FINAL

MS4 Stormwater Outfall Inventory Manual

Stormwater Management Program

Virginia Department of Transportation
1401 East Broad Street
Richmond, VA 23219

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APPENDICES

ACRONYMS

BMP	Best Management Practice
CMP	Corrugated Metal Pipe
CPP	Corrugated Plastic Pipe
CUA	Census Urban Area
GIS	Geographic Information Systems
GPS	Global Positioning System
DCR	Virginia Department of Conservation and Recreation
DEQ	Virginia Department of Environmental Quality
EPA	U.S. Environmental Protection Agency
FL	Flowline
GIS	Geographic Information System
HTRIS	Highway Traffic Records Inventory System
HUC	Hydrologic Unit Codes
IDDE	Illicit Discharge Detection and Elimination
LAP	Locally Administered Projects
LUP	Land Use Permit
MCM	Minimum Control Measure
MOT	Maintenance of Traffic
MS4	Municipal Separate Storm Sewer System
MUA	Modified Urbanized Areas
NAD	North American Datum
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resource Conservation Service
NHD	National Hydrography Dataset
NLFID	Network Linear Feature Identification
NOAA	National Oceanic and Atmospheric Administration
NWI	National Wetland Inventory
OHWM	Ordinary High Water Mark
PDA	Personal Data Assistant
POD	Point of Discharge
PVC	Poly Vinyl Chloride
QA/QC	Quality Assurance/Quality Control
RCP	Reinforced Concrete Pipe
ROW	Right-of-Way
SDE	Spatial Database Engine
SWM	Stormwater Management
SWMP	Stormwater Management Plan
TMDL	Total Maximum Daily Load
USGS	United States Geological Survey
VCP	Vitrified Clay Pipe
VPDES	Virginia Pollutant Discharge Elimination System
VSMP	Virginia Stormwater Management Program
VDOT	Virginia Department of Transportation
WB	Waterbodies
WLA	Waste Load Allocation

Revision Number	Date	Person	Purpose for Revision
#1	5/27/2022		Previously, the Manual focused on the collection of existing Outfalls. This update focuses on collection of new Outfalls through project delivery as they are generated through construction projects or are discovered during other field projects, in addition to existing Outfalls. Graphical illustrations, definitions, and field protocols and procedures have been added. Other minor edits have been made.

1.0 INTRODUCTION

1.1 Objective of Manual

The Virginia Department of Transportation (VDOT) has developed this manual to provide a systematic and consistent approach necessary to complete its storm sewer map as required by VDOT's VPDES MS4 Permit No. VA0092975 (the Permit). A copy of the Permit can be found at the following web link:

https://www.virginiadot.org/business/resources/LocDes/VA0092975_VDOT_MS4_Permit_2017.pdf

The Permit is part of Virginia's regulatory Stormwater Management Program (VSMP), is regulated under the Virginia Stormwater Management Act and administered by the Virginia Department of Environmental Quality (DEQ). The MS4 permit issued by DEQ is part of the larger federal National Pollution Discharge Elimination System (NPDES) program. The Permit authorizes stormwater discharges from VDOT's regulated municipal separate storm sewer system (MS4) to surface waters of the Commonwealth. Part I, Section C.3.e of the permit requires VDOT to:

"…develop and implement written procedures to maintain an up-to-date Geographic Information System (GIS) map of the permittee's separate storm sewer system that includes…location of all outfalls owned or operated by the permittee discharging to state waters; known points of discharge to downstream adjacent MS4s; a unique identifier for each outfall and point of discharge; names of receiving waters to which the outfalls discharge…""

This manual serves to meet the requirement to develop written procedures to develop and maintain an up-to-date storm sewer map. Specific information about the requirements can be found in Section 2.0

To maintain a complete storm sewer map as required under the Illicit Discharge Detection and Elimination (IDDE) minimum control measure (MCM) of the Permit, VDOT must identify and document the regulated outfalls within VDOT's MS4 regulated area, including changes to VDOT's existing Outfall Inventory. The Outfall Inventory is a critical part of VDOT's efforts to reduce the discharge of pollutants from its MS4. The VDOT Outfall Inventory consists of VDOT's known mapped regulated outfalls in VDOT's MS4 regulated area and an associated database populated with the required information for all outfalls. More information on VDOT's current Outfall Inventory, definitions, identification of outfalls, and several representative examples are provided in Section 2.

There are two common times when VDOT's Outfall Inventory is updated. First, new outfalls are added to the inventory at the time of project delivery or project acceptance through existing VDOT programs. Second, existing outfalls are added to the inventory over time as they are identified through an outfall reconnaissance project. This manual describes each of these categories that will lead to maintaining a complete and up-to-date map and database. A summary of each is explained below, with more details provided in Sections 3.0 through 6.0.

> ***Category A: Maintaining and Updating Outfall Inventory*** (see Section 3). New outfalls will continually be added to the inventory through the secondary street acceptance program, the Locally Administered Projects (LAP) program, other roadway and drainage plans for projects, and planned maintenance. Projects completed through

the LAP process that add new outfalls to the storm sewer system will need to inventory, map, and conduct illicit discharge screening at the time of project delivery. Existing outfalls that are relocated, modified, or removed will also need to be updated in the Inventory. It is necessary to capture these outfalls at that time.

Category B: Outfall Reconnaissance Inventory (ORI) of Existing Outfalls (see Section 5). VDOT at times also reviews existing mapping and initiates data collection following a review of VDOT's MS4 regulated area and identification of potential outfall locations. Targeting specific areas, VDOT then conducts outfall reconnaissance inventory field data collection. VDOT historically used a process called the Target Selection Model developed by VDOT to identify these areas. This process is no longer a primary method used to update VDOT's Outfall Inventory, however the historical method is presented in Section 5. Currently, outfalls and PODs may be identified during other field activities. This can include BMP inspections, maintenance activities, and IDDE responses. All existing outfalls and PODs are added to the database using the methods described below.

Database Population (see Section 6). VDOT has an existing Outfall Inventory database with data stored that can be viewed through the ArcGIS Online (AGOL) application. This database is maintained by VDOT Central Office Location and Design Division and must be updated as new outfalls are created, removed or modified, regardless of how the update was initiated. There are two ways to update the database. First, the field data, including GPS coordinates, form entries, and photographs can be entered directly into the ArcGIS online system through Apple iPads or Android table computers, which is then fed directly to the cloud upon submission from the field. Second, the Outfall Inventory Field Sheet paper form and GPS points can be used to log data in the field and submitted to VDOT Central Office Location and Design Division to populate the database.

1.2 Background on VDOT'S MS4 Program

VDOT's MS4 Program has been developed with a consistent statewide implementation strategy since VDOT maintains multiple discrete MS4s (or components of regulated MS4s) within 14 Census Urbanized Areas (CUAs) under a single permit. CUA areas are determined by the latest Decennial Census of the U.S. Bureau of Census throughout Virginia (see Table 1 below). VDOT's MS4 Stormwater Management Program (MS4 Program) is presented in the form of Best Management Practices (BMPs) in the MS4 Program Plan to satisfy the seven minimum control measures (MCMs) required by VDOT's small MS4 Permit. The permit requires VDOT to incorporate the following seven MCMs into the MS4 Program for VDOT property within the MS4 regulated area:

(1) Public Education and Outreach
(2) Public Involvement and Participation
(3) Illicit Discharge Detection and Elimination (IDDE)
(4) Construction Site Stormwater Runoff Control
(5) Post Construction Runoff from Areas of New Development and Development of Prior Developed Lands

(6) Pollution Prevention and Good Housekeeping
(7) Infrastructure Coordination

The area regulated by the MS4 permit (herein referred to as the regulated area) covers any separate storm sewer system that is owned and/or operated by VDOT and located within CUAs of Virginia. Table 1 summarizes these fifteen areas.

Table 1. *Fourteen (14) Census Urbanized Areas in Virginia*

- Blacksburg
- Bristol
- Charlottesville
- Fredericksburg
- Harrisonburg
- Kingsport
- Lynchburg
- Richmond
- Roanoke
- Staunton-Waynesboro
- Virginia Beach
- Washington, DC
- Williamsburg
- Winchester

(Source: 2010 U.S. Census Bureau)

There are limited instances where VDOT has elected to extend the regulated area beyond the CUAs. For example, when the urbanized area transverses the center of a roadway, and segregates different portions of the road as non-regulated and regulated, then VDOT has elected to extend the regulated area to include both portions of the road. A more detailed discussion of this topic is included in the MS4 Target Selection Model process in Section 5 of this manual. VDOT recognizes this approach includes additional areas that are not required to be included under the permit. The VDOT State District and CUA map showing regulated and non-regulated areas can be found in Appendix A. A more detailed map can be obtained by either referencing VDOT's ArcGIS Online geodatabase, AGOL, or by contacting the State MS4/Stormwater Management Engineer in VDOT's Central Office Location and Design Division; see Section 4.0 of this manual for more information. VDOT District Offices maintain control of the separate storm sewer systems within their assigned primary and secondary roads and interstate public rights-of-way (ROWs), excluding those jurisdictions that operate and maintain their own MS4s. VDOT District Contact information can be found in Appendix B.

1.3 Infrastructure Ownership

This section on Infrastructure Ownership is provided for informational purposes only and is supplied for context to support the use and application of this Manual; it should not be used as an authoritative source. VDOT maintains the primary road system, the secondary road system, the interstate road system, state-maintained bridges (including culverts) and tunnels, and the value of the land under these systems (ROW). Furthermore, VDOT has jurisdiction, control and clear ownership over the primary and interstate road systems. While VDOT has the jurisdiction and control over the secondary road system, ownership is not clear in many cases. However, the Commonwealth has determined VDOT has primary responsibility for the maintenance of these systems. VDOT does not maintain urban road systems; they are the responsibility of the respective cities and towns. Once construction is completed on an urban road, it is deeded to the city or town. In addition, although VDOT provides funds for the maintenance of the urban systems, the localities perform the actual maintenance. All infrastructure inventoried by VDOT is categorized by the road inventory network.

The Road Inventory network includes the following subsystems:

1. **Primary or Interstate Routes** –VDOT *owns* the ROW and associated easements. If the outfall in question is located *inside* the ROW, it *is* a VDOT outfall. If it is *outside* the ROW, it is a VDOT outfall *only if* VDOT owns a drainage maintenance easement encompassing the outfall location.

2. **State Secondary Routes (#600 – 999)** –VDOT *owns* the ROW or VDOT is responsible under a prescriptive easement. If the outfall is located *inside* the ROW, it *is* a VDOT outfall. If it is *outside* the ROW, it is a VDOT outfall *only if* VDOT owns a drainage maintenance easement encompassing the outfall location. For VDOT roadway projects constructed within the past 30 years, VDOT may have purchased a drainage easement. For roads older than that, the status of any drainage easements is unknown.

3. **Local Subdivision/ "Secondary" Streets (#>999)** –The local governing body has adopted a Resolution requesting VDOT to add a subdivision street to the *locality's* "secondary system". The Resolution guarantees the Commonwealth of Virginia (sic VDOT) an unrestricted right-of-way, with the necessary easements for cuts, fills, and drainage. The attachments associated with the Resolution typically show the specific street(s) which is subject of the request, and typically provide documentation of the width of ROW (usually the area between the county tax plat lines on either side of the roadway) subject to VDOT maintenance. For these subdivision streets, we a*ssume that the locality owns the ROW and all associated easements.* If the outfall in question is located *inside* the area that VDOT maintains, it *is* a VDOT outfall. If not, then the outfall is the locality's outfall.

2.0 OUTFALL INVENTORY

Over the past several years, VDOT inventoried more than 29,175 outfalls within its regulated MS4 areas statewide. This existing database includes multiple data fields, geo-referenced location, and photographs. See Section 3 for details. To achieve consistency in past and future data collection, it is essential that all individuals involved in this inventory clearly understand the items being inventoried: outfalls. The definition of outfalls and points of discharge are provided below. Next, several conceptual graphics are provided as representative examples of conditions that may be found in the field. Each concept notes what should be considered an outfall and what should not.

2.1 Outfall Definition

For the purposes of VDOT's MS4 Program and this Inventory, an outfall is defined as follows:

> **"Outfall"** means the point at which any discernible, confined, and discrete conveyance that is part of VDOT's municipal separate storm sewer system discharges to surface waters.

