

VDDOT

**Hampton Roads
District
SWM Basins
Inventory & Inspection
Manual**



2005

A. Phase 1 – SWB Initial Assessment

1. Field Data Collection

The SWB Assessment phase shall include a comprehensive assessment and inspection of a current functional condition of VDOT owned and/or operated storm-water basins (SWBs) within VDOT's Hampton Roads District's jurisdictional boundaries. This assessment will be conducted in accordance with the details, forms, protocols and evaluation methodologies contained within this manual.

In addition, we will ensure that all inspectors are qualified personnel. This will be assured by the Hampton Roads District team assigned this responsibility.

2. Field Data Forms

Upon SWB identification, its location is collected by GPS. The SWB has will be assigned an ID number consisting of 5 digits. If the SWB was not previously identified and assigned a number, one is generated for it that follows sequentially.

The field inspection begins by collecting site-specific information that falls into two categories: SWB *assessment/inspection data* and SWB *support data*. Data will be collected electronically. Back up hard copy forms should be used in the field in case of the need for back-up data retrieval.

The following general information shall be recorded for all SWBs during each individual basin assessment and is found on all field forms (included as **Attachment B – VDOT SWB Assessment/Inspection Form**):

- **Date** – The date inspection was performed.
- **Inspector Name** – Initials of the inspector(s).
- **Precipitation** – Cumulative precipitation over last 3 days (72 hours) prior to actual inspection.
- **Structure number** – ID number of the structure associated with a discharge structure (e.g. riser or weir wall for a basin outfall).
- **SWB number** – Unique 5-digit ID # where the first two digits are the county ID number and the other three digits increase sequentially.
- **Coordinate Source** – The source of the coordinates shall be documented. Coordinates for the SWBs may be measured and verified by using Global Positioning System (GPS) or by ground survey. This may be done during the inspection or later when several SWBs are surveyed in succession. All coordinate data from surveys conducted shall be used to correct and validate available VDOT data.
- **Appurtenances** – Any features beyond typical or original design that may have been added to the SWB to improve the function of the basin.
- **Retrofit** – Any apparent modifications to the SWB site after initial construction that improved the SWB performance. This information may not be readily identifiable during the field investigation and may only come from design plans as made available by VDOT upon request.

3. SWB Inspection Data

The following represents the inspection criteria (ratings) and parameters of a SWB. The two basic types of SWBs, detention and retention, are each rated using the same basic parameters. A comprehensive SWB assessment/inspection form is provided as Attachment 1.

Each SWB parameter must be thoroughly reviewed by visual assessment, inspection, and potential physical testing, as necessary. All aspects of the SWBs should be looked at closely, including access, the riser, all inlet and outlet points of the basin, both sides of the embankment, and the downstream outlet and channel.

4. SWB Field Inspection Parameters

Each of the inspection parameters is rated on a scale of 1 to 5 (in some cases 0 to 5). The scoring defines the relative condition of each parameter. The objective is to provide a consistent framework for performing the scoring of individual parameters. In general the ratings reflects:

1 – Operating as Designed, No Issues Observed

2 – Functional, Minor Problems Exist

3 – Functional, Moderate Problems Exist

4 – Performance is Compromised, Major Problems Exist

5 – Non-Functional, Imminent Failure, Failure

In addition, where a parameter identifies an element that is not part of the SWB or could not be located or identified, then the rating would be: 0 – Not Applicable

In addition to this manual the following sites are available for additional information:

<http://www.virginiadot.org/business/locdes/resources/VDOT2004ESC&SWMManual3-04.pdf>

<http://www.dcr.virginia.gov/sw/e&s.htm>

The following inspection/assessment parameters shall be recorded for SWBs:

1. **Watershed Condition**

Watershed condition rates the overall condition of the drainage area being captured by the SWB. Unlike all of the remaining SWB parameters, this parameter should be assessed by a visual overview of up-gradient drainage area in close proximity to the inlet. The visual overview should be conducted while standing in close proximity of the SWB being evaluated. A complete visual survey of the entire drainage area is not required.

Individual Rating Value Evaluation:

- 1 – No apparent construction, erosion, slope failures, or other sources of potential sediment load or other pollutant discharges is occurring up-gradient from the SWB.
- 2 – Watershed shows minor construction, erosion, or other source of potential sediment or other pollutant load is occurring up-gradient from the SWB. No maintenance is required, but condition should be monitored.
- 3 – Watershed shows *moderate* evidence of construction, erosion, or other source of potential sediment or other pollutant load is occurring up-gradient from the SWB and is likely contributing to compromise of SWB performance. Maintenance should be performed to include possible further investigation of sources.
- 4 – Watershed shows *major* evidence of construction, erosion, or other source of potential sediment or other pollutant load is occurring up-gradient from the SWB and is clearly contributing to compromise of SWB performance. Maintenance should be performed to include further investigation of sources.
- 5 – Watershed activity has caused SWB to completely fail. Redesign and reconstruction is likely required.



Erosion in watershed upstream of Basin inlet

2. **Q-in Condition**

Q-in condition rates the overall condition of the discharge points into the basin and the adverse effects that may impair the performance of the SWB. Erosion or sediment build-up of the basin as the result of un-stabilized discharge points should be evaluated. This evaluates the result of Q-in stability or instability as found in the inlet area and/or floor of the basin. (see item #3)

Individual Rating Value Evaluation:

- 1 - Basin is operating as designed and there are no problems as the result of any discharge channels or pipe conveyances. No maintenance required at this time.
- 2 - Basin is operating as designed, but has *minor* issues related to sedimentation or basin scour as the result of the discharge channels or pipe conveyances. No maintenance is required, but condition should be monitored.
- 3 - Basin shows *moderate* evidence that SWB performance is compromised. Sedimentation or scour is causing problems with the performance of the basin. Maintenance should be performed.

- 4 - Basin shows *major* evidence that SWB performance is not being maintained. Maintenance should be performed to avoid complete failure.
- 5 - Basin shows evidence that SWB performance has completely failed. Maintenance should be performed immediately.



Sediment build-up in inlet due to conveyance channel instability

3. Q-in Stability

Q-in Stability rates the condition of all conveyance channels and storm drains (just upstream) discharging into the SWB. Any evidence of erosion or down cutting of the channel should be evaluated. This is a condition assessment of actual conveyance(s) into the basin. Is the area immediately upstream stabilized or show signs of erosion. The result of this element will be documented in Q-in condition.

The data requirements document provides for a maximum of 5 distinct identifiers for pipe, paved channel, and unpaved channel conveyances. If the number of Q-in conveyances exceeds this number any one of the conveyance types, such notation should be made in the comments data field after corresponding to the rating on the 5th such conveyance type.

Individual Rating Value Evaluation:

- 1 - Channels or conveyance pipes are functioning properly. No maintenance required at this time.
- 2 - Channels or conveyance pipes show *minor* evidence of erosion. No maintenance is required, but condition should be monitored.
- 3 - Channels or conveyance pipes show *moderate* evidence of erosion. Erosion is actively occurring and discharging sediment in the SWB. Maintenance should be scheduled.
- 4 - Channels or conveyance pipes show *major* evidence of erosion. Erosion is actively affecting the structural integrity of the embankment. Erosion may potentially affect the structural integrity of the embankment. Maintenance should be performed.
- 5 - Channels or conveyance pipes are eroded. Channel or pipes have failed or failure is anticipated during the next precipitation event. Maintenance should be performed immediately.



Stabilized conveyance channel into Basin



Un-stabilized conveyance channel into Basin inlet

4. **Fence**

Fence rates the presence of a structurally sound fence with a locked gate. This parameter should be evaluated based on the physical location of the SWB to public access and site conditions.

Individual Rating Value Evaluation:

If a SWB is located along the edge of VDOT right-of-way and there is public access adjacent to the SWB or there is evidence of public presence, then the rating should accurately reflect the presence or absence, and condition of the fence with locked gate.

If a SWB is located within roadway ramps on VDOT right-of-way, where there is no authorized access to the public, and there is no evidence of a public presence, then a fence is not required and a rating of "0" should be recorded.

0 – No fence.

1 – Fence is functioning as designed and there are no problems as the result of any discharge channels or pipe conveyances. No maintenance required at this time.

2 - Fence is operating as designed, but has *minor* issues related to vegetation/woody growth. No maintenance is required, but condition should be monitored.

