Dry NOAA forecast

Three Day NOAA weather forecasts are "Dry" when the probability of precipitation during each of the three consecutive days is less than 20%. National Weather Service precipitation forecasts for a project location can be found on www.weather.gov. Follow the steps below:

1) Enter the city/state or the zip code into the top-left blank.
2) Scroll down the page to see the detailed forecast.
3) Obtain the numerical probability of precipitation (0-100%) by clicking on "Hourly Weather Graph".
4) The brown line on the third section of the graph shows the hourly probability of precipitation.
5) To see this in a tabular form, instead of a graph, click "Tabular Forecast" near the bottom right of the web page.



Stormwater Management

The intent of this section is to provide clarifications to the current version of the 2000 Maryland Stormwater Design Manual, Volumes I & II (Design Manual) for MDOT SHA projects. Sound engineering judgment should be applied to all designs. The information listed below is referenced by the section number in the Design Manual that it refers to:

Chapter 2, Section 2.1:

Based on the 2007 Stormwater Management Act and the revisions to Chapter 5 of the Design Manual, the criterion for calculating Environmental Site Design Volume (ESDv) is now the same statewide. Therefore, P=1.0 inch should be used statewide for water quality and Tables 5.3 should be used to determine statewide ESDv.

Chapter 2, Section 2.3 page 2.8, Clarification on Cpv requirements for Eastern Shore:

Based on the 2007 SWM Act and the revisions to Chapter 5 of the Design Manual, ESDv, and therefore Channel Protection Volume (Cpv), is required for the Eastern Shore. There are multiple Cpv waivers that Eastern Shore projects may qualify for due to the prevalence of tidal water. However, Chesapeake Bay Critical Area Regulations may require full ESDv on Eastern Shore. Critical Area required management cannot be waived by PRD.

Chapter 2, Section 2.4 and 2.5, The following is a clarification to information provided on page 2.12, and 2.13 of the manual:

Existing agricultural land uses within the project LOD should be modeled as meadow in good condition in the existing condition.

Existing agricultural land uses that are outside the LOD should be modeled as the present land use in both the existing and proposed conditions.

Downstream impacts should be identified and addressed when culverts are enlarged as part of a development project. See Sections 4.1.C and 4.2.C in the "MDOT SHA Sediment and Stormwater Guidelines and Procedures – Part A" (Guidelines).

Chapter 3, Section 3.1.1 page 3.8, Additional guidance on feasibility:

Dry detention facilities may be used to provide quantity management (Qp2, Qp10, or Qf100).

Wet ponds are not permitted in Use III and IV Waters, or within 4 miles of airports.

Watershed and Stream Use information can be obtained from the following web sites:

Interactive 6 and 8 Digit Watershed Map:
https://data.maryland.gov/Energy-and-Environment/Maryland-s-8-Digit-Sub-Watersheds/e9j9-vuxg/data

Interactive Stream Use Map:
http://mde.maryland.gov/programs/Water/TMDL/WaterQualityStandards/Pages/DesignatedUsesMaps.aspx

Chapter 5, Section 5.1.3.1:

Loss of water quality applies to both new development and redevelopment projects when an existing system that provides water quality is altered. It should be evaluated throughout the design development process. Changing a roadway from open section to closed section is only considered to be a loss of water quality (LOWQ) if the existing roadside swale has an MDOT SHA BMP number.

If the area to be developed was providing stormwater management (SWM) in existing conditions for an adjacent drainage area within MDOT SHA right-of-way (ROW) or through an agreement where MDOT SHA accepted responsibility for providing management, then the management being lost must be replaced. If a new BMP replaces an existing BMP or other SWM feature, such as a grass channel or disconnection, the new BMP must be designed to replace the existing management in addition to satisfying the proposed management requirements.

Chapter 5, Section 5.1.3.1:

A discussion of the erosion & sediment control approach should be included in the Concept SWM narrative.

Chapter 5, Section 5.2, page 5.17:

The manual refers to and encourages the use of "treatment trains" as part of an overall system for meeting the project's stormwater water requirements. A minimum P_E of 1 inch needs to be treated by ESD, but it does not have to be attained in a single facility. It is acceptable to provide practices in parallel or in series. For example, a treatment train of three bioswales is essentially the same as a single bioswale with three separate segments or units for ESDv. The facilities are connected, and one drains to the other, but each individual unit has a sub-drainage area that drains directly to it.