Examples of items that **do not** meet the definition of an outfall and will not be inventoried include:

- Open conveyances connecting two MS4s, or pipes, tunnels or other conveyances which connect segments of the same stream or other surface waters and are used to convey surface waters.
- Discharges from a conveyance that is connecting segments of the same stream or other surface waters of the Commonwealth and is used to convey surface waters of the Commonwealth, such as a cross culvert under a road.
- Discharges from VDOT's storm sewer system that leave VDOT right-of-way before entering surface waters of the Commonwealth. Although these locations are not outfalls, if they are in the area of investigation for outfalls they will be collected and identified as Points of Discharge (PODs).
- Discharges from VDOT's storm sewer system to another storm sewer system component, such as a catch basin, pipe, ditch, channel, culvert, or conduit.
- Discharges from VDOT's storm sewer system to an open conveyance connecting the VDOT storm sewer system with another city/county/agency storm sewer system. These points are considered to be interconnections and are not being collected at this time.
- Stormwater runoff that enters surface waters of the Commonwealth from diffuse sources or sources other than a discernible, confined, and discrete conveyance of VDOT's storm sewer system.
- Discharges from pavement subsurface drainage features, such as pipe underdrains, prefabricated edge drains, aggregate drains, and discharges from bridge drains located on the bridge deck.

Outfalls and points of discharges have different definitions and should not be conflated. PODs are not classified as outfalls.

> "**Point of Discharge (POD)**" means a location at which concentrated stormwater runoff is released from VDOT's MS4 regulated area.

Note: If the concentrated flow has not been released into a surface water by the time it leaves VDOT's ROW through a regulated outfall, then it is a POD. Therefore, in VDOT's application, PODs occur at VDOT's edge of ROW.

A surface water is defined as follows by the Code of Virginia:

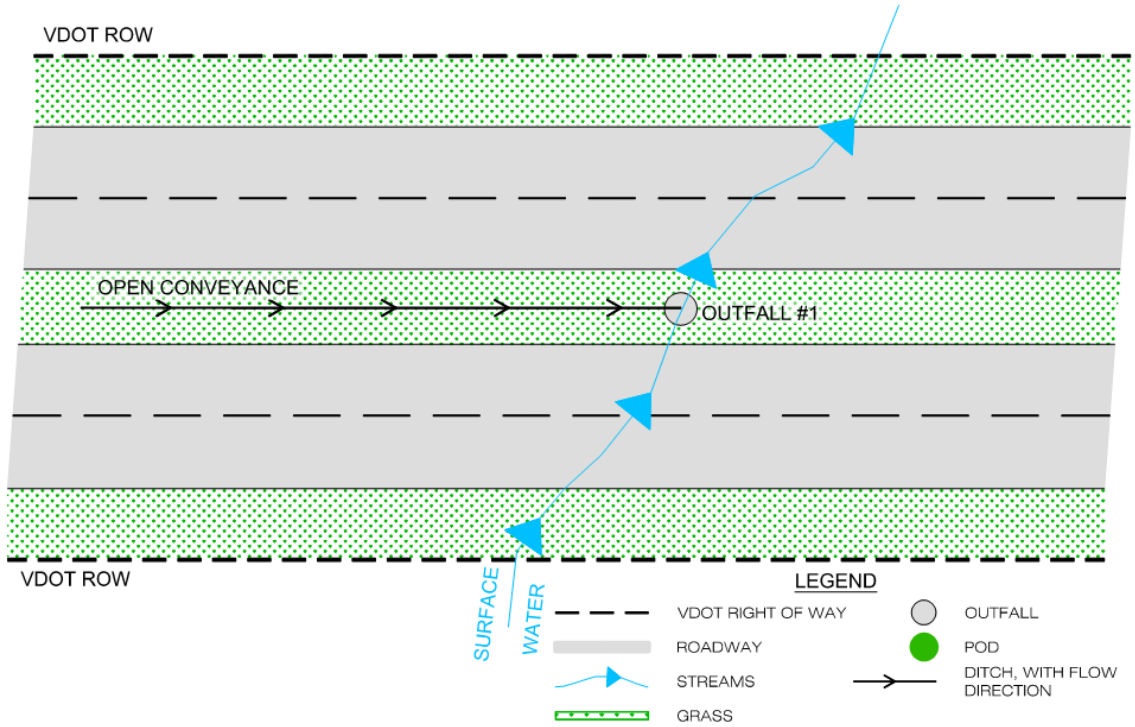
> **"Surface Water"** means any water in the Commonwealth, except ground water, as defined in § 62.1-255.

Additional information on types of surface waters including perennial, intermittent, and ephemeral streams, and wetlands, as well steps to recognizing Waters of the US (WOTUS) is provided in the Field Data Collection Section 4 of this Manual. For suspect or indeterminate outfalls, please contact the State MS4/Stormwater Management Engineer in VDOT's Central Office – Location and Design Division for further guidance.

2.2 Outfall Scenarios and Examples

A total of eleven (11) scenarios depicting various conditions that may be found in the field are shown graphically below. For each scenario, the outfalls and POD locations are identified as "Outfall #" or "POD #" and summarized below the graphic. The scenarios provided herein are not intended to be comprehensive, as other layouts will be discovered in the field. They are intended instead to provide useful guidance to assist with accurately and consistently identifying multiple outfalls at a given location. More information on the definitions of surface water may be found in Section 4, Field Data Collection.

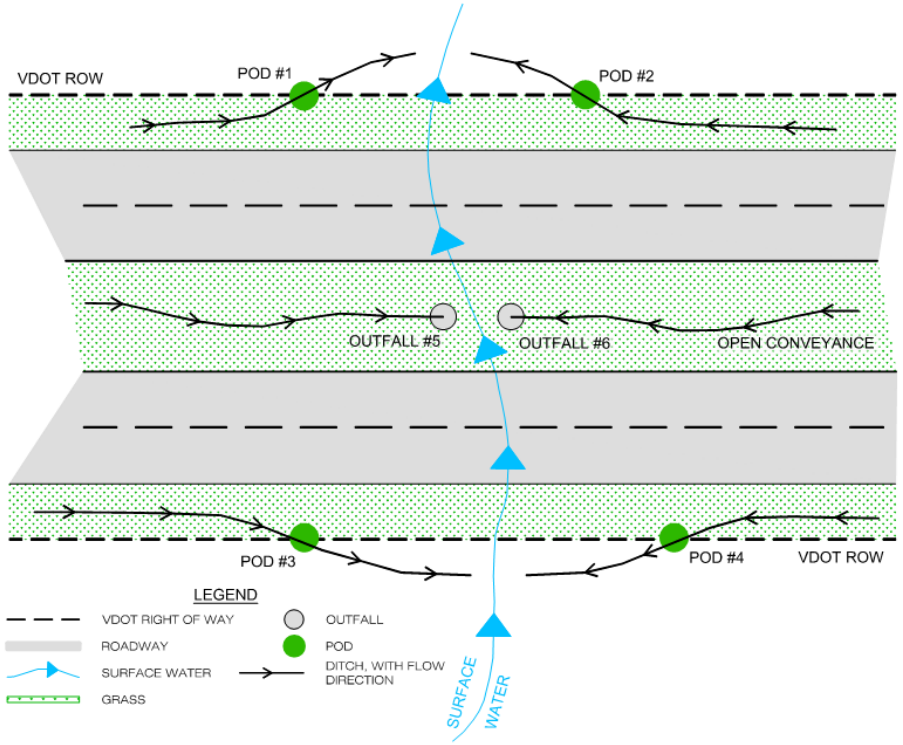
Figure 1. Scenario 1 - Conceptual Sketch of Outfall Occurrences



Scenario 1: A surface water feature flows from one side of the ROW to the other via box culvert, bridge, or otherwise. A pipe or open ditch conveys concentrated flows from within the VDOT median to the surface water.

Type & # of Discharges	Description
1 Outfall	The point at which the concentrated flow discharges to surface water within the VDOT median is an outfall and needs to be documented.
0 POD	There are no Points of Discharge in the area shown.

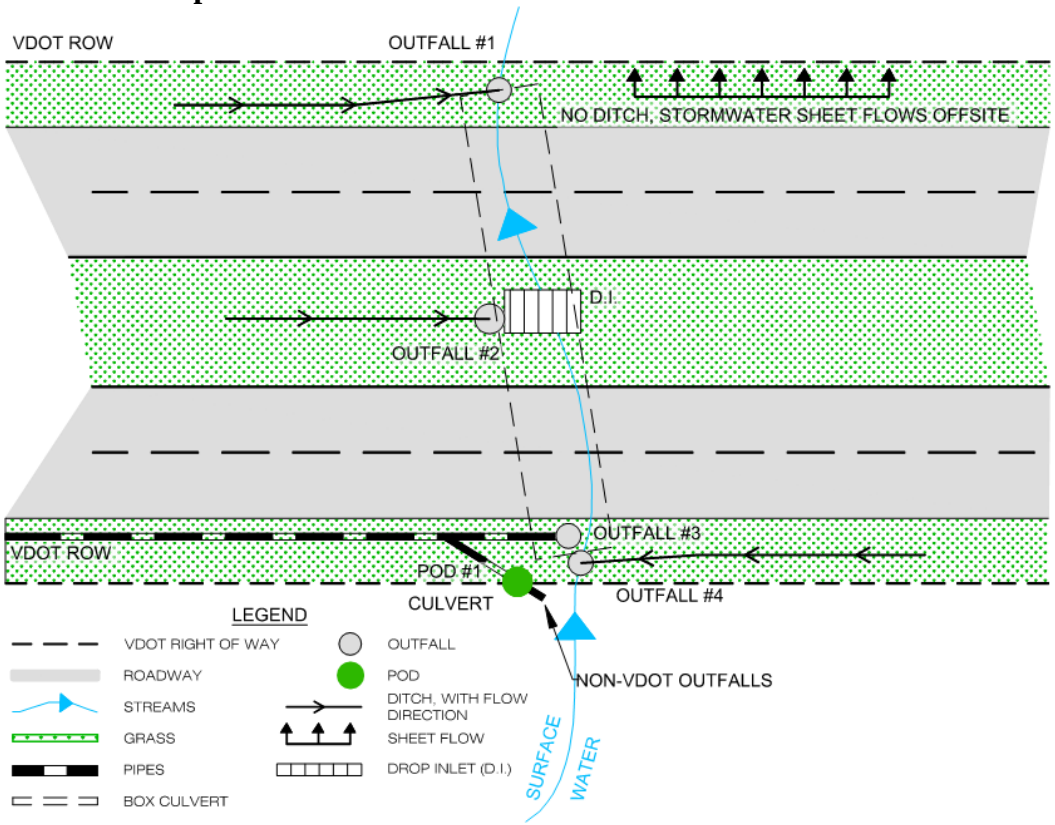
Figure 2. Scenario 2 - Conceptual Sketch of POD and Non-VDOT Outfall Occurrences



Scenario 2: A surface water feature flows from one side of the ROW to the other. An open conveyance ditch conveys concentrated flows within the VDOT median to the surface water. Ditches between the roadway and ROW drain offsite before reaching surface waters.

Type & # of Discharges	Description
2 Outfalls	Two ditches within the VDOT median discharge concentrated stormwater to surface water and need to be documented as VDOT outfalls. Four other ditches that are located outside of the VDOT ROW also reach surface water, however because they are not within the ROW are considered non-VDOT outfalls and do not need to be documented by VDOT.
4 PODs	The concentrated stormwater within the ditches between the roadway edge and ROW leave the ROW prior to discharging to surface water and are considered PODs.