3 – Fence is operating as designed, but shows *moderate* evidence that vegetation/woody growth is compromising integrity. Maintenance should be scheduled.

4 – Fence is not operating as designed. Access to basin can be made easily without using access gate due to vegetation/woody growth compromised fence integrity or other cause. Fence needs partial replacement and maintenance should be performed to avoid complete failure.

5 – Fence is not operating as designed. Access to basin can be made easily without using access gate due to vegetation/woody growth compromised fence integrity or other cause. Fence needs entire replacement.



Fence surrounding Basin with gate unsecured and saplings growing in fence line

5. Access

Access rates the available access for inspection personnel and maintenance equipment to access the basin from VDOT right-of-way. The access should be at least 10 feet wide, on a slope of 3:1 (H:V) or less, and stabilized to withstand the periodic or infrequent passage of heavy equipment. The evaluation of this parameter should take into consideration fill roadway elevations, which are often steeper than 3:1 slopes, configuration of roadway in respect to SWB, the natural topography surrounding the basin, and the potential for constructing a stabilized access road to the basin. In addition, the rating considers vegetation or debris that may impede access.

Due to varying site conditions, access roads may not be easily identifiable. However, if an area surrounding the SWB meets the above criteria, then the access parameter has been satisfied. Other access considerations could be from county or local roads or private right-of-way when access is restricted by the construction of noise walls and chain-linked protective fences. The presence of roadway guardrail should not be taken in to consideration because these items can be removed and reset after the maintenance operation.

Individual Rating Value Evaluation:

- 1 - Access road satisfies the design requirements and is stable.
- 2 - Access road may not be constructed, but topography surrounding the basin allows for ease of access and minimal construction of an access road to the SWB.
- 3 - Access road may exist or site conditions makes the use or construction of an access road moderately difficult, slopes are 3:1 and/or access routes other than VDOT right-of-way may be used. Other access routes may be County or local roads, or private property.
- 4 - Access road is not constructed, configuration of the SWB makes the construction of an access road difficult, slopes are 2:1, and/or access routes other than VDOT right-of-way may be used.
- 5 - Access road is not constructed, site conditions make it difficult to access, potential access road construction would be difficult, slopes are steep, and there is no gate or door associated with fence or noise wall and/or no access routes are available.



Good access to Basins as well as all the way around Basins for maintenance

6. SWB-Vegetation

SWB-Vegetation rates the overall (live) vegetative condition of the SWB related to the type, size, percent cover, soils, and SWB type. Some facilities by design may lack an abundance of vegetation. Basins with a permanent pool normally have vegetation along the fringe and in water depths of less than 6 inches. Basins with no permanent pool should have vegetation throughout the basin.

Wetland herbaceous vegetation should be the dominant type of vegetation within the basin. Woody vegetation is acceptable as long as it does not compromise the function or present a hazardous condition with the basin. The presence of woody vegetation on the embankment should be evaluated at the Downstream Cover/Toe and Downstream Cover/Toe parameters and should not be rated at this parameter.

Individual Rating Value Evaluation:

- 1 - Vegetation within the basin consists of 100% herbaceous cover or stabilized along the fringe of the permanent pool areas.
- 2 - Vegetation within the basin consists of 75% herbaceous cover and/or minor sapling woody vegetation less than 1 inch in diameter identified.
- 3 - Vegetation consists of 50% herbaceous cover and/or moderate woody vegetation, ranging in size from 1 to 2 inches in diameter, identified. Areas along the permanent pool are partially stabilized with a potential for erosion or slope failure.
- 4 - Vegetation within the basin consists of 25% herbaceous cover and/or major woody vegetation greater than 2 inches in diameter identified. Areas along the permanent pool are un-stabilized and fluctuating water levels are causing slope failure.
- 5 - Woody vegetation is causing a maintenance problem as the result of woody/leafy debris buildup at the riser and principal spillway. Maintenance should be performed immediately.



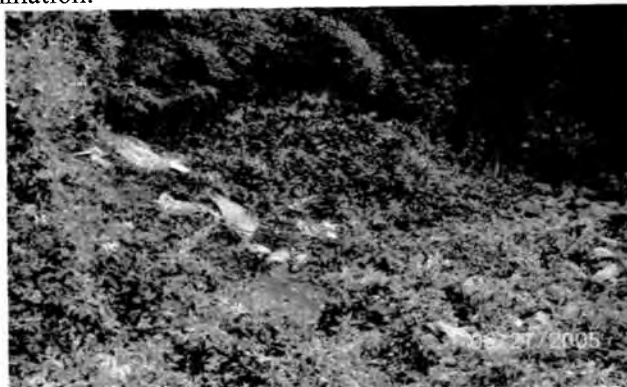
Shallow "Wet" basin with herbaceous vegetation "Dry" Basin with leafy and small woody vegetation

7. **SWB-Contamination**

SWB Contamination rates the overall condition of the SWB related to possible residue of man made contaminants. Examples are visual evidence of oil sheen on the water surface from illegal dumping or roadway runoff, residual waste, garbage, or potentially hazardous waste (oil drums, vehicle batteries, and tires, etc.). This evaluation should consider the type of contamination, potential effects of the decomposition of the material, quantity within the basin, and potential effects to downstream resources.

Individual Rating Value Evaluation:

- 1 Basin is absent of residual waste, garbage and potentially hazardous waste material and no potential for contamination.
- 2 Basin has minor accumulations of residual waste or garbage and no potentially hazardous waste and no potential for contamination.
- 3 Basin has moderate accumulations of residual waste or garbage and no potentially hazardous waste and minor potential for contamination.
- 4 Basin has major accumulations of residual waste or garbage and minor potentially hazardous waste and moderate potential for contamination.
- 5 Basin has major accumulations of residual waste or garbage and potentially hazardous waste and major potential for contamination.



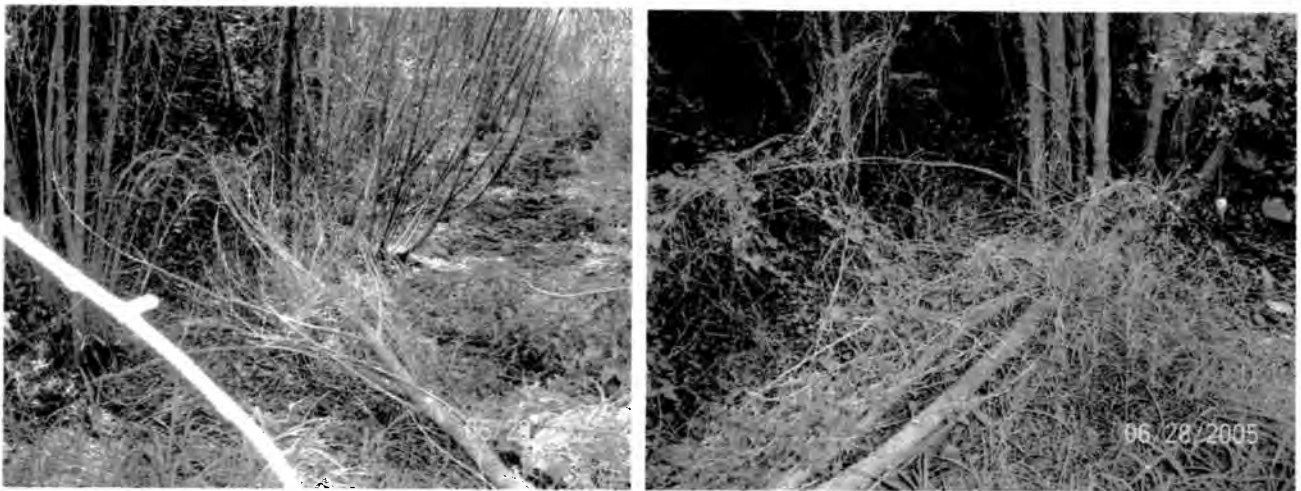
Trash, building materials, & yard waste accumulation

8. SWB-Debris

SWB Debris rates the overall condition of the SWB related to the physical presence of natural debris such as dead woody/leafy material and sedimentation, which any of these could decrease the performance of the SWB and possibly block the outlet structure. This parameter should be evaluated based on the existing debris and/or sediment build-up, amount of potential sources of debris and/or sediment, and potential blockage that could occur during future precipitation events.