For ESDv design purposes, the drainage area is the portion that drains directly to the individual unit. If each unit in the treatment train is designed to treat the same level of P_E from its individual sub drainage area, there should be no overflow into the downhill unit during the ESDv design storm, except for grass swales. However, if the P_E treated varies from unit to unit, the downhill facility will have to include overflow from the uphill facility for the ESDv design storm. For quantity analysis (Qp), the drainage area is cumulative and gets progressively larger for each downhill practice, as it does with a storm drain system. See the Design Manual for design constraints for swales.

If the cumulative ESDv provided meets the target Pe and ESDv, then the ESDv treatment provided by the treatment train is satisfactory. Water quality credit is not given for the portion of P_E above 1.0 inch, except for TMDL projects.

Add the following to Chapter 5, Section 5.2:

5.2.6: Impervious Area Requiring Treatment

The following procedure should be used for identifying, evaluating, and classifying POI/LOI for MDOT SHA projects and calculating treatment requirements:

A. Identify the points of investigation (POIs) and lines of investigation (LOIs)
A POI must be identified at every location where concentrated runoff leaves the ROW. A line of investigation (LOI) must be identified at every location where sheet flow leaves the ROW. In some cases, it may be acceptable to place the POI where runoff leaves the LOD, but this is unusual. If new points of concentrated flow are created or if there is a proposed increase in peak flow, the applicant must obtain a letter from the adjacent property owner acknowledging and accepting the impact(s) to his/her property. POIs with shifted drainage area divides may result in increases in runoff and may have additional quantity management requirements.

B. Determine Waiver Applicability
Areas that qualify for a 3.3.A waiver are not required to provide stormwater management. If the entire POI qualifies for a 3.3.A waiver, there is no need to proceed with this process for that POI, other than identifying the POI location.

C. Evaluate POIs
Provide a drainage area map delineating the drainage area to each POI for both existing and proposed conditions. The drainage area, impervious area, time of concentration (Tc) flow path, and runoff curve number (RCN) are required for each POI unless it qualifies for a 3.3.A waiver.

D. Classify POIs
Calculate the percentage of existing impervious area (%I) for each POI. The area used for calculating %I is the Stormwater Study Area (SSA) and will correspond to either the LOD or ROW within the drainage area to the POI. The same method of calculating %I (LOD or ROW) must be used for all POIs in the project. The designer should check the POI classifications using both methods to determine the best choice for the project.

   a. If I>40%, the POI is classified "redevelopment" and reconstructed areas require 50% WQ treatment and no Cpv is required. New impervious cover requires 100% ESDv (WQv and Cpv).
   b. If I≤40%, the POI is classified "new development". Both reconstructed areas and new impervious cover requires 100% ESDv (WQ and Cpv).

E. Calculate IART

LOD = Limit of Disturbance (acres)
A_i = Impervious area (acres)
Existing A_i = The total impervious area in the existing condition within the LOD(1)
Proposed A_i = The total impervious area in the proposed condition within the LOD(1)
ΔA_i = Net change in Ai within the LOD (Proposed Ai – Existing Ai)(2)
I = Impervious cover (%)

(1) Exclude impervious area that is maintenance and qualifies for a 3.3.A waiver. Impervious areas associated with isolated small foundations or posts for signs and lighting structures are considered de minimis and should also be excluded from IART computations. Large structures and areas or concrete pads should be included in IART calculations.

(2) This value will be negative when there is a net decrease in impervious area.

For Redevelopment POIs (I>40%):

IART = (Proposed Ai – Existing Ai) + 50% (Existing Ai), therefore:
IART = ΔAi + 50% (Existing Ai)

For New Development POIs (I≤40%):

IART = (Proposed Ai – Existing Ai) + (Existing Ai), therefore:
IART = Proposed Ai

The sum of impervious areas treated by all ESD facilities for water quality (P_E=1.0") must equal or exceed IART. ESD facilities must be sized for the area draining to them. If the project has excess WQv from ESD facilities or Chapter 3 bioretention facilities with a total drainage area of less than 3 acres, it will be credited to the MDOT SHA Water Quality Bank. Other Chapter 3 facilities may be used to treat project IART but may not be credited to the WQ Bank.

Generally, when using the IART method, if IART ≤ 0 for a POI then stormwater management treatment is not required for that POI. There are a few exceptions to this such as improvements that generate no additional impervious area, but the disturbed area is expected to be heavily compacted, or when the RCN is expected to increase in post development condition. For those situations, the designer is expected to address SWM requirements using the method of DA to POI (Table 5.3 in the SWM Manual).