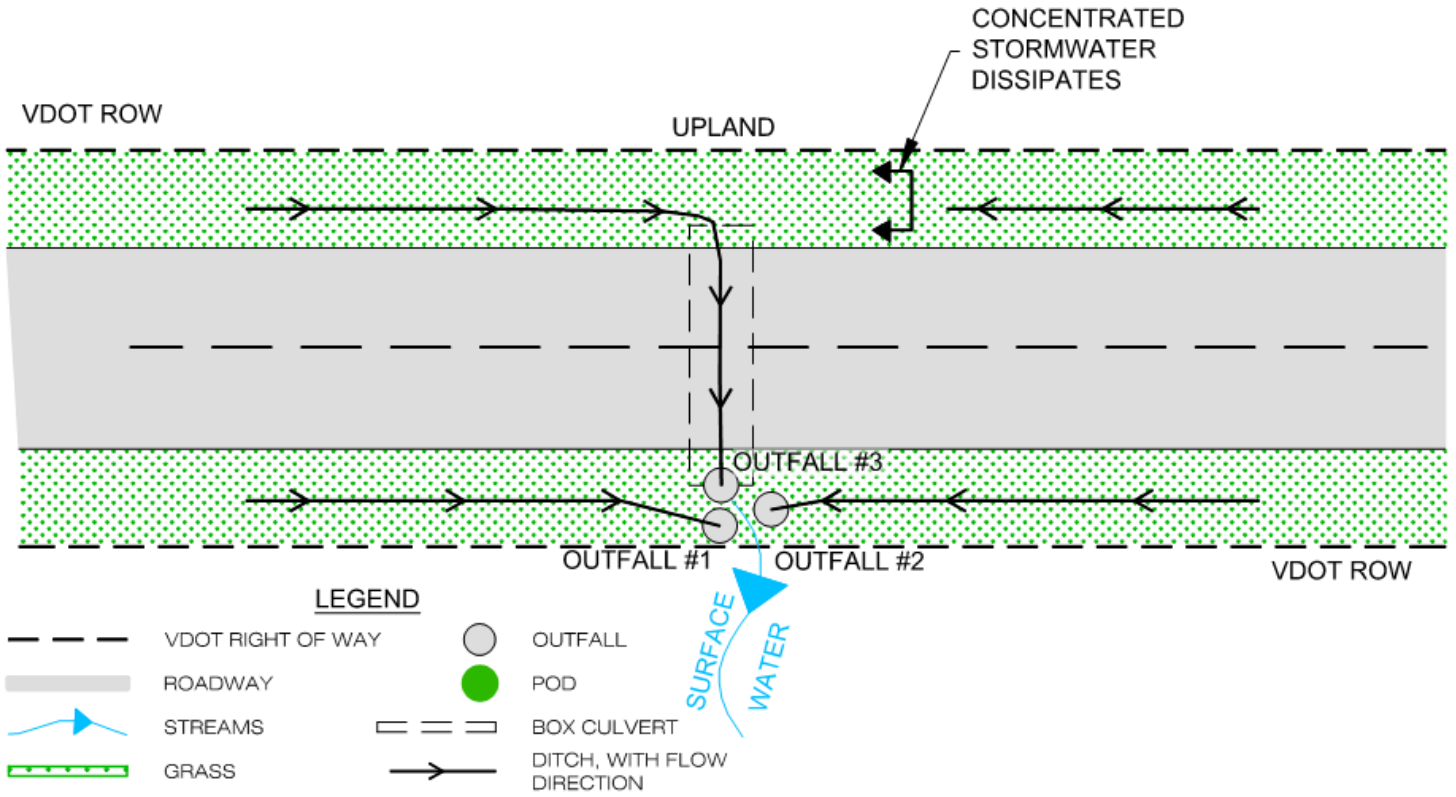
Figure 3. Scenario 3 – Ditches and Drop Inlets to Surface Water and Sheet Flow Offsite



Scenario 3: A drop inlet collects stormwater conveyed in a median ditch, a storm drain pipe discharges to surface water and a roadside shoulder sheet flows off-site.

Type & # of Discharges	Description
4 Outfalls	Two ditches between the roadway edge and ROW drain to surface water. One ditch within the median drains to a drop inlet conveying surface waters. One concentrated flow between the roadway edge and ROW drains to surface waters. All four of these points are considered outfalls. Sheet flow from the roadway draining offsite and outside the ROW are not outfalls or PODs.
1 PODs	Concentrated flow leaves the ROW prior to reaching surface waters.

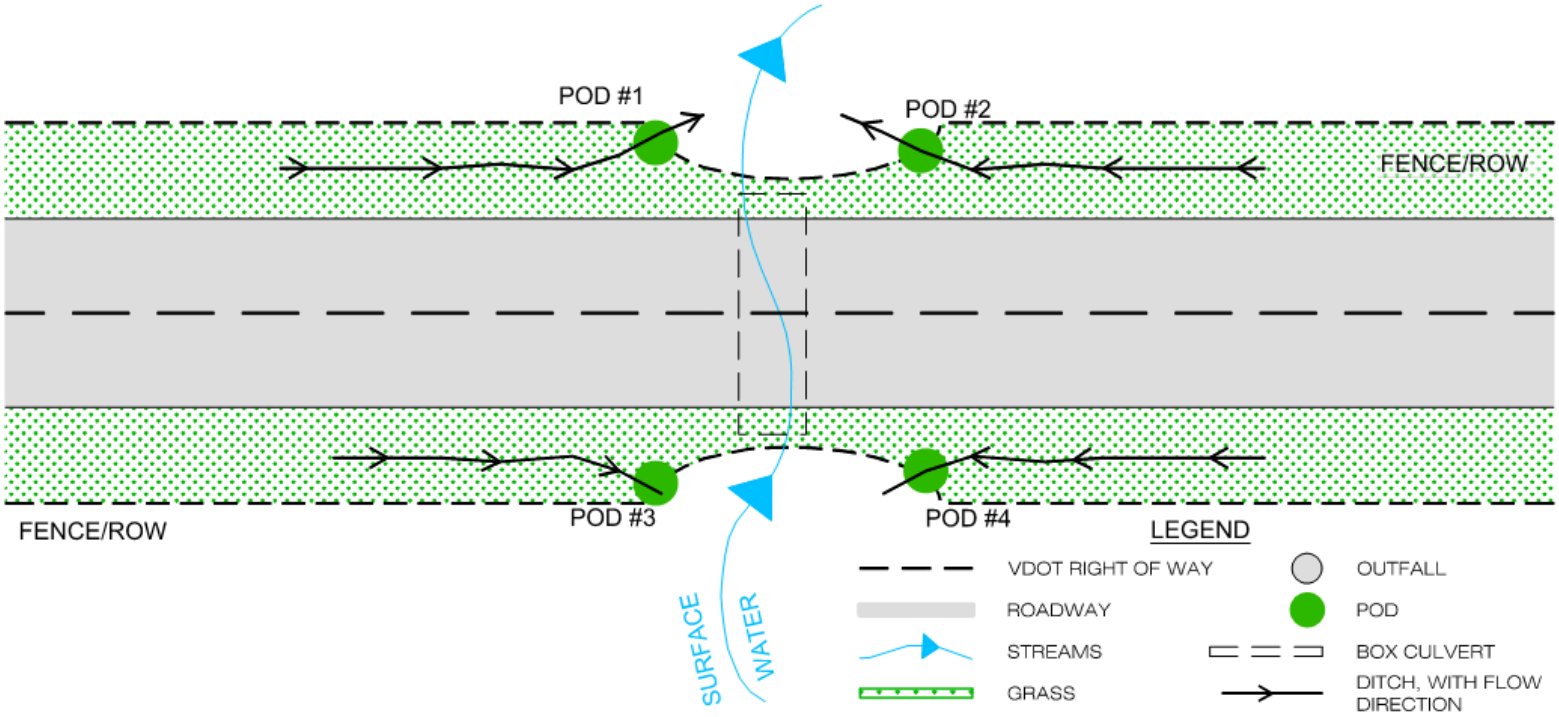
Figure 4. Scenario 4: Box Culvert to Surface Water and Dissipation of Concentrated Flow to Sheet Flow



Scenario 4: Roadside ditches and a box culvert under the roadway discharge to surface water.

Type & # of Discharges	Description
3 Outfalls	Two ditches between the roadway and ROW, and one upland ditch that flows into a box culvert, drains to surface water, resulting in three VDOT outfalls which need to be documented. One upland ditch flattens out and dissipates concentrated stormwater into sheet flow, resulting in no outfall at this location.
0 PODs	There are no PODs in this scenario.

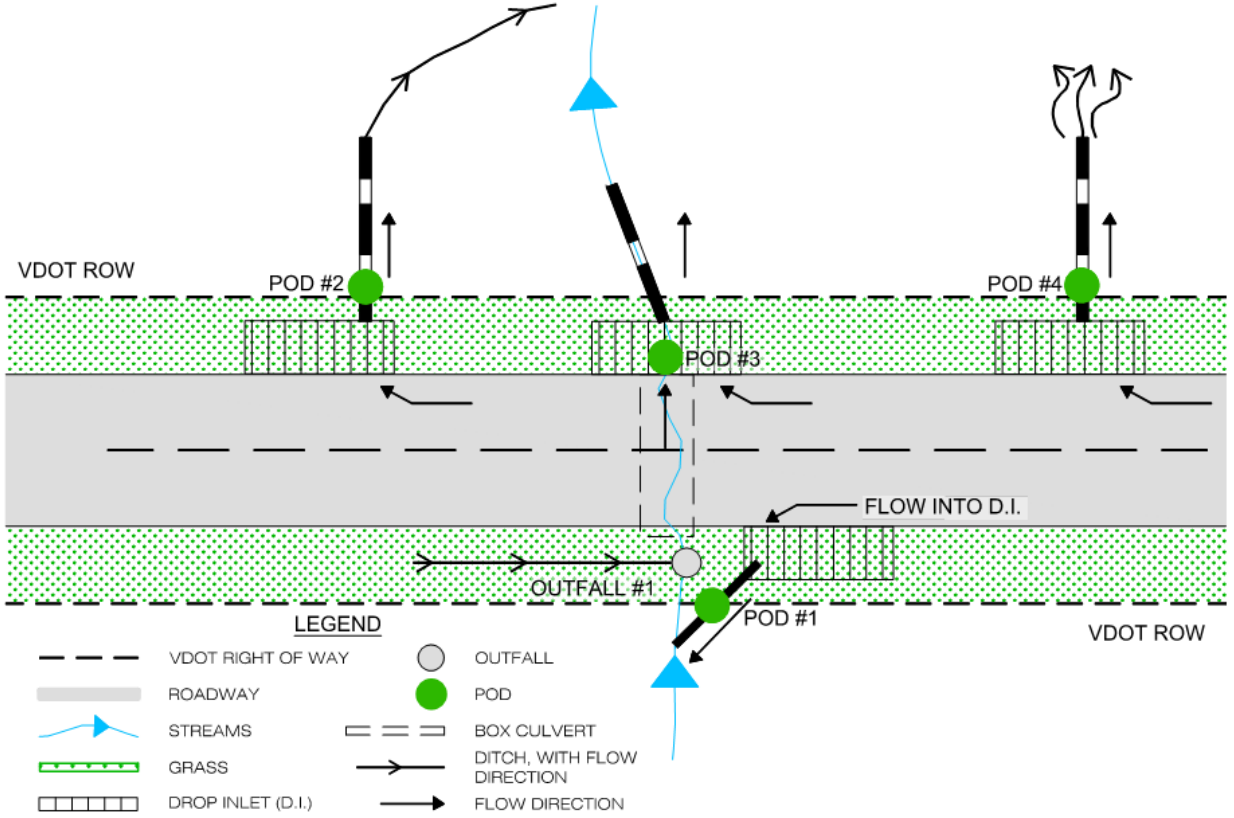
Figure 5. Scenario 5 - Ditches Leaving ROW as PODs before Reaching Surface Water



Scenario 5: Roadside ditches and a box culvert under the roadway discharge to surface water.

Type & # of Discharges	Description
0 Outfalls	There are no outfalls in this scenario. None of the concentrated flows drain to a surface water before leaving the ROW.
4 PODs	Four ditches between the roadway edge and ROW leave the ROW prior to discharging to a surface water and are therefore each classified as PODs.