Individual Rating Value Evaluation:

- 1 Basin is absent of woody/leafy debris and/or sediment accumulations.
- 2 Basin has *minor* accumulations of woody/leafy debris and/or sediment blocking 0 to 25% of the outlet structure.
- 3 Basin has *moderate* accumulations of woody/leafy debris, garbage, and/or sediment blocking 26 to 50% of the outlet structure and/or the amount of debris potentially could cause problems during future precipitation events. Maintenance needs to be scheduled.
- 4 Basin has *major* accumulations woody/leafy debris, garbage, and/or sediment blocking 51 to 75% of the outlet structure and/or the amount of debris potentially could cause problems during future precipitation events. Maintenance needs to be performed immediately.
- 5 Basin has overwhelming accumulations of woody/leafy debris, garbage, and/or sediment blocking 76 to 100% causing the outlet structure and the structural integrity of the basin to be compromised. Maintenance needs to be performed immediately.



Fallen and dead woody vegetation can cause blockage in basin and possibly block outlet

9. SWB-Ponding

SWB Ponding rates the overall condition of the SWB related to unwanted/additional ponding that may impact SWB performance. Retention (Wet) basins will retain a permanent volume of water and, therefore, this parameter will not apply and a 0 should be recorded. Detention (Dry) basins briefly store the volume of runoff then discharge at a slow rate. Depending on the SWB type, the evaluation of this parameter needs to be SWB-specific. Failure to identify excessive ponding involves the loss of the designed storage volume, potential for more-frequent discharge through the emergency spillway, and potential for dam breaching.

Evidence of ponding may include water lines, woody/leafy debris and garbage accumulations. In addition, if woody vegetation along the fringe of the water edge appears to be dead, then this may indicate a water level increase. This occurs because the woody vegetation cannot survive in inundated soil conditions.

Water levels above normal design may be due to a malfunctioning dewatering device or a blockage of the outlet structure. Extreme ponding problems may be associated with debris, sedimentation, scour, post construction runoff directed to the basin as the result of new roadway construction, or improper construction or design.

The inspector should be conscious of precipitation events prior to the inspection of any basin. By waiting 72 hours before performing SWB inspections, this allows adequate time for the basin to dewater and return to design water levels.

Individual Rating Value Evaluation:

- 0 Retention (Wet) Basin or no ponding present.
- 1 Basins are dewatering at their design rate.
- 2 Basins have *minor* ponding, but overall are functioning properly. Facilities are retaining approximately 0 to 25% more volume than designed.
- 3 Basins have *moderate* ponding. Basin bottom surface area is retaining approximately 26 to 50% more volume than designed.
- 4 Basins have *major* ponding. Basin bottom surface area is retaining approximately 51 to 75% more volume than designed.
- 5 Basins have ponding causing the emergency spillway to be regularly utilized to release runoff during precipitation events. Basin bottom surface area is retaining approximately 76 to 100% more volume than designed. Erosion is actively occurring near the earthen berm with a potential of dam failure during future precipitation events.



Major "Ponding" due to blockage of outlet



Random "Ponding" within basin

10. Forebay

Forebay rates the condition of the forebay relating capacity to trap incoming sediment. Forebays should have adequate freeboard to capture and retain sediment. If freeboard is absent, then sediment removal is warranted.

Individual Rating Value Evaluation:

- 0 Forebay does not exist.
- 1 Forebay is absent of woody/leafy debris, garbage, and/or sediment accumulations.
- 2 Forebay has *minor* accumulations of woody/leafy debris, garbage, and/or sediment comprising of 0 to 25% of the volume.
- 3 Forebay has *moderate* accumulations of woody/leafy debris, garbage, and/or sediment comprising of 26 to 50% of the volume. SWB is receiving minor accumulations of sediment. Maintenance needs to be scheduled.
- 4 Forebay has *major* accumulations woody/leafy debris, garbage, and/or sediment comprising of 51 to 75% of the volume. SWB is receiving moderate accumulations of sediment. Maintenance needs to be performed immediately.
- 5 Forebay is non-functional and has major accumulations of woody/leafy debris, garbage, and/or sediment comprising of 76 to 100% of the volume. SWB may be receiving major accumulations of sediment. Maintenance needs to be performed immediately.



The following parameters are specific to structural elements specific to impoundments with embankments/berms and/or have structural outlets. These parameters are, likewise, critical for assessments of SWBs that have structural elements that, if they fail, significant damage may occur.

11. Upstream Embankment - Cover

Upstream Embankment – Cover rates the overall vegetative condition of the upstream slope of the embankments throughout the basin related to type, size and percent coverage. Where there is a concrete weir wall present, evaluate the immediate earthen area adjacent to the vertical portion of the wall. There should be no woody vegetation on the embankments due to the potential of piping along the root systems from the upstream to the downstream trees.

The inspector should take into consideration whether the embankment is a combination of roadway/basin embankment or just a basin embankment. In many situations, roadway fill embankment will be used as the basin embankment, which can exceed normal design widths for basin fill embankments. Therefore, if woody vegetation is identified on a roadway basin embankment and the potential for piping along the upstream root systems reaching the downstream root systems, then the presence of woody vegetation should be evaluated on slope stability.

Individual Rating Value Evaluation:

- 1** Upstream cover on the embankment is densely vegetated with 100% herbaceous cover. There should be no woody vegetation
- 2** Upstream cover on the embankment is moderately vegetated with 76 to 100% herbaceous cover and/or minor sapling woody vegetation less than 0.5 inches in diameter identified. Maintenance should be scheduled.
- 3** Upstream cover on the embankment is moderately vegetated with 51 to 75% herbaceous cover and/or moderate woody vegetation, ranging in size from 0.5 to 1.5 inches in diameter identified. Maintenance should be scheduled.
- 4** Upstream cover on the embankment is vegetated with 26 to 50% herbaceous cover and/or major woody vegetation greater than 1.5 inches in diameter identified. Maintenance should be performed immediately.
- 5** Upstream cover on the embankment is vegetated with 0 to 25% herbaceous cover and/or woody vegetation greater than 1.5 inches in diameter that has compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Well maintained and acceptable Basin embankment



Basin embankment with woody vegetation of 0.5 to 2 inches

12. Upstream Embankment - Stability

Upstream Embankment Stability rates the condition of the upstream embankment stability related to erosion, void/weak areas due to settlement, rodent infestation, woody materials or other potential causes. Evaluation should consider identifying un-vegetated (denuded) areas, establishing source of hydrology for problem areas, as well as any problems with settlement, scouring, horizontal or longitudinal cracking, sloughing or rutting. The notes section should be used to document potential causes if apparent.

Individual Rating Value Evaluation:

- 1 Upstream embankment shows no evidence of surficial erosion or instability, slides, sloughing, or settlement. Embankment appears stable.
- 2 Upstream embankment shows *minor* evidence of surficial erosion or instability with no significant soil loss, settlement, or small sized horizontal/vertical slope cracks, but no evidence of sloughing. Erosion and settlement areas are small and isolated. Embankment appears stable.
- 3 Upstream embankment shows instability or *moderate* evidence of surficial erosion or sloughing **AND** *minor* embankment loss, settlement, or medium sized horizontal/vertical cracks with slight evidence of sloughing. Embankment appears stable, but requires maintenance.
- 4 Upstream embankment shows instability or *major* evidence of surficial erosion with major embankment loss, settlement or large sized horizontal/vertical cracks **AND** *moderate* evidence of sloughing that potentially may compromise the structural integrity of the embankment. Maintenance needs to be performed immediately.
- 5 Upstream embankment shows instability or *major* evidence of surficial erosion with major embankment loss, settlement, or large sized horizontal/vertical slope cracks **AND** *major* evidence of sloughing that has compromised the structural integrity of the embankment. Maintenance needs to be performed immediately.

13. Downstream Embankment - Cover

Downstream Embankment – Cover rates the overall vegetative condition of the downstream slope of the embankment related to type, size and percent coverage. Where there is a concrete weir wall present, evaluate the immediate earthen area adjacent to the vertical portion of the wall. There should be no woody vegetation on the dam embankments due to the potential of piping along the root systems from the upstream to the downstream trees.

The inspector should take into consideration whether the embankment is a combination of roadway/dam embankment or just dam embankment. In many situations, roadway fill embankment will be used as the dam, which can exceed normal design widths for dam fill embankments.

Therefore, if woody vegetation is identified on a roadway fill embankments and the potential for piping along the downstream root systems reaching the downstream root systems, then the presence of woody vegetation should be evaluated on slope stability.

