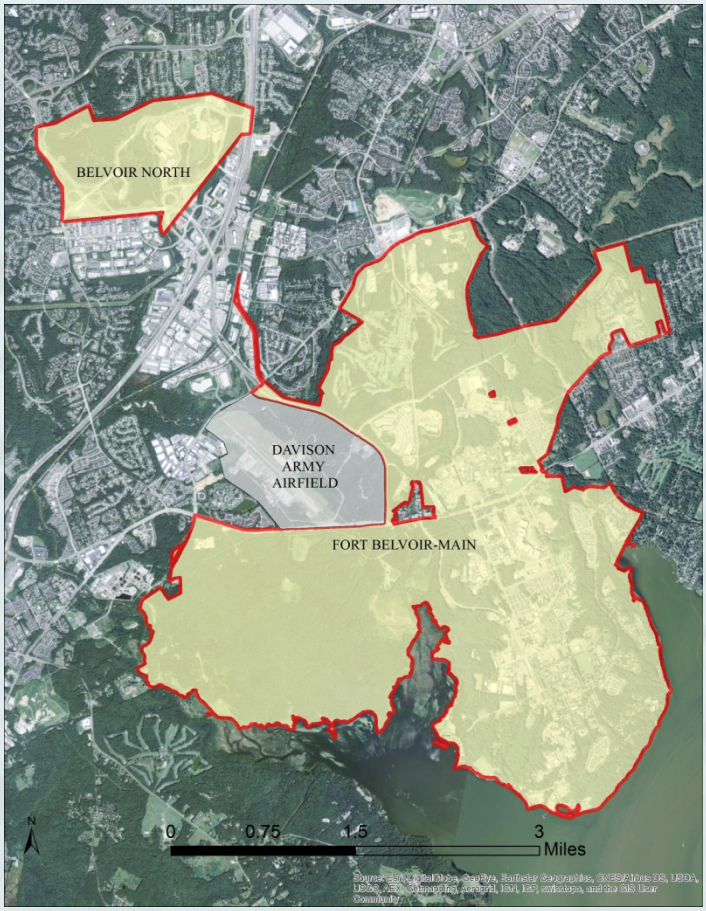
CHESAPEAKE BAY TOTAL MAXIMUM DAILY LOAD (TMDL) STUDY FOR FORT BELVOIR



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July 2015
Revised March 8, 2016

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EXECUTIVE SUMMARY

Introduction

The United States Installation Management Command (IMCOM) tasked the United States Army Corps of Engineers (USACE) to provide technical data pertaining to Chesapeake Bay pollutant load reduction requirements for Fort Belvoir, Virginia.

The Clean Water Act (CWA) established a basic structure for regulating pollutants in United States waters to keep them "fishable and swimmable". The U.S. Environmental Protection Agency (USEPA) established the requirements for state Watershed Implementation Plans (WIPs) as part of a larger Chesapeake Bay Total Maximum Daily Load (TMDL) accountability framework.

There are three pollutants identified as having the greatest impact on the Chesapeake Bay: total nitrogen (TN), total phosphorus (TP), and total suspended solids (TSS). States have identified impaired waters and together with the USEPA, developed a "pollution diet" to restore them. This pollution diet is known as a Total Maximum Daily Load (TMDL), or the amount of pollutant a waterbody can carry and still achieve its designated uses (drinking water, recreation, etc.). The Commonwealth of Virginia utilizes Municipal Storm Water Sewer System (MS4) permits to ensure developed lands achieve nutrient and sediment reduction requirements. This study will satisfy the MS4 Phase II General Permit, Chesapeake Bay TMDL Action Plan requirement (Section I C) and will be submitted to the Virginia Department of Environmental Quality (VADEQ) for its review and acceptance.

Data Collection and Mapping

Land use, stormwater infrastructure and drainage area data were collected and mapped in order to calculate baseline and current load rates for TN, TP, and TSS running off of the Garrison and to determine methods for reducing those pollutant loads.