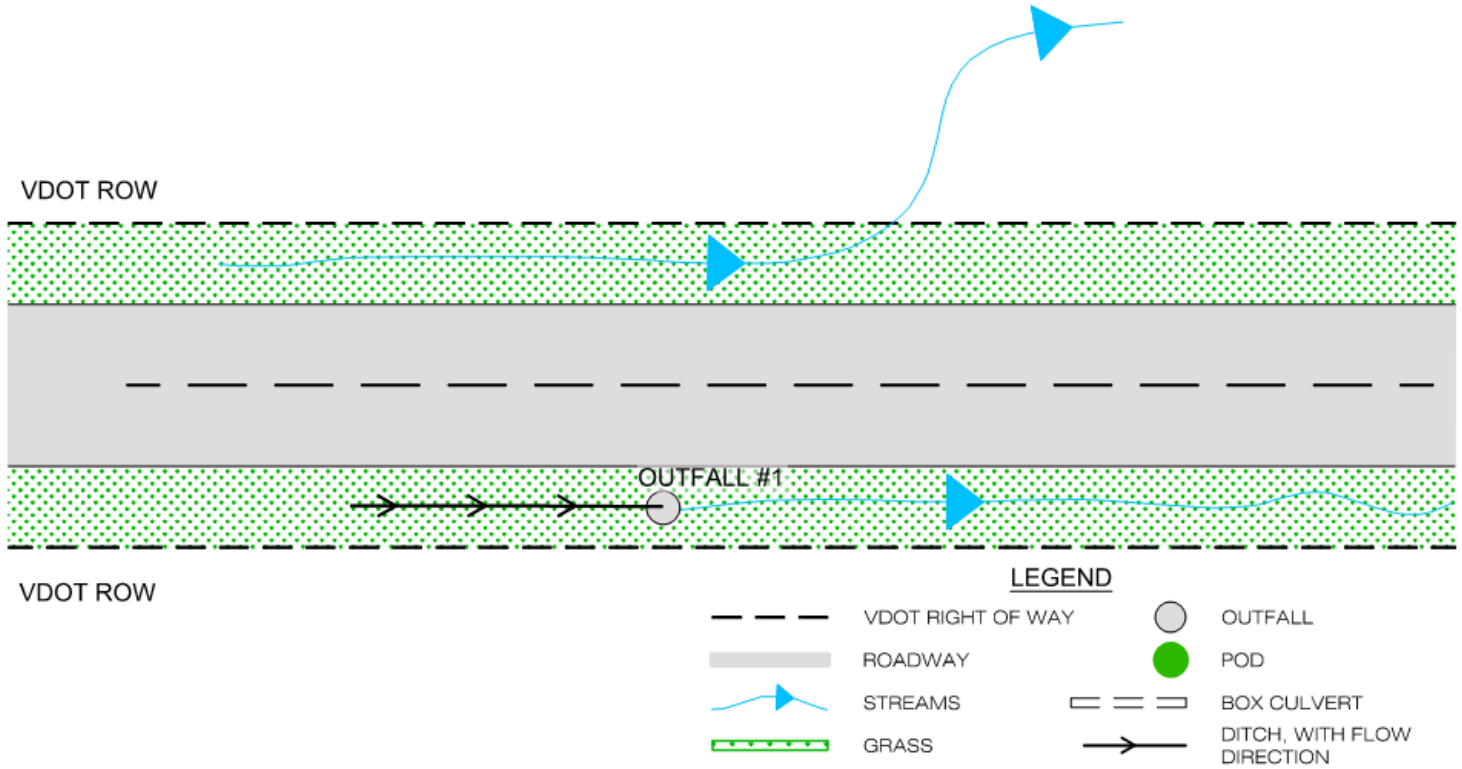
Figure 6. Scenario 6 - Roadway Gutter Flow Drainage to Drop Inlets



Scenario 6: Roadway Gutter Flow Drainage to Drop Inlets

Type & # of Discharges	Description
1 Outfall	The outfall that needs to be documented occurs where the roadside ditch drains to the stream surface water on the up-gradient terminal of the box culvert.
4 PODs	Roadside gutter flow drains directly to four drop inlet structures in the VDOT ROW. Three of these drain to natural channels outside of the ROW and are considered PODs. One inlet that receives stormwater also connects to a box culvert that conveys a stream under the roadway; this point discharges non-concentrated flow directly into the natural channel and is considered a POD.

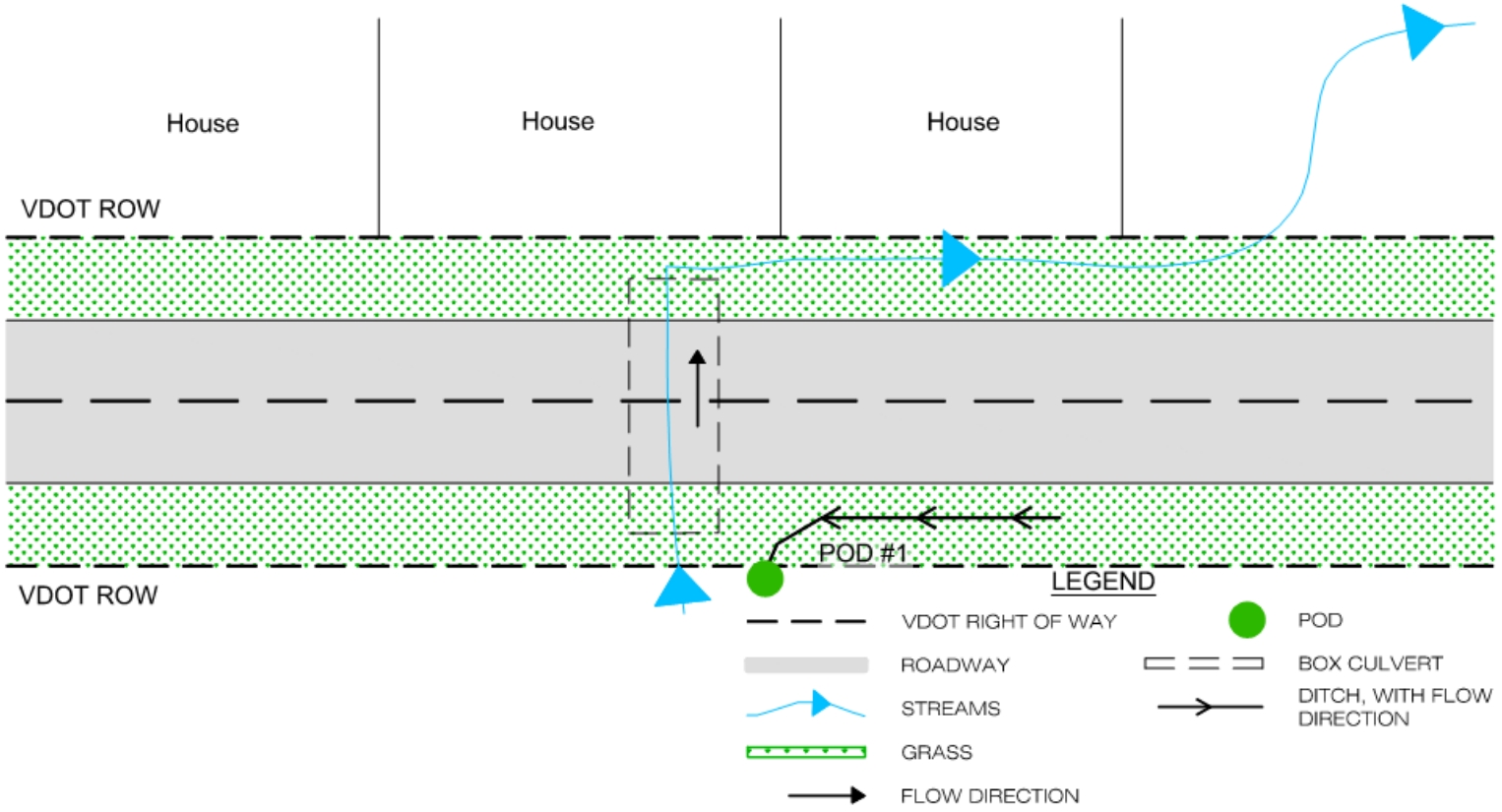
Figure 7. Scenario 7 - Transition of Roadside Ditch to Jurisdictional Surface Water



Scenario 7: Roadside ditches transitioning to jurisdictional surface water and surface water leaving ROW

Type & # of Discharges	Description
1 Outfall	One roadside ditch between the roadway edge and ROW transitions to a jurisdictional surface water, which represents an outfall point. This point represents an outfall and needs to be documented. The second conveyance is an existing jurisdictional surface water that does not collect concentrated roadway stormwater runoff and therefore is not considered an outfall.
0 PODs	There are no PODs in this scenario.

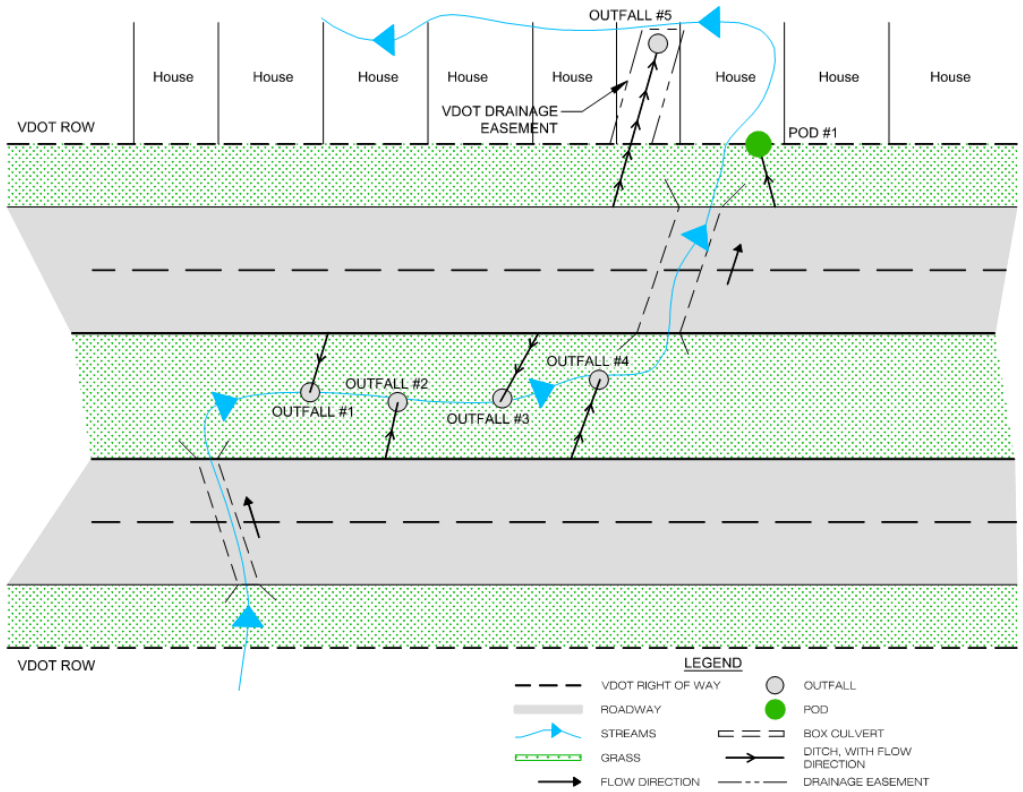
Figure 8. Scenario 8 – Roadside Ditch and Surface Water Draining Offsite



Scenario 8: Roadside ditch and surface water through box culvert discharging offsite.

Type & # of Discharges	Description
0 Outfall	A surface water flows through a box culvert under the roadway and conveys flows adjacent to the roadway before discharging offsite. This conveyance is an existing jurisdictional surface water that does not collect concentrated roadway stormwater runoff and therefore is not considered an outfall.
1 PODs	A roadside ditch parallels the roadway and leaves the ROW before draining to a surface water. Because it leaves the ROW prior to joining the jurisdictional surface water, it is considered a POD.