In addition, when SWB outlet structures are connected to and discharge into a closed storm sewer system where the final pipe outfall and corresponding downstream parameters cannot be readily accessed or found, such conditions will warrant a 0 rating. Such closed storm sewer system outfalls will be evaluated for applicability under VDOT's outfall inventory/assessment program, not contained within the scope of this contract.

Individual Rating Value Evaluation:

- 0 SWB outlet appears to discharge into a closed storm sewer system and/or downstream parameters cannot be readily found
- 1 Downstream cover on the embankment is densely vegetated with 100% herbaceous cover. There should be no woody vegetation
- 2 Downstream cover on the embankment is moderately vegetated with 76 to 100% herbaceous cover and/or minor sapling woody vegetation less than 0.5 inches in diameter identified. Maintenance should be scheduled.
- 3 Downstream cover on the embankment is moderately vegetated with 51 to 75% herbaceous cover and/or moderate woody vegetation, ranging in size from 0.5 to 1.5 inches in diameter identified. Maintenance should be scheduled.
- 4 Downstream cover on the embankment is vegetated with 26 to 50% herbaceous cover and/or major woody vegetation greater than 1.5 inches in diameter identified. Maintenance should be performed immediately.
- 5 Downstream cover on the embankment is vegetated with 0 to 25% herbaceous cover and/or woody vegetation greater than 1.5 inches in diameter that has compromised the structural integrity of the embankment and emergency spillway. Maintenance should be performed immediately.



Properly vegetated downstream embankment w/minor erosion

14. Downstream Embankment - Stability

Downstream Embankment Stability rates the condition of the downstream embankment stability related to erosion, void/weak areas due to settlement, rodent infestation, woody materials or other potential causes. Evaluation should consider identifying un-vegetated (denuded) areas, establishing source of hydrology for problem areas, as well as any problems with settlement, scouring, horizontal or longitudinal cracking, sloughing or rutting. The notes section should be used to document potential causes if apparent.

Individual Rating Value Evaluation:

- 0 SWB outlet appears to discharge into a closed storm sewer system and/or downstream parameters cannot be readily found
- 1 Downstream embankment shows no evidence of surficial erosion or instability, slides, sloughing, or settlement. Embankment appears stable.
- 2 Downstream embankment shows *minor* evidence of surficial erosion or instability with no significant soil loss, settlement, or small sized horizontal/vertical slope cracks, but no evidence of sloughing. Erosion and settlement areas are small and isolated. Embankment appears stable.
- 3 Downstream embankment shows instability or *moderate* evidence of surficial erosion or sloughing **AND** *minor* embankment loss, settlement, or medium sized horizontal/vertical cracks with slight evidence of sloughing. Embankment appears stable, but requires maintenance.
- 4 Downstream embankment shows instability or *major* evidence of surficial erosion with major embankment loss, settlement or large sized horizontal/vertical slope cracks **AND** *moderate* evidence of sloughing that potentially may compromise the structural integrity of the embankment. Maintenance needs to be performed immediately.
- 5 Downstream embankment shows instability or *major* evidence of surficial erosion with major embankment loss, settlement, or large sized horizontal/vertical slope cracks **AND** *major* evidence of sloughing that has compromised the structural integrity of the embankment. Maintenance needs to be performed immediately.

15. Downstream-Seep

Downstream Seep rates the condition of downstream embankment related to water seeping out. Direct discharge and saturated soil conditions along the embankment face and/or toe should not merely be identified as a natural groundwater seep.

Care should be taken in the determination process, because this condition may be evidence of piping through the embankment and the beginning of embankment failure.

Indicators of seepage would be saturated soil conditions, direct discharge, surficial erosion, sediment accumulations at the embankment toe, slides or sloughing, vertical or horizontal settlement, and any changes in vegetative characteristics, such as isolated hydrophilic (wetland) vegetation on embankment.

Individual Rating Value Evaluation:

- 0 SWB outlet appears to discharge into a closed storm sewer system and/or downstream parameters cannot be readily found
- 1 Embankment is stable with no indicators of seep discharge.
- 2 Embankment is stable with *minor* soil saturation at the embankment toe. No evidence of concentrated discharge or erosion.
- 3 Embankment shows evidence of *moderate* evidence of soil saturation. Condition should be inspected and monitored annually.
- 4 Embankment shows evidence of *major* soil saturation, concentrated discharge and surficial erosion that potentially may compromise the structural integrity of the embankment. Maintenance needs to be performed immediately.
- 5 Embankment has concentrated discharge and surficial erosion that has compromised the structural integrity of the embankment. Maintenance needs to be performed immediately.

16. Emergency Earthen/Vegetated Spillway-Stability

Emergency Earthen/Vegetated Spillway Stability rates the stability of the emergency spillway relating to erosion of its embankments and bottom. Emergency spillway is generally located within undisturbed grounds, however, may be located at the intersection of the SWB fill embankment and undisturbed ground, or entirely within the embankment and stabilized with herbaceous vegetation, riprap or gabions.

An inspector should be conscious of precipitation events prior to the inspection of the SWB so that emergency spillway use frequency can be established. If the SWB is functioning properly, then by design, the emergency spillway should only be utilized to pass flows during high precipitation events.

In the event, that there is no emergency earthen spillway and the riser design utilizes a combination of principal/emergency spillway the rating for this parameter should be "0".

Individual Rating Value Evaluation:

- 0 No emergency earthen spillway exists.
- 1 Emergency earthen spillway is stabilized and functioning properly.
- 2 Emergency earthen spillway is stabilized with *minor* erosion of the sides and channel.
- 3 Emergency earthen spillway has *moderate* erosion of the sides and channel but the crest invert remains stable. Maintenance needs to be scheduled.
- 4 Emergency earthen spillway has evidence of *major* erosion of the sides and channel. Riprap may have relocated to the toe of slope or gabions have been undermined. Sediment accumulations are present from active erosion of the crest invert that potentially may compromise the structural integrity of the embankment. Maintenance needs to be performed immediately.
- 5 Emergency earthen spillway is actively eroding on the sides and channel, and crest invert. Active erosion of the crest invert has compromised the structural integrity of the embankment. Maintenance needs to be performed immediately.

17. Emergency Earthen/Vegetated Spillway-Opening

Emergency Spillway Opening rates the condition of the emergency spillway weir opening to function as designed when necessary. The emergency spillway crest invert should be a minimum of 1 foot below the top of the settled embankment. The weir cross-sectional opening should be free of debris and woody vegetation. Fence posts or fences should not be constructed within the weir cross-sectional opening because this is a potential for debris collection.

If there is no embankment emergency earthen spillway and the riser is a combination principal/emergency riser structure, then the Riser Top-Overflow Spillway (#22) parameters will be evaluated.

Both emergency spillway conditions should be evaluated and rated based not only on the existing conditions, but also for future precipitation events that may potentially compromise the function of the opening.

Individual Rating Value Evaluation:

- 0 No earthen emergency spillway exists.
- 1 Embankment emergency spillway cross-section is free of any woody/leafy and garbage debris and potential blockage. Emergency spillway opening is free of any woody/leafy and garbage debris accumulations.
- 2 Embankment emergency spillway cross-section has *minor* woody/leafy and garbage debris and potential blockage. Emergency spillway opening has *minor* woody/leafy and garbage debris accumulations.
- 3 Embankment emergency spillway cross-section has *moderate* woody/leafy and garbage debris and potential blockage. Emergency spillway opening has *moderate* woody/leafy and garbage debris accumulations. Maintenance should be scheduled.
- 4 Embankment emergency spillway cross-section has *major* woody/leafy and garbage debris and potential blockage. Emergency spillway opening has *major* woody/leafy and garbage debris accumulations. Maintenance should be performed immediately.
- 5 Embankment emergency spillway cross-section is blocked with woody/leafy and garbage debris. Emergency spillway opening is blocked with woody/leafy and garbage debris accumulations. The blockage may have compromised the structural integrity of the embankment. Maintenance should be performed immediately.

18. Riser Low-Flow Orifice

Riser Low-Flow Orifice rates the opening of the low flow orifice to allow for proper drainage of the basin. This parameter evaluates the presence of vegetation, woody debris, sediment, and garbage to block the orifice. There should be no temporary sediment control appurtenances attached to the riser structure that would restrict the orifice function.

Riser Low-Flow Orifice should be evaluated and rated based not only on the existing conditions, but also for future precipitation events that may potentially be able to compromise the function of the opening.