Loss of water quality treatment (LOWQ) must be replaced or otherwise addressed.

F. Provide ESD to the MEP

ESDv =(Pe)(Rv)(A)/12

Where: Pe = 2.6 for A or B soils
Pe = 2.2 for C soils
Pe = 2.0 for D soils
Rv = 0.95
A = ΔAi, for redevelopment POIs (I>40%)
A = Proposed Ai, for new development POIs (I≤40%)

ESDv is comprised of a water quality component (WQv and Rev) equivalent to the first 1.0 inch of P_E and a channel protection component (Cpv) equivalent to the full target P_E. When the project includes redevelopment POI's that have a combination of new impervious and reconstructed impervious, it is necessary to calculate these components separately.

Water Quality Volume (WQv)

ESD practices (Chapter 5 of the Design Manual) must be used to treat the WQv (Pe=1"). Quality management does not have to be provided within the drainage area of the POI but must be provided within the same six-digit watershed. WQv provided by a facility is limited to the impervious area within the drainage area to the facility. For example, if the impervious area draining to the facility is 0.3 acres, physically sizing the facility to treat 0.5 acres will not result in additional water quality credit.

If Chapter 5 practices are demonstrated to be impracticable, Chapter 3 facilities may be used. However, a variance from providing ESD treatment for new development impervious surfaces must be justified and approved by PRD for Chapter 3 facilities to be used. If both Chapter 5 and Chapter 3 facilities are impracticable, a debit from the MDOT SHA Water Quality bank may be used if there is sufficient credit for the watershed and the Highway Hydraulics Division (HHD) approves the transaction. A debit from the WQ Bank satisfies both WQv and Rev requirements for the debited acreage. Typically, WQ Bank debits are intended for projects with a limited scope where IART requirements are minimal and there are circumstances that preclude the use of SWM facilities, such as limited ROW, wooded areas, karst, steep slopes, or urbanized corridors. Examples include Americans with Disabilities Act (ADA) sidewalk projects, safety and resurfacing projects, and projects of a similar nature.

Channel Protection Volume (Cpv)

This is the portion of ESDv that comes from "new" impervious area. It represents the minimum volume that must be provided in the POI to satisfy the Cpv requirement. The channel protection volume storage requirement must be met at each POI.

a. For POI's that are classified as redevelopment (I>40%), Cpv is required for the increase in impervious cover (ΔA_i).
b. For POI's that are classified as new development (I≤40%), Cpv is required for all impervious area within the LOD (Proposed Ai).

Cpv requirements are calculated using the ESDv equation and are inclusive of the first 1" for WQv. If the WQ Bank will be used to address the WQv requirements at a POI or the WQ obligations will be satisfied elsewhere on the project, the required ESDv to satisfy Cpv requirements at an individual POI is still the full target Pe and resulting ESDv for all new development pavement (not the target Pe minus 1"). Additional treatment flexibility can be granted if the WQv portion of the ESDv is satisfied elsewhere, since the selected BMP would then not be required to have a WQ component. The total ESDv provided within a POI should equal or exceed the required ESDv for that POI. It is allowable to provide excess ESDv in one facility to compensate for a shortage of ESDv in another within the

same POI DA. The maximum ESDv is limited to the 1-year storm (2.6 inches). Criteria for Cpv waivers is included in Section 3.3.B of the Guidelines.

ESD practices should be used to the maximum extent practicable to meet the Cpv portion of the ESDv requirements. If ESD practices are provided for the first 1" Pe and Cpv cannot be provided within an ESD facility, sufficient information shall be provided to demonstrate why ESD practices are not feasible for providing Cpv. With sufficient justification and PRD approval, structural practices (Chapter 3) may be used to meet the Cpv requirement.

When structural practices are used to address Cpv requirements, the Soil Conservation Service (SCS) curve number methodology from Appendix D.11 should be used to calculate the runoff volume that must be captured and managed by the structural practice. The reduce curve number from Table 5.3 should be used in this methodology to include the quantity management provided any ESDv treatment that partially treats the target Pe. The runoff curve number (RCN) may be reduced for the 2-year peak discharge based on the amount of rainfall treated by ESD practices within the POI.

Recharge Volume (Rev)

Rev requirements are determined based on the classification of the POI. If the POI is classified as redevelopment (I>40%), recharge is required for the increase in impervious area (ΔAi,) within the LOD. If the POI is classified as new development (I≤40%), recharge is required for the entire impervious area within the LOD (Proposed Ai). If an ESD practice has an underdrain and recharge is required for the contributing area, a storage reservoir must be provided below the invert of the underdrain. If the WQ Bank is used to satisfy the WQv requirements for a POI, the WQ Bank debit also satisfies the Rev requirement.