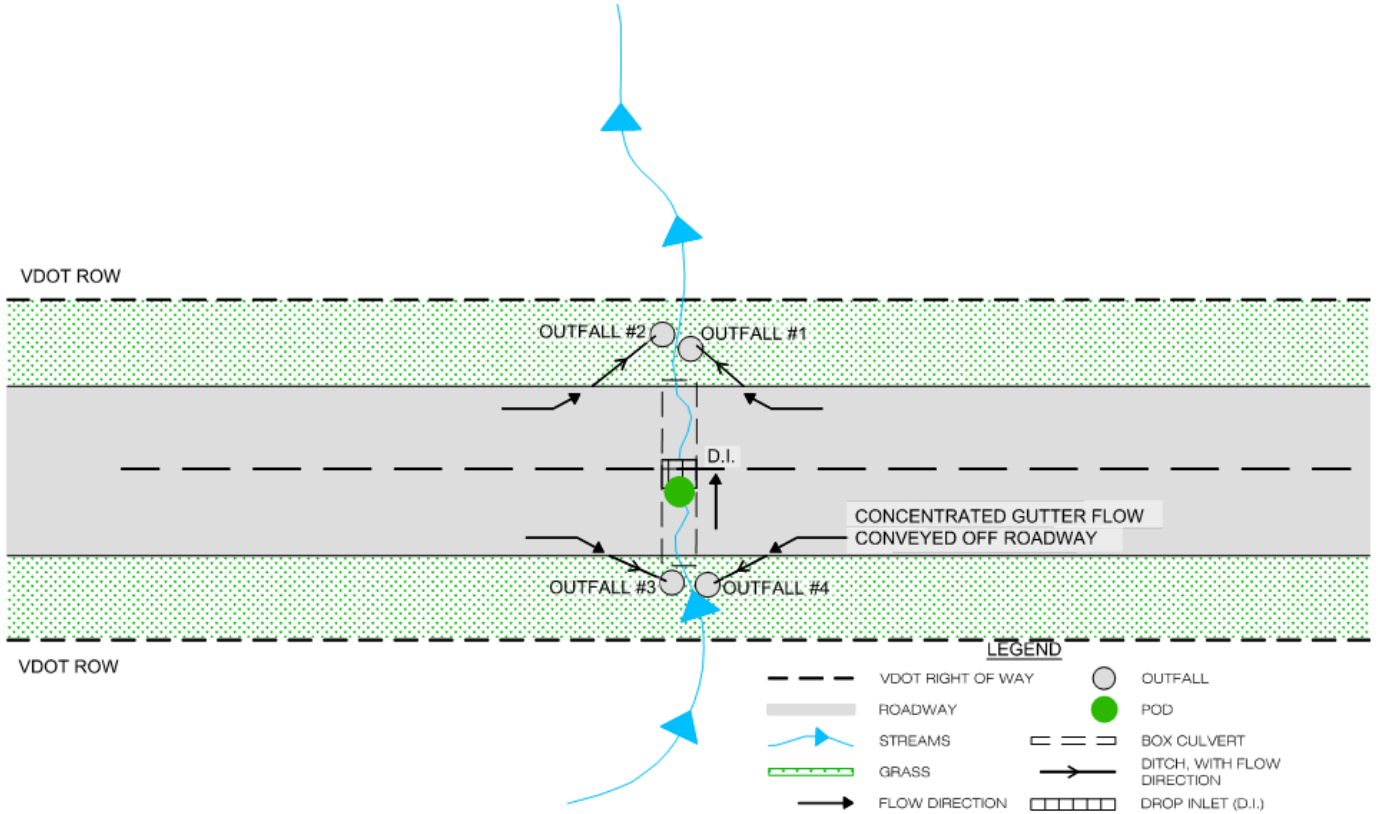
Figure 9. Scenario 9 - HOA Private Property Owner and VDOT Drainage Easement



Scenario 9: Drainage onto Adjacent HOA private property with VDOT Drainage Easement.

Type & # of Discharges	Description
5 Outfalls	An adjacent HOA and private property receive runoff from the VDOT roadway system. There is a dedicated drainage easement conveying the runoff to a jurisdictional surface water. Because the concentrated flow leaves the VDOT easement at the point it meets the surface water, an outfall exists and needs to be collected. In addition, four ditches within the median convey concentrated runoff to a jurisdictional surface water feature and need to be documented as outfalls.
1 POD	There is one POD where the concentrated flow leaves the ROW before reaching a surface water.

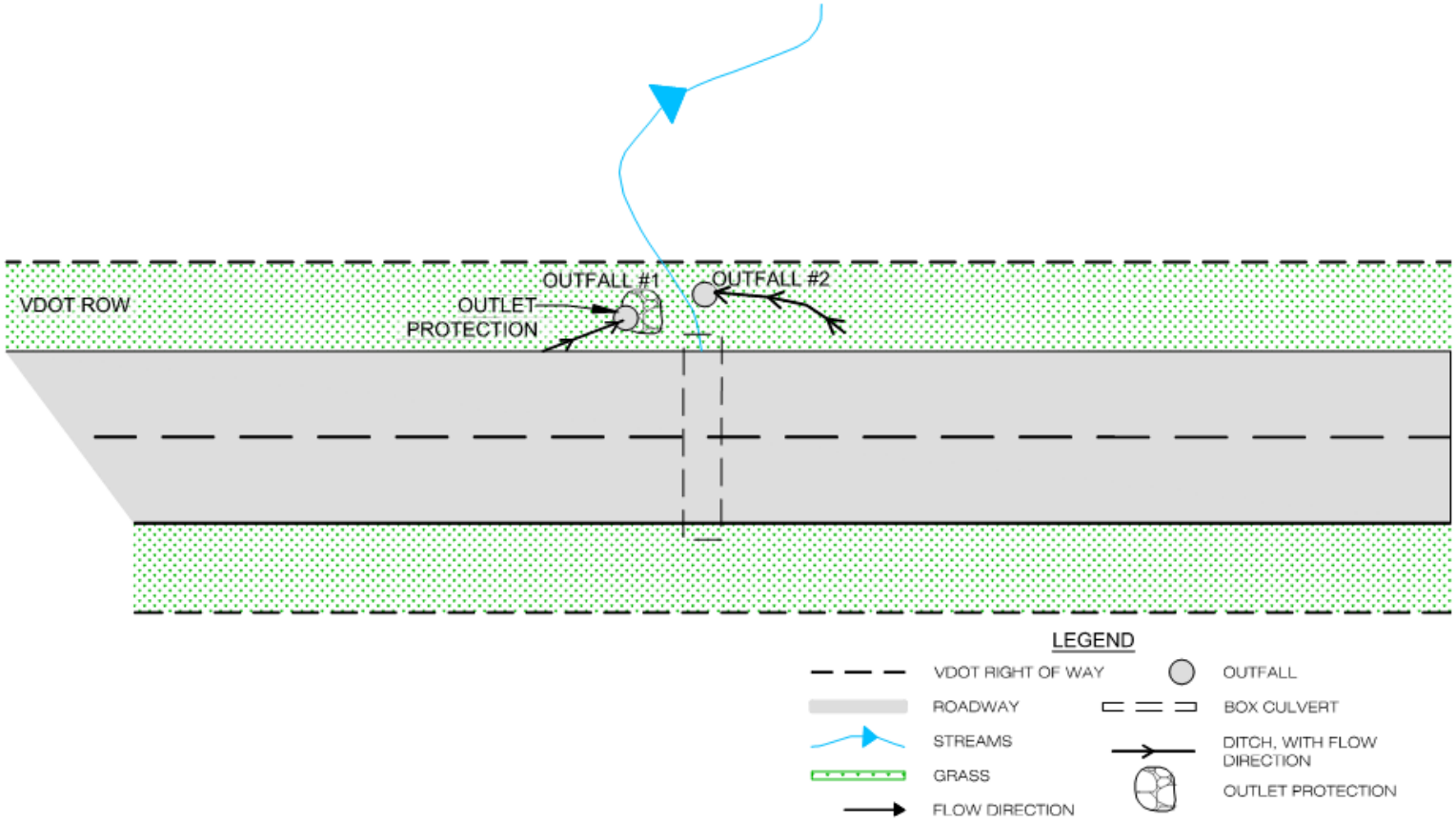
Figure 10. Scenario 10 - Concentrated Flows to Surface Water within ROW



Scenario 10: Roadside drainage and concentrated flow to surface water that is conveyed under the roadway.

Type & # of Discharges	Description
4 Outfalls	Four ditches collect concentrated gutter flow at near the low point of the roadway and drain to a jurisdictional surface water. All four of these points represent outfalls and need to be documented.
1 PODs	There is one point of discharge from the drop inlet into the stream, where non-concentrated flow from the roadway discharges into a jurisdictional surface water.

Figure 11. Scenario 11 - Headwater at Culvert Outlet.



Scenario 11: Headwater at Culvert Outlet Roadside.

Type & # of Discharges	Description
2 Outfalls	A jurisdictional feature begins at the outlet of the culvert, effectively serving as the headwater of the jurisdictional surface water. Two outfalls exist where concentrated flows drain through ditches to this headwater system.
0 PODs	There are no PODs in this scenario.

2.3 VDOT MS4 Outfall Identification

As discussed previously, VDOT produced mapping of its MS4 regulated area that has been and will continue to be used in conjunction with determining if there are outfalls that need to be inventoried. All outfalls within VDOT's ROW that involve VDOT roads within the 14 CUAs of Virginia need to be inventoried. If the outfalls are located outside of the MS4 regulated area, they do not need to be mapped. In addition, all outfalls at VDOT facilities (District offices, Residencies, Area Headquarters, rest areas, storage areas, and other similar facilities) have been and shall continue to be inventoried under this program. The inventory process for facilities should follow the procedures in the *Field Data Collection,* Section 4 of this manual.

Unique features and circumstances involving the boundaries of VDOT's MS4 regulated area present a challenge to achieving consistent data collection statewide. In the case where a CUA boundary runs along one side of a VDOT roadway, the entire roadway drainage system on both sides of the road should be inventoried within the VDOT right-of-way and within VDOT's MS4 regulated area. Interchanges should be inventoried to the end of all ramps.

3.0 MAINTAINING AND UPDATING THE OUTFALL INVENTORY

New outfalls will continually be added to the inventory over time through the Regulated Land Disturbance Activity (RLDA) program, Locally Administered Projects (LAP) program, Secondary Street Acceptance Requirements (SSAR) program, other roadway plans for projects, planned maintenance, and other activities. It is necessary to capture these outfalls upon completion of those activities. The necessary information shall be provided at the completion of these activities in either electronic or paper format so that it can be imported into the Outfall Inventory database at the time the activity (e.g., project delivery). This process will avoid requiring VDOT to go back out to the site at a later time to collect the information related to the outfalls, which is required by VDOT's MS4 tracking program and in the submittal of the annual report.

3.1 Adding and Updating Outfalls through Regulated Land Disturbance Activity (RLDA)

Projects that are delivered through the RLDA process shall have information on newly created and modified outfalls collected at the time of project delivery. Outfall data are collected from as-built drawings provided during submittal of the LD-445D form and entered into the RLDA system. During the nightly update, the system runs a script in the background which identifies new outfalls within the database and incorporates the new outfalls into the VDOT ArcGIS online Outfall and POD Inventory database. The steps involved include:

1. Completed projects are submitted via the LD-445D form process with the associated as-built documents
2. The LD-445D form and as-built documents are submitted to the GIS Geospatial Section Manager and assigned to GIS Section staff to complete the following actions.
    a. Assess current Outfall Inventory and locations within project limits
    b. Inventory outfalls that have been added or changed including:
        i. New outfalls being added to the system
        ii. Relocation, removal, or modification of existing outfalls

iii. Disconnection of existing outfalls
iv. Confirmation of existing outfalls that remain unchanged

c. Document outfall information and update Inventory

3.2 Adding Outfalls through Locally Administered Projects (LAP)

Projects that are delivered through the Locally Administered Projects (LAP) process shall have information on newly created and modified outfalls collected at the time of project delivery. The steps involved include:

1. Assess current Outfall Inventory and locations within project limits
2. Inventory outfalls that have been added or changed including:
    a. New outfalls being added to the system
    b. Relocation, removal, or modification of existing outfalls
    c. Disconnection of existing outfalls
    d. Confirmation of existing outfalls that remain unchanged
3. Document outfall information and update Inventory

Capturing this information and updating the inventory may be accomplished in one of two ways: 1.) completing the Outfall Inventory Field Sheet Form (Appendix C) or by 2.) logging the information through the VDOT ArcGIS online Outfall Inventory database. If the field sheet form is utilized, photographs of the outfall (maximum 2) and specific location (lat/long) recorded through GPS or otherwise to within 1 meter must be obtained. The ArcGIS online Outfall Reconnaissance tool utilizes the Outfall Inventory Field sheet form and allows for the collection of lat/long and photographs. Table 2 below summarizes the information that must be recorded, and Section 4 describes the field data collection process. See Appendix C for a sample of the full field collection form.

Table 2. *Summary of Information to be Collected*

A. LOCATION

Section	Category	Description
	Latitude, longitude	The outfall or POD location to be mapped

B. OUTFALL INVENTORY FIELD SHEET

Section	Category	Description
1	Team Data	Investigators, date, recent rainfall, temperature
2	Background Data	ID, lat/long, subwatershed, outfall or POD, photos, land use
3	Outfall Description	Closed pipe, open drainage, or drop inlet and material, shape, and dimension; drainage from VDOT or other sources.