If there is no riser structure present and only a pipe with an end-section exists, then an evaluation rating of "0" is recorded.

Individual Rating Value Evaluation:

- 0 No low flow orifice exists.
- 1 Riser Low-Flow Orifice is free of any woody/leafy and garbage debris.
- 2 Riser Low-Flow Orifice is blocked approximately 0 to 25% with woody/leafy and garbage.
- 3 Riser Low-Flow Orifice is blocked approximately 26 to 50% with woody/leafy and garbage debris. Maintenance should be scheduled.
- 4 Riser Low-Flow Orifice is blocked approximately 51 to 75% with woody/leafy and garbage. Maintenance should be performed immediately.
- 5 Riser Low-Flow Orifice is blocked approximately 76 to 100% with woody/leafy and garbage. As the result of the blockage, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Clear low flow orifice w/ functional trashrack Low flow orifice blocked by trashrack

19. Riser Low-Flow Orifice - Trashrack

Riser Low-Flow Orifice - Trashrack rates the structural condition of the trashrack on the low flow orifice. Two (2) inch stone may be substituted for the trashrack. This parameter evaluates any damage, presence of vegetation, woody debris, sediment, and/or garbage in and around the orifice.

If there is no riser structure present and only a pipe with an end-section exists, then an evaluation rating of "0" is recorded.

Individual Rating Value Evaluation:

- 0 No trashrack on the low flow orifice exists.
- 1 Orifice-Trashrack is free of any woody/leafy and garbage debris. Trashrack is undamaged and functioning properly.
- 2 Orifice-Trashrack is blocked approximately 0 to 25% with woody/leafy and garbage. Trashrack has *minor* damage, but functioning properly.
- 3 Orifice-Trashrack is blocked approximately 26 to 50% with woody/leafy and garbage debris. Trashrack has *moderate* damage and only functioning partly. Maintenance should be scheduled.
- 4 Orifice-Trashrack is blocked approximately 51 to 75% with woody/leafy and garbage. Trashrack is missing or has *major* damage and efficiency is compromised. Maintenance should be performed immediately.
- 5 Orifice-Trashrack is blocked approximately 76 to 100% with woody/leafy and garbage. Trashrack is damaged and is compromised. As the result of the blockage, ponding is occurring, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Functional trash rack



Trash Rack blocked by silt/mud and plastic

20. Riser Upper-Stage Orifice

Riser Upper-Stage Orifice rates the opening of the upper-stage orifice to allow for proper multi-stage drainage of the basin. This parameter evaluates the presence of vegetation, woody debris, sediment, and garbage to block the orifice. There should be no temporary sediment control appurtenances attached to the riser structure that would restrict the orifice function.

Riser Upper-Stage Orifice should be evaluated and rated based not only on the existing conditions, but also for future precipitation events that may potentially be able to compromise the function of the opening.

If there is no riser structure present and only a pipe with an end-section exists, then an evaluation rating of "0" is recorded.

Individual Rating Value Evaluation:

- 0 No upper-stage orifice exists.
- 1 Riser Upper-Stage Orifice is free of any woody/leafy and garbage debris.
- 2 Riser Upper-Stage Orifice is blocked approximately 0 to 25% with woody/leafy and garbage.
- 3 Riser Upper-Stage Orifice is blocked approximately 26 to 50% with woody/leafy and garbage debris. Maintenance should be scheduled.
- 4 Riser Upper-Stage Orifice is blocked approximately 51 to 75% with woody/leafy and garbage. Maintenance should be performed immediately.
- 5 Riser Upper-Stage Orifice is blocked approximately 76 to 100% with woody/leafy and garbage. As the result of the blockage, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Clear & functional upper stage riser orifice



Clear & functional upper stage orifice

21. Riser Upper-Stage Orifice - Trashrack

Riser Upper-Stage Orifice - Trashrack rates the structural condition of the trashrack on the upper-stage orifice. This parameter evaluates any damage, presence of vegetation, woody debris, sediment, and/or garbage in and around the orifice.

If there is no riser structure present and only a pipe with an end-section exists, then an evaluation rating of "0" is recorded.

Individual Rating Value Evaluation:

- 0 No trashrack on the upper-stage orifice exists.
- 1 Riser Upper-Stage Orifice - Trashrack is free of any woody/leafy and garbage debris. Trashrack is undamaged and functioning properly.
- 2 Riser Upper-Stage Orifice - Trashrack is blocked approximately 0 to 25% with woody/leafy and garbage. Trashrack has *minor* damage, but functioning properly.
- 3 Riser Upper-Stage Orifice - Trashrack is blocked approximately 26 to 50% with woody/leafy and garbage debris. Trashrack has *moderate* damage and only functioning partly. Maintenance should be scheduled.
- 4 Riser Upper-Stage Orifice - Trashrack is blocked approximately 51 to 75% with woody/leafy and garbage. Trashrack has *major* damage and efficiency is compromised. Maintenance should be performed immediately.

- 5 Riser Upper-Stage Orifice - Trashrack is blocked approximately 76 to 100% with woody/leafy and garbage. Trashrack is damaged and is compromised. As the result of the blockage, ponding is occurring, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.

22. Riser Top – Overflow Spillway

Riser Top – Overflow Spillway rates the openings at the top of the riser structure into the riser chamber to allow for proper flow through the top of the spillway. If there is no Emergency Spillway – Earthen/Vegetated, then the Riser Top – Overflow Spillway should be performing as both the principal and emergency spillways and evaluated as one spillway in this attribute.

Riser Top – Overflow Spillway evaluates the presence of vegetation, woody debris, sediment, and garbage to block the riser top. There should be no temporary sediment control appurtenances attached to the riser structure that would restrict the orifice function.

If there is no riser structure present and only a pipe with an end-section exists, then only the Principal Spillway – Barrel (#26) parameter should be evaluated and rated. In the comment section, no riser structure should be documented as “0”.

Individual Rating Value Evaluation:

- 0 No riser exists
- 1 Riser Top – Overflow Spillway is free of any woody/leafy, sedimentation, and garbage debris.
- 2 Riser Top – Overflow Spillway is blocked approximately 0 to 25% with woody/leafy, sedimentation, and garbage.
- 3 Riser Top – Overflow Spillway is blocked approximately 26 to 50% with woody/leafy, sedimentation, and garbage debris. Maintenance should be scheduled.
- 4 Riser Top – Overflow Spillway is blocked approximately 51 to 75% with woody/leafy, sedimentation, and garbage. Maintenance should be performed immediately.
- 5 Riser Top – Overflow Spillway is blocked approximately 76 to 100% with woody/leafy, sedimentation, and garbage. As the result of the blockage, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Functional & clear overflow spillway



Non functional overflow spillway

23. Riser-Trashrack

Riser Trashrack rates the structural condition of the trashrack on the riser structure. This parameter evaluates any damage, presence of vegetation, woody debris, sediment, and/or garbage in and around the Riser-Trashrack.

Individual Rating Value Evaluation:

- 0 No trashrack exists.
- 1 Riser-Trashrack is free of any woody/leafy and garbage debris. Trashrack is undamaged and functioning properly.
- 2 Riser-Trashrack is blocked approximately 0 to 25% with woody/leafy and garbage. Trashrack has *minor* damage, but functioning properly.
- 3 Riser-Trashrack is blocked approximately 26 to 50% with woody/leafy and garbage debris. Trashrack has *moderate* damage and only partly functioning. Maintenance should be scheduled.

- 4 Riser-Trashrack is blocked approximately 51 to 75% with woody/leafy and garbage. Trashrack is missing or has *major* damage and efficiency is compromised. Maintenance should be performed immediately.
- 5 Riser-Trashrack is blocked approximately 76 to 100% with woody/leafy and garbage. Trashrack is damaged and efficiency is compromised. As the result of the blockage, ponding is occurring, storage volume is reduced and other problems related to the SWB have compromised the structural integrity of the embankment. Maintenance should be performed immediately.



Trash rack clear and functional and structurally sound

24. Riser-Sediment

Riser Sediment rates the amount of sediment accumulation located inside the riser chamber that could restrict the flow performance of the riser. In addition to sediment, any accumulation of woody/leafy debris, garbage, remnant construction concrete forms, and/or riprap should be evaluated and recorded. This parameter should be evaluated based on the existing debris build up, amount of potential sources of debris, and potential blockage that could occur during future precipitation events.