Impervious Area Shifts

If drainage areas are shifted as part of the project, include a description of the shifts in the SWM report narrative. The MDOT SHA Impervious Area Shift Matrix table should be used to present the impervious area shifts in a clear and concise manner. Quality and quantity requirements for the shifted drainage area should be addressed as follows:

a. Quantity management requirements (Cpv/Qp/Qf) must be addressed at the POI that area is being shifted to. This applies to shifted areas both inside and outside the LOD.

b. Quality Management is also required if impervious area within the LOD is being shifted.
    i. The shifted impervious must be treated as new impervious in the POI it is shifted to (Receiving POI).
    ii. There may be a water quality credit in the POI it is shifting from (Giving POI), depending on the development classification of that POI:
        - New Development Giving POI's receive no credit for the shifted impervious area.
        - Redevelopment Giving POI's receive 50% credit for the shifted impervious area.

G. Provide Qp and Qf

County requirements for Overbank Flood Protection Volume (Qp) and Extreme Flood Protection Volume (Qf) are shown on Table 2 of the Guidelines. If peak management is required, the proposed peak discharge rate must be equal to or lower than the existing peak discharge rate for the applicable design storm. If the project proposes to remove an existing quantity management BMP, the existing quantity management must be replaced. Peak management of the 100-year storm event is required for POIs located in Inter-Jurisdictional Flood Hazard Watersheds.

The Reduced Runoff Curve Number method is permitted for the 2-year analysis only. As an alternative, HydroCAD or Haestad software may be used to route the 2-year or 10-year storm through the SWM BMPs to demonstrate peak flow reduction for those storms.

Refer to Section 3.3.B of the Guidelines for a classification of POIs that are eligible for Qp or Qf waivers. When a 3.3.B.3 waiver is applicable, a concurrence letter from the county must be provided prior to Final Approval. If the POI discharges to private property, concurrence from downstream property owner may be required. See Sections 4.1.C and 4.2.C of the Guidelines.

H. Stormwater Management Report

The Stormwater Management report and calculations should address the following:

a. Demonstrate that the impervious area treated (IAT) $\geq$ IART. This should be evaluated for each watershed. WQv can be provided anywhere in the project as long as it is in the same six-digit watershed.
b. Demonstrate that IART is treated for a P_E of at least 1.0 inch in ESD facilities.
c. Demonstrate that the provided ESDv $\geq$ the required ESDv for each POI. If not, discuss how the shortfall is being addressed.
d. Demonstrate that Cpv requirements have been addressed at each POI.
e. Demonstrate that Qp and Qf requirements been addressed at each POI.
f. Address the following for each outfall:
    i. Discuss where each POI outfalls and what is downstream (open channel, pipe, pond, dam, structure, etc.). If it flows to an open channel, demonstrate that it is stable under existing conditions and the proposed velocities are non-erosive. If it is not stable in existing conditions, discuss how this will be addressed and whether proposed velocities have been designed to be at or below existing velocities.
    ii. If a new point of concentrated discharge is being created, discuss what measures have been taken to prevent future erosion (level spreader, BMP, etc.).
    iii. Demonstrate that adequate outfall protection is provided.
    iv. If the POI outfalls into a closed storm drain system, demonstrate, at a minimum, there is available capacity in the system for the 10-year design storm. Capacity for larger storm events may be required in cases where ponding water may create an unsafe condition.

v. Outfall assessment is required for all outfalls at concept stage. Unstable outfalls must be stabilized as part of the project. Exceptions can be requested when the project scope is limited in nature, the POI qualifies for 3.3.A waiver, and/or the project is classified as redevelopment or maintenance. If the unstable outfall is not stabilized as part of the project, confirm that the outfall will be added to the HHD, TMDL, or district list of outfalls to be monitored and stabilized when warranted.
vi. Outfall stabilization is required as part of the project for POI's with Cpv variances.

Chapter 5, Section 5.4.1, Page 5.55, the following are additional ESD practices:

Innovative Technology and Proprietary Devices
PRD recognizes the need for and encourages the development of innovative practices where site constraints are exceptionally limiting. If these devices are proposed, provide the MDE approval letter for the practice and MDOT SHA material acceptance letter in the stormwater management report.