C. PHOTOGRAPHS

Section	Category	Description
	Minimum of 2 and a Maximum of 4 digital photographs	Show outfall or POD location with contributing drainage area looking upland
		Show outfall or POD location and downstream surface waters or where concentrated flow leaves ROW

		Show other points of interest and other outfalls in close proximity if present

Part 2 – Project Management, Chapter 12 Project Development and *Part 3 – Standards and Practices for Locally Administered Projects, Chapter 15 Environmental Requirements* of the LAP Manual contain more information regarding the LAP process in the context of Outfall Inventory data collection and reference this Outfall Inventory Manual. The specific procedures for collecting data in the field can be found in Section 4, *Field Data Collection* of this manual.

3.3 Adding and Updating Outfalls through SSAR or Other Activities

New outfalls are often added when secondary streets are accepted into VDOT's system. Less frequently, outfalls may be added as they are identified through maintenance activities, BMP inspections, and IDDE responses. As part of the acceptable procedures, information on the new outfalls shall be provided to VDOT to allow for the maintenance and updating of VDOT's Outfall Inventory mapping and database.

4.0 FIELD DATA COLLECTION

4.1 Objective of Field Data Collection

At a confirmed outfall location, the required attributes of the outfall are documented on a tablet computer using the ArcGIS Field Maps Outfall Reconnaissance application. The Outfall Inventory Field Sheet form (Appendix C) provides an overview of the data to be collected in the field. GPS coordinates are digitally recorded in the background data based on the GPS locator program within the tablet, if using the ArcGIS Field Maps Outfall Reconnaissance application. Data collected in the field is then verified for completeness.

The inventory part of the survey involves taking digital photographs and recording other inventory data, such as the watershed, city, location of outfall, shape of outfall, size of pipe, condition of pipe, pipe material, condition of outfall channel and determination of whether the stormwater discharge point is a regulated MS4 outfall or a point of discharge to another MS4. The inspection part of the survey involves a complete assessment of the outfall location for potential illicit discharges. The completed inventory and inspection data are entered into the Collector application or onto the Outfall Inventory Field Sheet form found in Appendix C. A geodatabase is used to maintain the data; this information can be transferred to a report and outfall maps can be generated.

4.1.1 Recognizing "Waters of the United States"

The staff conducting the field data collection will have experience in identifying regulated waterways or "waters of the United States." The linear nature of VDOT's MS4 and the alteration of the landscape from road construction may present a challenge to consistently and accurately determining whether an outfall is present, since classifying a discharge as an "outfall" requires the existence of waters of the United States.

40 CFR 230.3(s) defines the term, "waters of the United States" as

1. *All waters which are currently used, or were used in the past, or may be susceptible to use in interstate or foreign commerce, including all waters which are subject to the ebb and flow of the tide;*
2. *All interstate waters including interstate wetlands;*
3. *All other waters such as intrastate lakes, rivers, streams (including intermittent streams), mudflats, sandflats, wetlands, sloughs, prairie potholes, wet meadows, playa lakes, or natural ponds, the use, degradation or destruction of which could affect interstate or foreign commerce including any such waters:*
    a. *Which are or could be used by interstate or foreign travelers for recreational or other purposes; or*
    b. *From which fish or shellfish are or could be taken and sold in interstate or foreign commerce; or*
    c. *Which are used or could be used for industrial purposes by industries in interstate commerce;*
4. *All impoundments of waters otherwise defined as waters of the United States under this definition;*
5. *Tributaries of waters identified in paragraphs (s)(1) through (4) of this section;*

6. *The territorial sea;*
7. *Wetlands adjacent to waters (other than waters that are themselves wetlands) identified in paragraphs (s)(1) through (6) of this section; waste treatment systems, including treatment ponds or lagoons designed to meet the requirements of CWA (other than cooling ponds as defined in 40 CFR 423.11(m) which also meet the criteria of this definition) are not waters of the United States.*

Waters of the U.S. include all ephemeral, intermittent, and perennial streams as described below.

- ***Perennial Stream*** - A stream that has flowing water year-round during a typical year. The water table is located above the streambed for most of the year. Groundwater is the primary source of water for stream flow. Runoff from rainfall is a supplemental source of water for stream flow. During hydrological drought conditions, the flow may be impaired.
- ***Intermittent Stream*** - A stream that has flowing water during certain times of the year, when groundwater provides for stream flow. During the dry season and throughout minor drought periods, these streams will not exhibit flow. Precipitation is a supplemental source of water for stream flow. It is delineated with either dashed lines or solid, light blue lines on USGS topographic maps.
- ***Ephemeral Stream*** - A stream with flowing water only during, and for a short duration after, precipitation events in a typical year. Ephemeral stream beds are located above the water table year-round. Groundwater is not a source of water for the stream. Runoff from rainfall is the primary source of water for stream flow.

For the purposes of this inventory, a surface water shall be considered to be a water of the US if all of the following characteristics are present:

- *A defined "channel" which carries water for at least a minimal period of time and has an "ordinary high water mark" (OHWM).*
  - *A channel is the area between definite banks of a natural or artificial watercourse which confines and conducts continuously or periodically flowing water.*
  - *An OHWM is that line on the stream bank established by the fluctuations of water and indicated by physical characteristics such as clear, natural line impressed on the bank, shelving, changes in the character of soil, destruction of terrestrial vegetation, the presence of litter and debris, or other appropriate means that consider the characteristics of the surrounding areas.*

  Note: When roads were originally constructed, sometimes streams and local drainage features were rerouted to build the road. This situation may not be reflected on mapping. Most roadside ditches have either ephemeral or intermittent flow and do not discharge directly into waters of the US. As a result, most roadside ditches are not regulated surface waters. Roadside ditches and smaller streams may not be displayed on USGS topographic maps and NRCS soil surveys, so a thorough field reconnaissance is critical to identify all waters of the US that are present. All field staff must be able to recognize water for the US in light of the above information.

4.2 Requirements prior to Conducting Field Work

4.2.1 Access to VDOT Right-of-Way and Other Property

Before any field work and data collection begins at a VDOT roadway or facility, it is suggested that a meeting be scheduled with facility staff, consultants, and contractors to discuss the nature of the work to be performed and to gather drainage information, including a review of the plan, if that is considered appropriate. It is recommended to schedule meetings at least one week before the intended field visit to accommodate staff schedules and workload. This process should be identified on an overall project schedule, which can be distributed to personnel for reference. Note that some facilities are seasonal and access to these facilities while they are closed may require additional coordination. Data collection, documentation, and submission is the same as that for roadways and facilities, with the exception of including the facility address.

All proposed work shall comply with applicable requirements of the Virginia Manual of Uniform Traffic Control Devices and Part 6, Virginia Area Protection Manual (VAPM). Temporary traffic control is not expected to be needed for this inventory. If temporary traffic control is required to assess or collect data for an outfall, then VDOT's Central Office – L&D Division shall be consulted for approval and the VAPM shall be followed.

Before any work requiring people or vehicles at a VDOT facility may begin, contact the facility manager at the VDOT facility or property to inquire about access to the specific facility (see Appendix B).

4.2.2 Field Safety

Safety procedures shall be strictly followed. All individuals working in VDOT ROW shall be cognizant of their personal safety as well as the safety of the traveling public, including the following potential safety issues:

- Use of personal protective equipment, including a high visibility safety vest at all times.
- Cold weather (frostbite, hypothermia)
- Hot weather (sunburn, heat stress, exhaustion, and stroke)
- Recognition of poisonous plants, animals, and insects
- Other insects: mosquitoes (West Nile Virus) and ticks (Lyme disease)
- Driver safety and awareness, especially in winter weather
- Keeping distance from and maintaining visual contact with oncoming traffic when working near travel way
- Working in pairs to allow one individual to log data while second maintains visual contact
- Utilizing proper vehicle emergency lighting and parking vehicles away from travelways
- Hazardous or sharp items along roadsides
- Illicit discharges into VDOT's MS4
- Water safety: flash floods, drowning
- Maintaining communication with co-workers
- Steep slopes
- Uneven footing
- Confined space

4.2.3 Weather Conditions

Weather may restrict the feasibility of conducting some field work. In winter weather, snow and ice may inhibit the ability to locate outfalls or collect data and also create a safety risk for walking or driving.

4.2.4 Field Equipment

Equipment or other items required for field data collection include:

- Electronic field data collector such as a tablet computer (iPad or Android) or smart phone with the ArcGIS Collector application loaded. This application has the field form preloaded. The GPS receiver and camera are built into the tablet or phone already so there is no need for additional equipment.
    - A VDOT USERID is required ahead of time. This has to be requested via an email to the GIS Geospatial Section Manager at Central Office. It must be received prior to going out to the field.
    - Once the USERID is received, the requestor must log in on their desktop and create a password.
- If the electronic data collector will not be used, Field Sheet paper copies, GPS to sub-meter accuracy, and digital camera
- Tape measure/folding ruler
- Manhole cover tool for removing the covers
- Safety equipment
- Access letter to work in VDOT right of way/facility, if required by District

4.3 Field Data Collection Methodology

VDOT encourages efficiency, innovation and flexibility in field data collection methods, as long as data is collected safely in the format described in this manual so it can be uploaded to the MS4 Outfall Inventory database. Essential field data collection efforts shall involve the following:

- Review of VDOT regulated MS4 area maps, road maps, potential outfall locations, and other associated documents from VDOT records, if available, such as construction plans and straight-line diagrams.
- Location and assessment of potential outfall locations identified through the office data collection process.
- Evaluation of all potential target areas for the presence of outfalls.
- Recognition and documentation of actual "waters of the U.S." and identification of other water resource issues unique to the VDOT right-of-way.
- Field staff should be aware that often multiple outfalls may be present in close proximity to one another with longer outfall-free segments between outfall clusters.
- Field verification of potential outfalls identified through office research should take no longer than approximately 30 minutes. When outfalls cannot be located in the field within 30 minutes, field personnel shall document the efforts made and contact their supervisor regarding a possible follow-up investigation. Within the form under the MS4 section (Section 2:

Background Data), field personnel should select "Unable to Work" (UTW) as the choice in that data field, with an explanation (e.g., no access, locked entrance, under construction, etc.).

- When inventorying existing outfalls, if the source of the target generation (such as a pond or wetland) has been removed due to construction, or no outfall or POD is found, then a "No Outfall Found" point should be recorded.
- When inventorying existing outfalls, if the target/cluster is in an active construction zone, an "Unable to Work" point should be recorded.
- Although not expected, if maintenance of traffic (MOT) is required in order to be able to safely assess or collect data for an outfall, then the State Stormwater/MS4 Engineer in VDOT's Central Office – L&D Division shall be consulted for approval of such action.
- Once an item is determined to be an outfall, field data collection may begin (data are only collected for confirmed outfalls and PODs). Refer to Appendix C for a list of data to be collected. Data formats will be included in the ArcGIS Field Maps Outfall Reconnaissance application used for field collection.
- Field data collection should follow the QA/QC procedures identified in this section.