Individual Rating Value Evaluation:

- 0 No riser structure exists.
- 1 Interior of riser is absent of woody/leafy debris, garbage, and/or sediment accumulations.
- 2 Interior of riser has minor accumulations of woody/leafy debris, garbage, and/or sediment blocking 0 to 25% of the outlet structure.
- 3 Interior of riser has moderate accumulations of woody/leafy debris, garbage, and/or sediment blocking 26 to 50% of the outlet structure and/or the amount of debris potentially could cause problems during future precipitation events. Maintenance needs to be scheduled.
- 4 Interior of riser has major accumulations woody/leafy debris, garbage, and/or sediment blocking 51 to 75% of the outlet structure and/or the amount of debris potentially could cause problems during future precipitation events. Maintenance needs to be performed immediately.
- 5 Interior of riser has major accumulations of woody/leafy debris, garbage, and/or sediment blocking 76 to 100% of the outlet structure and the structural integrity of the basin has been compromised. Maintenance needs to be performed immediately.



Riser chamber w/excessive amount of sediment



Riser chamber clear of sediment & trash

25. Riser-Structure

Riser Structure rates the condition of the structural integrity of the riser or outlet structure. This parameter evaluates any potential cracks, spalling, bad joints, or errors in construction undermining, erosion, and/or leaning of the riser structure.

Individual Rating Value Evaluation:

- 0 No riser structure exists.
- 1 Riser or outlet structure has no evidence of cracks, spalling, bad joints, erosion, and/or leaning of the structure. Riser structure is stable.
- 2 Riser or outlet structure has minor evidence of cracks and spalling, but is functional and satisfactory condition.
- 3 Riser or outlet structure has moderate evidence of cracks, spalling, and joint problems, but is functional and in satisfactory condition. Maintenance should be scheduled.
- 4 Riser or outlet structure has major evidence of cracks, spalling, and joint problems, and/or leaning. Condition with riser structure is not functioning as designed and is in unsatisfactory condition. Condition may potentially compromise other parameters of the SWB. Maintenance needs to be performed immediately.
- 5 Riser or outlet structure has major evidence of cracks, spalling, and joint problems, and/or leaning. Condition of the riser has compromised the structural integrity of the SWB. Maintenance needs to be performed immediately.



This chamber is leaking water at barrel joint

26. Principal Spillway - Barrel

Principal Spillway - Barrel rates the overall condition of the principal spillway (pipe/barrel). This parameter evaluates any blocking, joint problems, sedimentation, irregularities in the flow line, and pipe structural integrity.

This evaluation should reflect the condition of the entire length of the barrel (including the inlet side if no riser is present). This parameter may dictate the need for extensive note to document apparent defects and related potential causes.

Individual Rating Value Evaluation:

- 0 No pipe/barrel exists.
- 1 Pipe barrel is free of any woody/leafy, sedimentation, and garbage debris. Flow is unrestricted. Pipe barrel shape, joints, and material condition are structurally in satisfactory condition. Repairs / retrofits remain in satisfactory condition.
- 2 Pipe barrel is blocked approximately 0 to 25% with woody/leafy, sedimentation, and garbage. Flow is partially restricted. Pipe shape, joints, and material condition are structurally in satisfactory condition. However, *minor* defects are present. Indicators may include minor changes in shape, dents, and/or slight gaps in joints.
- 3 Pipe barrel is blocked approximately 26 to 50% with woody/leafy, sedimentation, and garbage debris. Flow is restricted. Pipe shape, joints, and material condition are structurally in satisfactory condition. However, *moderate* defects are present. Indicators may include moderate changes in shape (top or side deflection), bolts or rivets under stress at the seams or joints may have gaps with minor soil exposure, pipe bottom may have moderate to major evidence of corrosion or abrasion, and/or minor flow line grade changes or deflections. Maintenance should be scheduled.

- 4 Pipe barrel is blocked approximately 51 to 75% with woody/leafy, sedimentation, and garbage. Flow significantly blocked. Pipe shape, joints, and material condition are structurally in unsatisfactory condition in isolated areas. Indicators may include major changes in shape (side or top deflection), stress fractured bolts or rivets at seams or joints have moderate gaps with minor voids and major soil exposure, culvert bottom has major evidence of corrosion or abrasion, and/or moderate flow line grade changes or deflections. Maintenance should be performed immediately.
- 5 Pipe barrel is blocked approximately 76 to 100% with woody/leafy, sedimentation, and garbage causing the flow to be completely blocked. Pipe shape, joints, and material condition are structurally in critical condition throughout the full length of the pipe. Indicators may include major changes in shape (side or top deflection), stress fractured bolts or rivets at the seams or joints have major gaps with major voids, major soil deposition within the pipe, pipe bottom is completely deteriorated, and/or major flow line grade changes or deflections. As the result of the condition, SWB structural integrity has been compromised. Maintenance should be performed immediately.



Exterior view of barrel from riser



Principal spillway with pipe only, no structure

27. **Spillway Outfall - Protection**

Spillway Outfall – Protection rates the overall condition of the outfall of the principal spillway outlet structure and associated outlet protection (Road and Bridge Standard EC-1). This parameter evaluates channel erosion, side slopes, transitions to natural stream areas or edge of right-of-way, sedimentation, and debris blockage.

Individual Rating Value Evaluation:

- 0 SWB outlet appears to discharge into a closed storm sewer system and/or downstream parameters cannot be readily found
- 1 Outfall shows no evidence of erosion. Channel invert and slopes are stabilized with dense vegetation or riprap. Outfall is free of any woody/leafy debris, sedimentation, and garbage debris.
- 2 Outfall shows *minor* evidence of erosion. Channel invert/outlet protection and slopes are stabilized with dense vegetation or some riprap. Outfall is blocked approximately 0 to 25% with woody/leafy, sedimentation, and garbage.
- 3 Outfall shows *moderate* evidence of erosion. Channel invert/outlet protection and slopes are moderately steep with non-uniform vegetative cover and slight erosion is actively occurring. Minor areas of riprap/outlet protection material are moving downstream. Outfall is blocked with about 26 to 50% with woody/leafy, sedimentation, and garbage.
- 4 Outfall shows *major* evidence of erosion. Channel invert and slopes are slightly wider than deep. Slopes are steep with no vegetation and minor sloughing actively occurring with stream channel. Major areas of riprap/outlet protection material are being washed out and relocated downstream. Outfall is blocked approximately 51 to 75% with woody/leafy, sedimentation, and garbage. Maintenance should be performed immediately.
- 5 Outfall has active erosion and the channel invert and slopes are as deep as they are wide. Slopes are steep with no vegetation and major bank sloughing actively occurring with stream channel. Major areas of riprap/outlet protection material are being washed out and relocated downstream. Outfall is blocked approximately 76 to 100% with woody/leafy, sedimentation, and garbage. Maintenance should be performed immediately.



Outlet at downstream embankment w/major erosion

28. SWB Overall Rating

SWB Overall Rating is a qualitative evaluation of the individual parameters to establish an overall rating value for the SWB. The objective of the rating classes is to evaluate the existing conditions, while also considering impending conditions. The rating categories can be used by VDOT in planning inspection intervals, maintenance schedules, repair or replacement of SWB, and potentially identify SWBs at-risk for failure. Table 2 summarizes the overall rating categories by identifying their scoring range and a brief description.

Table 2 - Overall SWB Rating Categories

Rating Class	Description
A	The SWB is functioning as designed with no problem conditions identified. No signs of impending deterioration. Candidate for annual inspection.
B	Minor problems are observed, however, SWB is functioning as designed with no critical parameters with problem conditions. Candidate for annual inspection, however, depending on problem conditions may require additional inspections.
C	Moderate problems are observed, however, SWB is functioning as designed with no critical parameters with problem conditions. SWB performance is being compromised. Candidate for bi-annual inspection depending on problem conditions. Structural defects may require repair and/or restoration. Maintenance of the SWB should be scheduled.
D	Major problems are observed, and basin is not functioning as designed with several critical parameters with problem conditions. Conditions associated with the basin have compromised the SWB performance. SWB shows signs of impending deterioration with potential for failure. Maintenance should be performed immediately.
E	Severe problems are observed, and basin is not functioning as designed with several critical parameters with problem conditions. Conditions associated with the basin have compromised the SWB performance. SWB shows signs of impending deterioration and/or failure. Maintenance should be performed immediately.