Equations 5.1, 5.2, and 5.3, Chapter 5, Pages: 5.83, 5.98 and 5.105:

Equations 5.1, 5.2, and 5.3 in Chapter 5 are regarded as planning tools to be used for site layout during concept design. These equations provide a two-dimensional approximation of the respective three-dimensional ESD practice. However, in the case of grass swales, the practice is two-dimensional, and Equation 5.3 provides an accurate assessment of the Pe.

Equation 5.1 should not be used for M-1 Rainwater Harvesting, M-2 Submerged Gravel Wetlands, M-3 Landscape Infiltration, other than for very rudimentary planning.

Equation 5.2 should not be used for: M-4 Infiltration Berms, M-5, Dry Wells, M-6 Micro-Bioretention, and M-8 Bioswales other than for very rudimentary planning.

Equation 5.3 should not be used for M-7 Rain Gardens, other than for very rudimentary planning.

M-8 Swales, Chapter 5, Page 5.108:

The Design Manual states that the drainage area contributing to all the design variants for swales should be less than one acre. However, this may not apply when a swale drainage area includes off-site lawn or wooded areas and the flow does not reach the swale until after the runoff from the impervious areas. If the flow velocity and depth requirements are met for the 1-year storm, the drainage area limitations may be exceeded, since the Design Manual allows swales to be used for conveyance.

Grass Swales, Chapter 5, Page 5.109:

Grass swales are included in the Design Manual to encourage the use of open section

roadways. Grass swales should be parallel to the contributing roadway and the runoff from the impervious surface must sheet flow into the swale. Being a linear application, the grass swale must be the same length as the surface it treats.

Since there is no storage volume in a grass swale, the provided ESD_v should be calculated based on the achieved P_E using Equation 5.3.

$P_E(in) = 10in. \times \frac{A_f}{DA}$ (Equation 5.3) and $ESD_v(ac-ft.) = \frac{P_E(in) \times R_v \times A(ac)}{12\ in/ft}$

Equation 5.3 is effectively requiring the surface area of the grass swale to be 10% of the drainage area when treating a P_E of 1.0 inch. To treat a target P_E of 2.6 inches, the surface area would have to be 26% of the drainage area.

If the P_E achieved by the grass swale is less than the target P_E, additional ESD practices (i.e. "treatment train") will have to be provided.

Grass swales may provide full ESDv treatment and, therefore, Cpv treatment. They automatically meet recharge requirements. However, because there is no storage volume captured in a grass swale, they cannot be used to compute a reduced RCN.

Bio Swales, Chapter 5, Page 5.109:

For the surface storage requirements of the bioswale in combination with using MDOT SHA bioretention soil mix, the designer may use the MDE Surface Storage tables. Alternatively, the designer may choose to provide 75% surface storage instead.

Other Supplemental Information:

Precision of Computations for TR-55 and TR-20

Engineering judgement should be used when rounding input and output data for TR-55 and TR-20 based on the size of the watershed. As a general guidance for MDOT SHA projects, input and output data should be rounded as follows unless the drainage area is large enough to warrant fewer significant digits. If so, the designer should state this in the SWM narrative. The information below is provided as general guidance. The designer should use engineering judgement and document any decisions to round differently than shown below:

- Drainage area: acres are preferred, rounded to two decimal places. If square miles are used for larger watersheds, they should be rounded to four decimal places.
- Impervious area: acres, rounded to two decimal places.
- Composite RCN: rounded to one decimal place
- Tc: hours, rounded to two decimal places.
- Pe: inches, rounded to one decimal place.
- Q: cubic feet per second, rounded to one decimal place.
- Tc: feet, rounded to the nearest whole number.

- Slope: feet/feet, rounded to two decimal places for ground surfaces and three decimal places for hard surfaces.

Dividing Drainage Areas

Roadways (and particularly highways) are not hydrologically homogeneous to the rest of the area draining to the point of investigation, so the roadway should be subdivided as a separate sub-drainage area. The time of concentration for the sub-drainage area with the roadway will be much shorter and the RCN will be higher than the adjoining drainage area. When determining Tc or flow to a BMP, similar considerations may be applicable.

Bridge Deck and Bridge Replacement

Bridge decks are impervious surfaces that collect pollutants regardless of whether they span pervious areas, pavement, or water. Water quality control must be provided for this surface, and the area must be included in computations for IART, unless the work meets the criteria to be classified as maintenance.