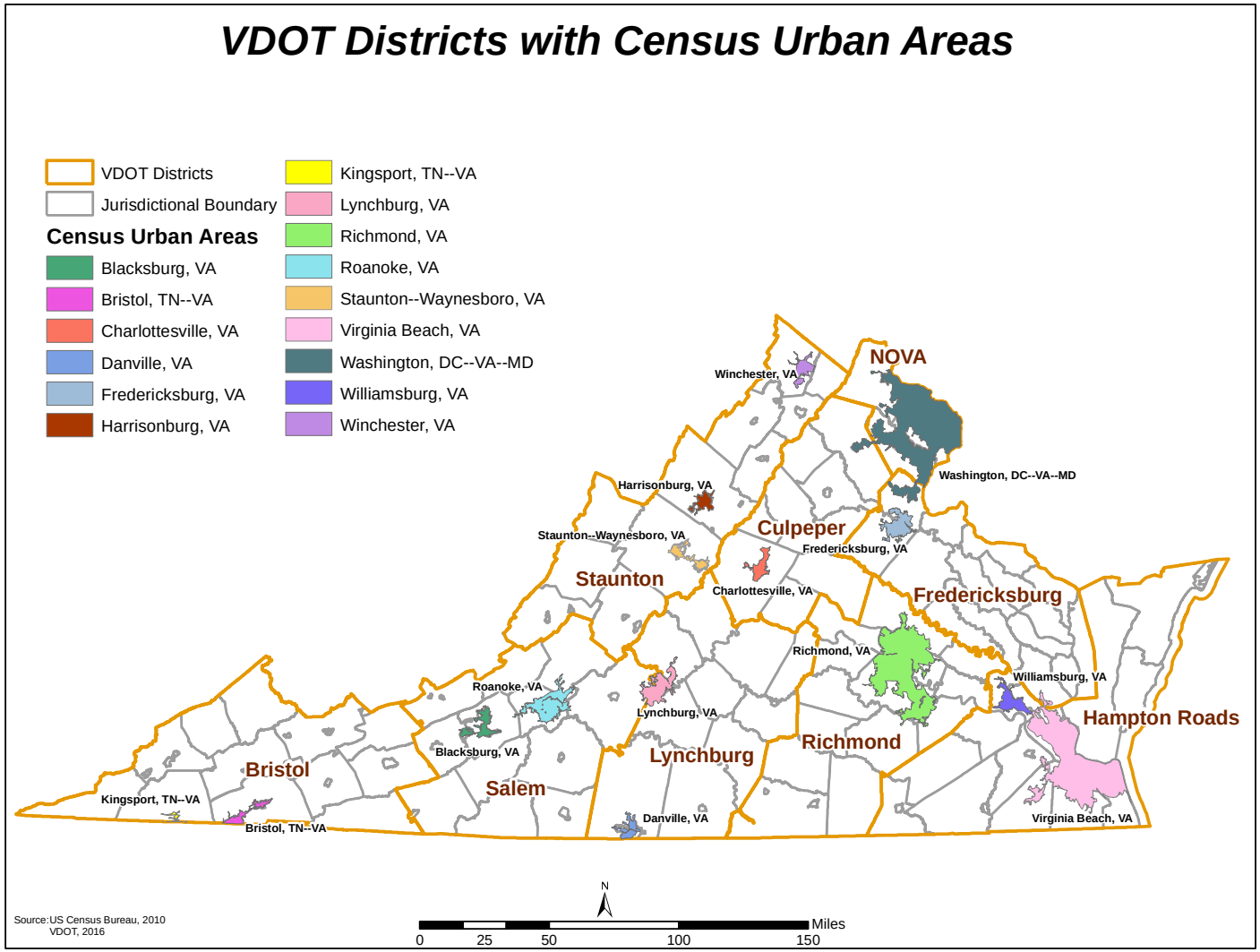
For all outfalls identified in the field, the necessary information will be collected and recorded on a tablet computer or smart phone using the ArcGIS Field Maps Outfall Reconnaissance application. The fields that are captured on this application follow the information shown on the ***Outfall Inventory Field Sheet*** provided in Appendix C. This Inventory provides information about the conditions that existed at the site when the field visit was made, outfall descriptive information, and information about any illicit discharges that may be present and the condition of the channel/pipe itself.

A minimum of two and a maximum of four digital (*.JPG) photographs may be taken and made part of the data file. The photographs should attempt to capture the outfall setting instead of being a close range shot of the actual outfall. However, close range photographs should be used to document suspected illicit discharges.

5.0 DATABASE POPULATION

Data collected in the office and field is prepared for entry into VDOT's MS4 Outfall Inventory Database maintained by the Geospatial GIS Section at the Central Office. This database resides on the cloud through the ArcGIS Online (AGOL) application. Data is currently being collected in the field using either a paper form or a field instrument (tablet computer) that stores the field data sheet as a data entry form through the ArcGIS Field Maps Outfall Reconnaissance application. This is a real-time application so that the data can be seen within minutes of being collected and submitted. Alternatively, the Outfall Inventory Field Sheet paper form (Appendix C) may be filled in and transmitted to VDOT Central Office Location and Design Division.

APPENDIX A - VDOT STATE DISTRICT AND CUA MAP



APPENDIX B - VDOT CONTACT INFORMATION

Point of Contact	**District** *Census Urbanized Area(s)*
Stephen Mumpower Bristol District NPDES Coordinator Stephen.Mumpower@VDOT.Virginia.gov 276-393-8868	**Bristol District** *Bristol CUA;* *Kingsport CUA*
Debra Switzer Culpeper District NPDES Coordinator Debra.Switzer@VDOT.Virginia.gov 540-727-7011	**Culpeper District** *Charlottesville CUA*
Michael Cartwright Fredericksburg District NPDES Coordinator Michael.Cartwright@VDOT.Virginia.gov 540-899-4474	**Fredericksburg District** *Fredericksburg CUA*
Jennifer Dail Hampton Roads District NPDES Coordinator Jennifer.Dail@VDOT.Virginia.gov 757-956-3275	**Hampton Roads District** *Virginia Beach CUA;* *Williamsburg CUA*
Amanda Winks Lynchburg District NPDES Coordinator Amanda.Winks@VDOT.Virginia.gov 434-221-0412	**Lynchburg District** *Lynchburg CUA*
Marian Carroll NOVA District NPDES Coordinator Marian.Carroll@VDOT.Virginia.gov 703-259-1739	**Northern Virginia District** *Washington, DC CUA*
Kendall Allen Richmond District NPDES Coordinator Kendall.Allen@VDOT.Virginia.gov 804-629-0035	**Richmond District** *Richmond CUA*
Jeff Ferguson Salem District NPDES Coordinator Jeffrey.Ferguson@VDOT.Virginia.gov 540-357-0129	**Salem District** *Roanoke CUA;* *Blacksburg CUA*
Larry Newman Staunton District NPDES Coordinator Larry.Newman@VDOT.Virginia.gov 804-690-4314	**Staunton District** *Staunton-Waynesboro CUA;* *Winchester CUA;* *Harrisonburg CUA*

Point of Contact	District *Census Urbanized Area(s)*
J. Alex Forasté, P.E. State MS4/Stormwater Management Engineer Alex.Foraste@VDOT.Virginia.gov (804) 786-2548	**Central Office** *All CUAs*
Michelle Fults Geospatial GIS Section Manager & Water Resources Support Michelle.Fults@VDOT.Virginia.gov 804-786-1294	**Central Office** *All CUAs*

APPENDIX C – OUTFALL INVENTORY FIELD SHEET SAMPLE

Outfall Inventory

Section 1: Team Data

Investigators:	Today's date:	
Rainfall (in.): Last 24 hours: Last 48 hours:	Temperature (°F):	iPad Unit:

Investigators:	Team ID:	
Today's date:	Rainfall (in.): Last 24 hours: Last 48 hours:	
Temperature (°F):	GPS Unit:	GPS SN or ID:
Camera:	Camera SN or ID:	

Section 2: Background Data (Grayed out areas are determined as part of process and does not required direct entry)

Outfall ID:			
Subwatershed: (Determined by GIS location and not Field Entry)		Latitude:	Longitude:
Photo #s: Note: Photo is taken and then attached to each Outfall and POD as part of the Processing and the Investigator does not need to separately record Photo No.	MS4 Outfall or POD: MS4 Outfall POD (Point of Discharge) NOF (No Outfall Found) UTW (Unable To Work – Please add Note) For POD: ID of County Structure Is POD a MS4 Interconnection (YES/No)[3] ID of County Outfall	Notes (e.g.., origin of outfall, if known such as SWM Basin):	

Land Use in Drainage Area (Check Predominate Use or add Multiple under Other):

☐ VDOT

☐ Industrial

☐ Ultra-Urban Residential

☐ Suburban Residential

☐ Commercial

☐ Open Space

☐ Institutional

Other: _____

_____

Known Industries: _____

_____

Inventory Review Reason (Outfall Survey, QA/QC, IDDE, TMDL)___USACE Default to **Phase I MS4**_____

MS4 Outfall Notes:

1 Because of IDDE call in and referrals not all outfalls inventories will be in MS4 area. VDOT is logging all outfalls into a wetland, water body or stream on VDOT R/W as VDOT outfall. County Tax plats will be imported to assist in the R/W determination, but it will be assumed that VDOT has a drainage easement to go around the end of any pipe culvert or box culvert accepted for maintenance. A discharge point cannot be both a MS4 outfall and a POD.

2 If VDOT discharges stormwater inside of a targeted area of MS4 investigation and the discharge is not directly into the wetland, water body or stream on VDOT R/W the point will be captured as a Point of Discharge (POD and the inventory and assessment completed.

3 If the POD is into a ditch, paved ditch or pipe then the POD is also a MS4 Interconnection (MS4 I). If the POD is into a flood plain or natural swale then the POD is not also a MS4 I.

Section 3: Outfall Description

LOCATION	MATERIAL	SHAPE	NO. OF PIPES	DIMENSIONS (IN.)	SUBMERGED
☐ **Closed Pipe**	☐ RCP ☐ CMP ☐ PVC ☐ HDPE ☐ Steel ☐ Other: _____	☐ Circular ☐ Elliptical ☐ Box ☐ Other: _____	☐ Single ☐ Double ☐ Triple ☐ Other: _____	Diameter: _____ Or Width: _____ Height : _____	In Water: ☐ No ☐ Partially ☐ Fully

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)
☐ **Open drainage**	☐ Concrete ☐ Earthen ☐ rip-rap ☐ Other: _____	☐ Trapezoid ☐ Parabolic ☐ V shaped ditch ☐ Other: _____	Depth: _____ Top Width: _____ Bottom Width: _____

LOCATION	MATERIAL	SHAPE	DIMENSIONS (IN.)
☐ Drop Inlet	☐ Curb Inlet ☐ Curb Inlet with Grate	Measure Slot – Grate area will not be measured	Height: _____ Width: _____
	☐ Flat DI	☐ Square or Rectangular	Length: _____ Width: _____
		☐ Circular	Diameter: _____
	☐ DI in V Ditch	Measure Grate Area	Length: _____ Width: _____
	☐ Other: _____		

☐ VDOT Right-of-Way ☐ Mixed VDOT and Other Sources ☐ Other Sources

APPENDIX D – HISTORICAL DATA COLLECTION METHODOLOGY

The purpose of this section is to describe the historical methods used to identify existing outfalls, add new outfalls to the database, and collect field data. Although these methods are not currently in practice, possible future updates to the program may require re-adoption of these techniques.

6.0 OUTFALL RECONNAISSANCE INVENTORY (ORI) OF EXISTING OUTFALLS

6.1 Objective of Office Data Collection and Research

It may be necessary to inventory existing outfalls post-installation if they were not previously inventoried. This section outlines procedures for office data collection and research. The objective of this section is to describe the data collection process in the office, which will provide a basis for further data collection in the field. The main purpose of the office data collection is to identify potential locations where outfalls could exist.

6.2 VDOT MS4 Potential Outfall Identification

See Section 2.3 for information on potential outfall identification.

6.2.1 MS4 Target Selection Model

Over the past several years, VDOT developed a process to inventory existing outfalls while developing the mapping of its storm sewer system. The process developed was called the MS4 Target Selection Model. While this method is no longer a primary focus at this time, the process and method are presented here for historical procedural documentation as it describes how the historical inventory was developed.

The function of the MS4 Target Selection Model is to predict the most likely location of VDOT stormwater conveyances discharging into surface waters (i.e., Waters of the US). The MS4 Target Model uses the most up-to-date hydrographic data and VDOT road centerline data, to identify locations where roadways maintained by VDOT are within a specified proximity to streams, water bodies or wetlands.

The model has been refined to enhance the target selection process. The following is a summary of the modifications:

1. *Census Urban Area Boundary Modification*: The CUA boundary was modified to include all features (roads, intersections, subdivisions, etc.) that were fractured by the CUA boundary. This change in the CUA was made to make field collection target area boundaries more understandable. For example, the Roanoke CUA boundary bisects interstate 81 and its intersections in many locations. The boundary was modified to move the CUA Boundary west of the interstate and its intersections for the complete length of the CUA, including the entire interstate roadway. The 2010 CUAs were also modified to include the areas from the 2000 CUAs that were removed from the 2010 CUAs.
2. *Inclusion of the most current data sources:*
    a. VDOT Linear Referencing System (LRS), most current quarter

b. United States Geological Survey National Hydrography Data (NHD flowlines and waterbodies)
c. National Wetlands Inventory (NWI)
d. State Jurisdictional boundaries
e. Aerial photography (Bing or Virginia Base Mapping Program from VGIN
f. Virginia Parcels (map service from VGIN)
g. Georeferenced "As built" plans from FALCON for projects in difficult areas
h. Any available information from pipes or discharge points from other cities, counties, towns or consultants.