29. **VDOT Maintenance Priority Rating –**

This rating is a qualitative evaluation of the individual parameters and the Overall Rating to establish a priority value for performing maintenance. The objective of the Maintenance Priority Rating is to provide recommended time estimation for maintenance on the existing SWB conditions.

Maintenance Priority Rating:

- A. SWB requires no maintenance.**
- B. SWB requires maintenance within 3 to 6 months.**
- C. SWB requires maintenance within 1 to 2 months.**
- D. SWB requires maintenance within 1 to 2 weeks.**
- E. SWB requires maintenance within 24 hours.**

Note: Ratings of D & E will normally imply an immediate threat to the traveling public, highway workers, or adjacent property owners.

30. **Photo Collection and Identification**

During each SWB inspection event, a number of photographs shall be taken to document visual evidence of the general condition of each SWB. The location of the photo reference point should be recognizable to allow for utilization in future inspections.

Sketch on field mapping the photo location point, the photo number, and the direction of view, so that the Photo Sketch could be drawn on the photo during data entry process. At a minimum, the following photos shall be taken and provided as electronic attachments to each completed inspection report form during each inspection event:

- While standing outside of each SWB, a picture capturing the apparent limits of the SWB
- While standing on or near riser, picture of up-gradient drainage area
- Close up picture capturing the limits of entire riser, principal and emergency spillway
- While standing in or near receiving channel of SWB, picture looking into and around outfall of SWB
- While standing on or near outlet of SWB, picture of down-gradient area or receiving channel/pipe system

All pictures shall be provided in an electronic JPEG format at a minimum 1280 x 960 pixel resolution.

31. **Photographic Documentation**

Photos will be taken to support the SWB description. Where possible, the photo should be comprehensive by including the riser, embankments, inlets, and outlets. The photo(s) should be saved as a digital image that shows an overall view of the basin and will be linked with the SWB database records. The location of the photo reference point should be recognizable to allow for use in future inspections. For significant SWBs, permanent markers may be installed or the location documented in a database comment field.

The most efficient and manageable digital format is JPEG (file type is JPG). If necessary, a photo may be taken conventionally then scanned into a digital image. The 5-digit structure id number is the digital photo file name. If additional site photos are taken, the structure id number plus an abbreviation to specify the SWB feature will identify the file name. For example, use **-in** for inlet and **-em** for embankment. Because the digital cameras assign an arbitrary number to the photograph, the photograph file name will need to be renamed in order to match the photograph with the SWB.

All photos shall be time stamped.

32. **Inspection Comments**

This section allows for any additional comments, such as specific site conditions, maintenance requests, and any other additional information associated with the SWB.

33. **SWB Support Data**

The SWB support data includes detailed physical information on the SWB, and size and inventory information on structures within a SWB.

Attachment B contains a hard copy of both the SWB Inspection and Support forms. In order to enhance the inspectors understanding of the support data parameters, Appendix C – Support Data is provided to include SWB type descriptions, support data options and general diagrams of SWBs.

34. SWB Location

To support the mapping of SWBs in GIS models, the SWB locations will be located by Global Positioning Systems (GPS) where possible. The positions will be taken in the format of Northing (longitude) and Easting (latitude) with sub-meter accuracy data loggers (a minimum accuracy of 3± meters). To rapidly gather consistent location data, real-time differential GPS (DGPS) positions should be utilized. However, uncorrected GPS may be utilized, but post processing of the data will be required.

The typical GPS equipment required:

- Data logger with GPS interface software
- Charged portable battery and extra battery for data logger and alternative power source
- Single GPS receiver unit or multiple receiver units.
- Charged battery and extra battery for GPS unit and alternative power source
- Portable GPS backpack
- Azimuth compass to record distance and bearing from difficult locations due to poor GPS reception.

35. SWB GPS Reference Points

The GPS reference points for basins should be taken at the riser structure or at the outlet of the basin. For infiltration trenches and chambers, the approximate center of trench should be used as the reference point. An example of the reference points naming convention would be for SWB number 13160. During the GPS survey, this point would be recorded as 13160pt.

The riser structure may not be accessible due to high water, fences, high embankments, or heavy tree/shrub cover, which may prevent the GPS antenna from receiving a corrected GPS signal. Depending on the GPS software, one (1) technique for locating structures in difficult situations is to find a location where the GPS signal is good and "throw the point" to the location. This is accomplished by measuring the azimuth and distance from the location of the good signal to the structure.

The GPS software automatically calculates the entered bearing and distance and records the latitude and longitude of the structure. This technique is preferred because it limits the amount of processing of the data. If the GPS software is unable to perform this operation, then record the azimuth and distance from a known GPS point and adjust mapping during data entry.

36. SWB GPS Outline or Polygon Points

GPS outline or polygon points are to be collected for basins. This information is collected to provide shapes to each SWB for the graphical enhancement of the GIS system. For basins, polygon features are recorded to outline the water surface level of the 10-year return period, which may be estimated by the riser structure. In a two-stage riser structure, the 10-year reference control point is above the low flow orifice, but below the top of the riser. If the riser structure has only one orifice and no other control point, outline the basin at this elevation. The starting point would be the SWB riser structure or outlet and the survey would end back at the riser structure or outlet. An example of the polygon outline points naming convention would be for SWB number 13160. The GPS polygon file would be recorded as 13160-ol.

Due to the reliability and accuracy problems associated with GPS and the potential that the polygon coverages cannot be created, the GPS survey of the basin outline only provides a temporary template. For the GIS input, the basin outline is re-drawn and the field template is removed from the database.

37. Data Management

Data Management is vital in developing and maintaining an accurate SWB inspection database. The tasks involved in the data management are data entry and transfer, and Quality Assurance / Quality Control (QA/QC) review of the field data.

Field data is collected in three (3) different phases. First, there is the inspection data, which is recorded on hard copy forms or on a pen-based computer if an interface is developed. Secondly, spatial data is recorded using differentially corrected GPS receivers. Third, digital photography is used to collect a visual representation of the SWB, riser, and any other pertinent feature related to the basin. Each of these data types are collected and processed differently. Compiled Inspection Data and GPS data shall be submitted in accordance with **VDOT**

Asset Management System Stormwater Basin Data Requirements Document (to be provided upon award of contract).

a. Inspection Data:

The previous section described the collection of the field data. Inspection data is logged on paper forms in the field but must be transferred to the Access database in the office. Those inspectors which collected the data should be directly involved in the transfer of the data. This is to insure that the data is logged properly and acts as a QC/QA check.

The form should clearly identify the inspector responsible for the data entry. The electronic data entry of each hard-copy inspection record can be generated in the office using database or spreadsheet programs.

If possible, the data entry at each SWB should be performed entirely by one inspector to maintain consistent and complete data entry. Data entry personnel should be trained to perform SWB Inspections, so they are familiar with all aspects of the investigation. If in the future, a computer interface is developed, then data collection can be directly entered into a digital format by utilizing pen-based computers. This approach is more efficient than hard-copy forms and minimizes the transfer of data. For pen based computer use, the digital inspection records should be compiled on a daily basis to ensure records are consistently entered before being transferred. The daily electronic records should have a consistent naming convention. One example is to name the daily records using a six-digit code containing the date in the format of "ddmmyy". A defined labeling system ensures consistency in archiving the raw digital field data. It is recommended that daily records be archived to maintain data integrity. The raw daily files should never be altered after the conclusion of the digital data entry. Any changes that must be made will take place during the data review checks.

b. GPS Data

Differentially corrected GPS data is collected in a latitude and longitude format, (in decimal degrees out to 6 places). Then the data is converted to a comma delimited ASCII file, which is then loaded into a spreadsheet software. This spreadsheet is then saved as a Dbase file. Each Dbase file is named according to the data, which it represents. One Dbase file would contain only outline points, named as the date of data collection plus -ol. An example would be 081099-ol for outline points collected on 8/10/99. This same naming convention would be done with the SWB reference points, 081099-SWB; the survey or endpoints of trenches, 081099-end; and stormdrain points, 081099-sd. An example of this would be GPS points, which represent the SWB point for SWB #13160. This point would be named 13160pt. The boundary points for this basin would be named 13160#1, 13160#2, and so forth as the points proceed around the basin.