Bridge deck replacement is maintenance and qualifies for a 3.3.A waiver. When an existing bridge is fully or partially reconstructed to the original footprint, elevation, and design without any widening, the work is also considered to be maintenance and qualifies for a 3.3.A waiver. In either case, full depth replacement of the roadway approaches is typical for proper transition of slopes. PRD will consider 50 feet on each side of the bridge of the pavement replacement to be maintenance.

When a bridge is widened, or the design otherwise altered, an area equal to the original impervious surface area will be considered reconstruction. Any additional surface area will be considered new impervious cover and requires both WQv and Cpv. County quantity management requirements, if applicable, must be addressed. Replacement of bridge approaches will be considered reconstruction within the existing footprint and new impervious outside the existing footprint.

When bridge scuppers are relocated, the extent of relocation shall be reviewed in determining its impact on stormwater management. It is preferred that scuppers not discharge directly into bodies of water. Water quality opportunities should be sought at the new discharge point. Water quantity and channel protection needs should be evaluated.

Pedestrian Bridges

Pedestrian bridges that cross existing impervious areas do not need to provide stormwater management. If a pedestrian bridge crosses new impervious area, either the pedestrian bridge or the impervious surface area below will have to be treated, dependent upon how the runoff from the bridge is collected and where it discharges. If the pedestrian bridge crosses pervious areas and the runoff from the pedestrian bridge reaches the pervious area below in a manner that disperses the flow (e.g. a wood plank pedestrian bridge where water runs off in the gaps between planks), then no SWM treatment is required. If that is not the case, then it is like a sidewalk and SWM is required.

Pervious Pavement

Pervious pavements are designed to allow rainfall to pass through pavement surface to infiltrate into the soils below that surface. In the SWM calculations, pervious pavements should be included in the IART calculations, but the surface area of the pervious pavements should also be included in the IAT. Care must be taken during the plan review and construction process to ensure that the in-situ soils below proposed pervious pavement areas are not compacted.

It is typical for drive aisles in permeable pavement parking lots to be constructed of traditional non-permeable pavement. It is acceptable for these pavement drive aisles to drain to the pervious pavement if the impervious run-on is limited, and the discharge onto the pervious pavement is evenly distributed and sheet flow. To consider these impervious pavement areas as treated, the pervious pavement section must provide storage for the ESDv required to treat those impervious areas in addition to the ESDv required to treat the pervious pavement itself. The drainage area to permeable pavements should not include vegetated pervious areas such as lawn or landscape areas because of the potential for clogging the surface of the pervious pavement.

Gravel and Ballast

Stone surfaces that are used for vehicular traffic, such as GAB or CR-6, are considered impervious because vehicles compact the surface over time, causing the surface to have the same hydrologic characteristics as a paved surface.

Stone used with a cellular confinement system or riprap used for erosion control or infiltration systems should not compact if it is properly installed. It is therefore considered a pervious or alternative surface.

Stone that is not used for vehicular traffic purpose is considered pervious. Examples of such use are: in stormwater management facilities, on pedestrian walkways, or as pads around electrical utilities and outlet protections.

A 50/50 mixture, by volume, of stone and topsoil, seed, and mulch utilized for shoulder edge drop off is considered pervious. Use of CR-6 or millings for the shoulder edge drop off is considered impervious.

Railroad ballast is generally considered to be pervious. Some railroad beds, however, are constructed atop compacted areas, thereby making the ballast impervious.

Reconstruction

If an impervious area that has existing water quality treatment (from a Chapter 3 or Chapter 5 water quality practice/credit or an acceptable innovative technology) is being reconstructed, additional water quality treatment is generally not required if it is demonstrated that the existing treatment has been maintained and is functioning as originally designed. An exception to this is when reconstruction is considered "new development" due to the existing I≤40% but the existing WQ treatment is only 50%. In this case, WQv treatment will have to be provided for 100% of the impervious (i.e. an additional 50%).

Soils Investigation

Refer to MDE Technical Memorandum 7 for required soils investigation information.

Stormwater Management BMP Recharge Volume

When a SWM facility has an underdrain, storage for the recharge volume must be provided in the facility if there is a recharge requirement. Typically, this is provided below the invert of the underdrain. When this is not feasible, it may be provided in a separate facility. If the recharge volume is provided upstream of the WQ or ESD facility, the required quality treatment volume may be reduced by the provided Rev. If the Rev is provided below the underdrain, it does not contribute additional volume to the provided WQv or ESDv by the treatment facility. This is consistent with page 2.5 of the Design Manual which says "Rev and WQv are inclusive. When treated separately, the Rev may be subtracted from the WQv when sizing the water quality BMP."