3. *VDOT maintained road review:* The VDOT "Linear Referencing System (LRS) Roadway Network" GIS Feature Class used in the model currently does not supply sufficient data to determine whether certain routes, such as business routes of US highways located in cities, are maintained by the cities or VDOT. A series of queries were run to make sure that roads owned and maintained by VDOT were marked as "Yes" in a column named "VDOTMain" for use in sorting the correct roads for the development of the targets. Roads that did not fit these queries and any questioned route were checked against the data in the Highway Traffic Records Inventory System (HTRIS) as well as the owner responsibility table, which is a feature service (VDOT Maintained Roads) within the LRS published map. The selected roads were marked as "No" when it was verified that the roads are not maintained by VDOT.
4. *Development of targets* by clipping the VDOT maintained roads to the buffers of the waterbodies, leaving only that portion of the road where it crosses the various waterbodies (streams, lakes, wetlands) as the potential location of an outfall.
5. *Grouping of targets*. To create the clusters, the targets within a specific proximity to each other were buffered by 15 meters. If there were any overlapping buffers, they were dissolved to create one continuous feature. For example, the five or six targets generated on the various road segments that make up an intersection at a stream crossing were grouped into one cluster.

As new or modified roadways are added to the system, the VDOT Location and Design MS4 Analyst staff will execute the target model selection process as necessary to identify any additional areas that require field reconnaissance for outfall identification. The basic framework of the process is outlined below:

1) Prepare input data

- Buffer the CUA boundaries to 35 meters ("CUA35 bounds"). The buffer process allows roadway targets to be calculated for water features outside of CUA boundaries but within the 35-meter distance limitation.
- Clip the following GIS input data shapefiles to "CUA35 bounds" to reduce file size and processing demands.
  - National Wetland Inventory shapefile (NWI)
  - Flowline (FL) for the National Hydrography Dataset (NHD)
  - Waterbodies (WB) from the NHD (remove the swamp/marsh classification, and use NWI instead)
  - Roads (naming format: VDOT_LRSquarter (example: LRS152)_Clipped
- Project all input data layers to Lambert Conformal Conic projection in NAD 83. Be sure to do all the buffering in this projection to maintain correct units of measure for the annual report. Once orthoimagery is pulled into the map the projection changes to Web Mercator and the distortion changes the true measurements.

2) Prepare the water feature 'cutter' layer (cookie cutter layer for target selection).

- ❖ Buffer NHD Flowline (FL) water features to 25 meters. Buffer NHD waterbody (WB) feature inputs and NWI features to 35 meters. The thirty-five meters corrects for shifting (possibly a datum shift) or inaccurate positioning of NHD polygon water features or NWI polygon water features.
  - Buffer all NHD Flowline (FL) features
  - Buffer only NHD Waterbody (WB) features that intersect FL features or are 5 meters from a FL (this represents "Waters of the US" and excludes undesired polygons such as swimming pools) (Include only FType = estuary, lake, pond, and reservoir. The swamp/marsh FType is excluded since the NWI is the authoritative source for wetlands.)
  - Buffer all NWI features (Include all NWI type = M, E, R, L and P)
- ❖ Dissolve each of the water feature buffers (NHD, WB, NWI). To be able to turn each of these on individual, keep them as separate layers. If a single homogenous data layer is wanted, then combine them together for one "cookie cutter" layer to use for clipping the roads which will generate the target sites.

  Note: Past notes suggested dissolving the three water features into one for ease of showing data, but this has been found to be very time consuming with merging and dissolving the water feature buffers to create one continuous water layer (Hydrography). This process slows down the overall program when pulling it up on the system. It may be smart to keep the separate layers on the map as well.
  - This single combined feature layer should have a naming format similar to this: NHDFLWB_NWICutter_monthyear (Example: NHDFLWB_NWICutter_1215). With each cycle there is a chance that the water layers will be different due to updates. Having a month and year will give a historical picture.

3) Clip MS4 Targets from the Roads layer

- ❖ Make sure that the only roads that are being used from the clipped LRS layer are the VDOT maintained roads, as determined by using the MS4 target selection model process. Use the VDOTMain column and select only those marked "yes". Those with "no" will be used in the overall map.
- ❖ Use the individual layers or the NHDFLWB_NWICutter_monthyear layer (produced in step 2) to clip the VDOTRoads_LRSquarter layer (produced in step 1 and clipped to CUA boundaries which are buffered to 35 meters) to create the preliminary MS4 targets. Select all targets that are completely inside or intersect the buffered CUA boundaries. Label the layer as MS4_FYyear_PreTargets.
- ❖ Use the MS4_FYyear_PreTargets and explode the multi-part features to separate targets that are located along the same route. This process leaves some adjoining targets as separate features if they have a different route ID.
- ❖ The final layer should follow this format: MS4_FYyear_FinalTargets_ monthyear (Example: MS4_FY15_FinalTargets_1215).

4) Assign a unique identification number to each target. A naming suggestion is to use the FID number generated by the computer followed by the monthyear (Example: 196_1215). This also allows tracking for historical purposes.

- ❖ Attach attributes to the MS4_FYyear_FinalTargets_monthyear layer from source layers (join layers by spatial location or by the field calculator). Example of some of

the attributes include, but not limited to, HUC6, CUA, USACE District, VDOTMain, etc.

5) Buffer the selected targets created in step 4 by 15 meters and dissolve the buffers. A suggested naming convention for the layer would be MS4_FYyear_Clusters
   - ❖ Assign a unique identification number to each cluster. A naming suggestion is to use the number in the FID field as generated by the computer and the monthyear (Example: 1562_1215). This FID will be different than the target identification due to the file type (line versus polygon).
   - ❖ Attach attributes to the clusters layer from source layers (join layers by spatial location and export them to capture new fields). Example of some of the attributes include, but not limited to, HUC6, CUA, USACE District, VDOTMain, NHDFL_Target, NHDWB_Target, NWI_Target, clear (for clearing the cluster), etc.

6.2.2 Infrastructure Ownership

See Section 1.3 for information on infrastructure ownership.

7.0 ADDING OUTFALLS THROUGH LOCALLY ADMINISTERED PROJECTS (LAP)

Projects that are delivered through the Locally Administered Projects (LAP) process shall have information on newly created and modified outfalls collected at the time of project delivery. The steps involved include:

4. Assess current Outfall Inventory and locations within project limits
5. Inventory outfalls that have been added or changed including:
   a. New outfalls being added to the system
   b. Relocation, removal, or modification of existing outfalls
   c. Disconnection of existing outfalls
   d. Confirmation of existing outfalls that remain unchanged
6. Document outfall information and update Inventory
7. Perform dry weather screening on all outfalls in project limits using VDOT's IDDE procedures

Capturing this information and updating the inventory may be accomplished in one of two ways: 1.) completing the Outfall Inventory Field Sheet Form (Appendix C) or by 2.) logging the information through the VDOT ArcGIS online Outfall Inventory database. If the field sheet form is utilized, photographs of the outfall (maximum 2) and specific location (lat/long) recorded through GPS or otherwise to within 1 meter must be obtained. The ArcGIS online tool utilizes the Outfall Inventory Field sheet form and allows for the collection of lat/long and photographs. Table 1 below summarizes the information that must be recorded. See Appendix C for the full form.

Table 1. Summary of Information to be Collected

A. LOCATION		
	Latitude, longitude	The outfall or POD location to be mapped
B. OUTFALL INVENTORY FIELD SHEET		
Section	**Category**	**Description**

1	Team Data	Investigators, date, recent rainfall, temperature
2	Background Data	ID, lat/long, subwatershed, outfall or POD, photos, land use
3	Outfall Description	Closed pipe, open drainage, or drop inlet and material, shape, and dimension; drainage from VDOT or other sources.
4	Illicit Discharge Survey	Dry or wet weather illicit discharge survey
5	Physical Indicators for Flowing Outfalls	Odor, color, turbidity, floatables and severity if flowing
6	Physical Indicators for Both Flowing & Non-Flowing Outfalls	Deposits/stains, abnormal vegetation, pool quality, pipe benthic growth, sediment accumulation and descriptions
7	Overall Outfall IDDE Characterization	Unlikely, potential, suspect, obvious illicit discharge
8	Outfall Channel Field Concerns	Channel blocked, erosion occurring or damage
9	Outfall Channel Rating	No maintenance required, monitor, review, or repair
10	Any Non-Illicit Discharge Concerns	Any related information not captured above
11	Administrative Review	Ownership, status, and last modification date

C. PHOTOGRAPHS		
	Maximum of 2 digital photographs	Show outfall or POD location with contributing drainage area looking upland
		Show outfall or POD location and downstream surface waters or where concentrated flow leaves ROW
		Show other points of interest and other outfalls in close proximity if present
		Show close-up of illicit discharge if observed

Part 2 – Project Management, *Chapter 12 Project Development* and *Part 3 – Standards and Practices for Locally Administered Projects*, *Chapter 15 Environmental Requirements* of the LAP Manual contain more information regarding the LAP process in the context of Outfall Inventory data collection and reference this Outfall Inventory Manual. The specific procedures for collecting data in the field can be found in Section 4, *Field Data Collection* of this manual.

8.0 FIELD DATA COLLECTION METHODOLOGY

VDOT encourages efficiency, innovation and flexibility in field data collection methods, as long as data is collected safely in the format described in this manual so it can be uploaded to the MS4 Outfall Inventory database. Essential field data collection efforts shall involve the following:

- Review of VDOT regulated MS4 area maps, road maps, potential outfall locations, and other associated documents from VDOT records, if available, such as construction plans and straight-line diagrams.
- Location and assessment of potential outfall locations identified through the office data collection process.
- Evaluation of all potential target areas for the presence of outfalls.
- Recognition and documentation of actual "waters of the U.S." and identification of other water resource issues unique to the VDOT right-of-way.

- Field staff should be aware that often multiple outfalls may be present in close proximity to one another with longer outfall-free segments between outfall clusters.
- Field verification of potential outfalls identified through office research should take no longer than approximately 30 minutes. When outfalls cannot be located in the field within 30 minutes, field personnel shall document the efforts made and contact their supervisor regarding a possible follow-up investigation. Within the form under the MS4 section (Section 2: Background Data), field personnel should select "Unable to Work" (UTW) as the choice in that data field, with an explanation (e.g., no access, locked entrance, under construction, etc.).
- When inventorying existing outfalls, if the source of the target generation (such as a pond or wetland) has been removed due to construction, or no outfall or POD is found, then a "No Outfall Found" point should be recorded.
- When inventorying existing outfalls, if the target/cluster is in an active construction zone, an "Unable to Work" point should be recorded.
- Although not expected, if maintenance of traffic (MOT) is required in order to be able to safely assess or collect data for an outfall, then the State Stormwater/MS4 Engineer in VDOT's Central Office – L&D Division shall be consulted for approval of such action.
- Once an item is determined to be an outfall, field data collection may begin (data are only collected for confirmed outfalls and PODs). Refer to Appendix C for a list of data to be collected and the proper data format.
- Field data collection should follow the QA/QC procedures identified in this section.

For all outfalls identified in the field, the necessary information will be collected and recorded on a tablet computer or smart phone using the ArcGIS Collector application. The fields that are captured on this application follow the information shown on the ***Outfall Inventory Field Sheet*** provided in Appendix C. This Inventory provides information about the conditions that existed at the site when the field visit was made, outfall descriptive information, and information about any illicit discharges that may be present and the condition of the channel/pipe itself.

A maximum of two digital (*.JPG) photographs may be taken and made part of the data file. The photographs should attempt to capture the outfall setting instead of being a close range shot of the actual outfall. However, close range photographs should be used to document suspected illicit discharges.

8.1 Field Data Quality Review

To ensure that data collection and documentation are performed uniformly by multiple field personnel, randomly selected outfalls shall be field reviewed as part of the process. The data set, including the digital photos and site sketch, should be field reviewed to ensure that documented measurements and observations are accurate, complete, and were performed in accordance with this manual. Quality control efforts shall be initiated in the early stages of the inventory so that corrective actions can be implemented to correct any noted inconsistencies. A more specific QA/QC procedure should be drafted for future reference, outlining the communication flow, information flow and identification of a responsible party for follow up information, data problem resolution, and general inventory questions and clarifications. The outline should be simple and indicate contact information, QA/QC hierarchy, and project responsibilities. VDOT reserves the right to field-verify outfall locations and data collection.