Once the Dbase file is added into the *Tables* section of GIS, this table is then added as an *Event Theme*, with *X* being represented by Northing and *Y* being represented by Easting. The outlines and endpoints are then used as a template for digitizing the boundary of the SWB. The polygon theme that is used to represent the SWB boundary is made active and the start-editing feature is turned on. Then connecting the dots digitizes the boundary, taking into consideration any notes made about the basin shape. Once the boundary is complete the user must go into the table of the theme and add the *Structure ID* in the *ID* field of the table. When the boundary is collected, all the template points used to represent the boundary are deleted. The point that is used to represent the SWB boundary is saved so that the latitude and longitude point can be entered into the corresponding fields in the database. The SWB reference points are checked for locational accuracy. Once all corrections are made, each SWBs associated latitude and longitude is inputted into the SWB Inspection Table of the database.

38. Deliverables

All deliverables associated with the tasks in Phase 1 shall be completed and submitted to VDOT within **60 days** of award of contract. Any such operations shall not commence until reviewed by the District Roadside Manager and authorized with a purchase order (PO) issued by the District Procurement Section.

39. Method of Payment

Lump Sum payment, per the bid price.

**Attachment B:
VDOT Stormwater Basin Assessment/Inspection Form**

VDOT Stormwater Basin (SWB) Assessment/Inspection Data Form			
Assessment/Inspection Category/Attribute	Rating	Comments	Descriptions
Date			field inspection date
Inspectors			Initials of inspectors
Structure #			SD ID # of structure associated w/ SWB (e.g. riser)
SWB #			ID # of SWB
Easting			Longitude position
Northing			Latitude position
Coordinate Source			Coordinate Source (GPS/DGPS, other)
Appurtances			Appurtances of SWB beyond minimum design
Retrofit			Post-construction retro-fit(s) assoc. w/ SWB
1 Watershed			Upgradient watershed condition
2 Qin Condition			Overall condition of the SWB due to discharge points
3 Qin Stability			condition of the discharge points into SWB
4 Fence			condition of fence related to public safety, no fence, none needed = 0
5 Access			Is there access for inspection and maintenance
6 SWB-Veg			overall condition of site relating to vegetation
7 SWB-Contam.			overall condition of site relating to unwanted contamination
8 SWB-Debris			overall condition of site relating to unwanted debris
9 SWB-Ponding			overall condition of site relating to unwanted ponding
10 Forebay			condition of forebay relating to sediment control. Not present = 0
11 U.S.E.-cover			cover/vegetation related to upstream embankment
12 U.S.E.-stability			Erosion/stability related to upstream embankment
13 D.S.E.-cover			cover/vegetation related to downstream embankment
14 D.S.E.-stability			Erosion/stability related to downstream embankment
15 D.S.-seep			seepage related to downstream embankment or toe
16 EEspwy-stability			stability of emergency earthen spillway. If no separate spillway = 0
17 Espwy-opening			opening related to emergency spillway weir capacity. If no separate spillway = 0
18 RiserL.F.-orifice			opening related to the low flow orifice. No orifice = 0
19RiserL.F.orifice-trash rack			condition of the trash rack on the low flow orifice. No trashrack = 0
20 RiserUpperStage-orifice			opening related to the upper-stage orifice. No orifice = 0
21 RiserUpperStage-orifice-trash rack			condition of the trash rack on the upper-stage orifice. No trashrack = 0
22 Riser top-Overflow Spillway			opening related to the top of riser overflow
23 Riser-trash rack			condition of the trash rack on the top of riser. No trashrack = 0
24 Riser-sediment			degree of the amount of sediment inside riser. No riser = 0
25 Riser-struct.			Structural stability of the riser or any outlet structure (ie cracks, spalling, joints)
26 Princ_spwy-barrel			Condition of principal spillway (barrel or channel)
27 Principle-Spillway-out			Condition of the spillway outfall
28 SWB Overall Rating			Overall condition to evaluate the priority of VDOT's response
29 VDOT Maintenance. Priority Rating			Description of necessary VDOT response to maintenance, etc
photo id			File name of digital photo

Attachment B (continued)

VDOT Stormwater Basin Assessment/Inspection Data Form		
SWB Support Data Form		
General Attribute	Retention	Detention
SWB number		
SWB Type		
Treatment Comments		
Spillway Drainage Type		
Spillway Comments		
Fence		
Dam Height		
Site Comments		
Riser ID number		
Riser Material.		
Riser Trashrack		
Riser Trashrack Type		
Outlet Type		
Outfall ID number		
End/Headwall Size		
Structure Type		
Outfall Material		
Outfall Comment		
Discharge SWM		
Discharge To		
Discharge From		
Comments		

Attachment C: SWB Support Data

SWB Types:

1. Retention Basin (RETBASIN) – a basin that has a permanent pool for water quality treatment. Temporarily impounds and retains on-site a specified amount of stormwater runoff then discharges it through a riser structure. The riser is connected to a principal spillway. An emergency spillway is included to discharge flows during extreme events. The riser typically includes a low flow orifice to maintain base flow downstream.
2. Detention Basin (DETBASIN) – a basin that drains stormwater runoff after each storm event or gradually. Temporarily impounds runoff and discharges it through an outlet structure. The riser is connected to a principal spillway. An emergency spillway is included to discharge flows during extreme events. Low flow orifice typically drains the basin over a period less than 24 hours, allowing for ponding of stormwater to occur. A base flow through the facility may be observed during non-rainfall periods.

Brief Definition of SWB Support Data:

SWB number - Unique 5-digit ID # where the first two digits are the county ID number and the other three digits increase sequentially.

SWB Type – type of SWB, Detention or Retention.

Treatment Comments – comments related to the type of treatment used.

Spillway Drainage Type – size and material of principal spillway/barrel.

Spillway Comments - identifies the use of the spillway drainage whether as a principal spillway or a combination of principal/emergency. **Do not use if Weir Wall present**

Fence – Yes or No regarding the presence of a fence.

Dam Height – height of the embankment of the basin associated with the principal spillway (ft). This is an estimated value recorded from the invert of the principal spillway to the top of the embankment.

Site Comments – Overall comments on the SWB site.

Riser ID number – identification number of the riser associated with the basin.

Riser Material – material of the riser structure.

Trashrack – Yes or No regarding the presence of a trashrack on the riser. If missing, answer NO. Also make comment that Trash rack is missing and pick appropriate type just below.

Trashrack Type – DI-7 Grate or newer SWM-1 Trashrack (birdcage)

Outlet Type – type of outlet structure (**see following page**)

Outfall ID number – stormdrain identification number of the outfall

End/Headwall Size – length and height of the endwall or headwall associated with the outfall of the basin (ft).

Structure Type – VDOT standard structure type for outfalls. **Use # if available, if not describe in “comment”**

Outfall Material – Outfall material. (**see following page**)

Outfall Comment – comments specific to the outfall of the basin.

Discharge SWM – Yes or No question to determine if the basin outfall discharges into another SWB downstream.

Discharge To – identification number of the VDOT structure at the outlet (riser) of the SWB.

Discharge From – identification number of the structure(s) that discharge into a VDOT SWB. Identifying outfalls verifies VDOT stormdrain and non-VDOT stormdrain systems.

Optional SWB Support Data Entries (not limited to):

SWB Treatment Types:

1. Retention
2. Detention

Spillway Type:

1. Corrugated Metal Pipe (CMP)
2. Reinforced Concrete Pipe (RCP)
3. Weir

Spillway Comments:

1. Principal Spillway – The primary structure (pipe from the riser or a weir) which discharges base flow and stormwater flow through a dam embankment (or down-gradient from roadside rights-of-way for outfall assessment).
2. Emergency Spillway – This typically is a structure separate from the principal spillway, whose purpose is to bypass excess flows in addition to the flows through the principal spillway. This structure is usually a low flow point in the basin embankment and aids in preventing the dam being overtopped.
3. Combination Principal/Emergency Spillway - The primary structure used as an outfall of the basin conveys both frequent runoff flows and extreme flows. The riser contains a sufficient opening to allow for these high flows.

Riser Material:

1. Concrete
2. Corrugated Metal
3. Other

Outlet Type:

1. Concrete Box Structure
2. Concrete Box Structure with infiltration low flow pipe
3. Riser with hood or trash rack

Outfall Material:

1. Concrete
2. Metal
3. PVC
4. Other

Outfall Structure Type:

1. Endwall
2. Headwall
3. End Section
4. Projecting
5. VA-###.## (where #'s reflect VA's standard designation)

GENERAL PROFILE OF A STORMWATER BASIN (WET OR DRY)