Field Investigation

Existing infrastructure that is designed to treat stormwater runoff on the Garrison, or Best Management Practices (BMPs) were inventoried, inspected and entered into an Access database. The database was designed as a tracking and record keeping tool to help the Garrison manage their stormwater program over time. It can be used to track required pollutant reductions and to generate annual progress reports.

Establishment of Baseline Pollutant Loads

VADEQ published guidance for pollutant load reduction requirements. They used Chesapeake Bay Program (CBP) models to provide load rates for the Potomac River to be used to calculate Garrison specific baseline load rates using land use data (VADEQ, 2014). Using 2009 land use data and the methods provided in the VADEQ guidance, an estimated 30,597 lbs of TN, 2,227 lbs of TP and 1,455,621 lbs of TSS per year are deposited into waterways from Fort Belvoir.

Pollutant Load Reductions

The Phase I WIP provides a general framework for meeting Chesapeake Bay TMDL requirements. The Phase II WIP provides a more specific plan and schedule for meeting the requirements. It details that based on the 2009 baseline conditions, 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres, and 6 percent of TN loads, 7.25 percent of TP loads and 8.75 percent TSS loads be reduced by the end of the third permit cycle in 2027. This equates to 2,449 lbs of TN, 236 lbs of TP and 265,780 lbs of TSS that need to be reduced from Fort Belvoir per

year by 2027. Five percent of these reductions are required to be completed by the end of the first permit cycle in 2017, and 35 percent are required to be completed by the end of the second permit cycle in 2022.

Fort Belvoir has completed several stream restoration projects, a shoreline management project, land use change, initiated a street sweeping program, and begun design for several more stream restoration projects since the 2009 progress run. The completed/implemented projects far exceed the L2 reduction requirements through 2027 for TN, TP, and TSS.

Costs

Costs to complete the existing projects were not available from the installation POC, as they were a part of larger efforts and not itemized in their respective contracts.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY I

1 INTRODUCTION 1-1
- 1.1 BACKGROUND AND PURPOSE 1-1
- 1.2 STUDY AREA 1-3
- 1.3 REPORT OUTLINE 1-5

2 MS4 PROGRAM AND LEGAL AUTHORITIES 2-1

3 DATA COLLECTION AND MAPPING 3-1
- 3.1 LAND USE 3-1
- 3.2 DRAINAGE AREAS 3-3
- 3.3 STORMWATER INFRASTRUCTURE 3-3

4 FIELD INVESTIGATION 4-1
- 4.1 STORMWATER BMP INVENTORY AND INSPECTION 4-1
- 4.2 STORMWATER BMP DATABASE 4-2

5 ESTABLISHMENT OF BASELINE POLLUTANT LOADS 5-1
- 5.1 METHODOLOGY 5-1
- 5.2 RESULTS 5-1

6 POLLUTANT LOAD REDUCTIONS 6-1
- 6.1 STREET SWEEPING 6-3
- 6.2 LAND USE CHANGE 6-3
- 6.3 SHORELINE MANAGEMENT 6-6
- 6.4 STREAM RESTORATION 6-7
- 6.5 IMPLEMENTATION SCHEDULE 6-11

7 COSTS 7-1

8 CONCLUSIONS 8-1

LIST OF FIGURES

Figure 1-1 Fort Belvoir Location Map 1-3
Figure 1-2 Fort Belvoir MS4 Regulated Area 1-4
Figure 3-1 Land Use Summary for Fort Belvoir 3-3
Figure 3-2 Fort Belvoir BMP Drainage Areas 3-4
Figure 6-1 Land Use Change Sites 6-5
Figure 6-2 Gunston Cove Shoreline Management 6-6
Figure 6-3 Stream Restoration Sites 6-10

LIST OF TABLES

Table 1-1 Data Collected 1-2
Table 1-2 Relating MS4 Permit to this Report 1-5
Table 3-1 Land Use Classifications 3-2
Table 4-1 Stormwater BMP Rating Description 4-1
Table 4-2 BMP Inventory Results 4-2
Table 4-3 BMP Inspection Rating Results 4-2
Table 5-1 Baseline Calculations for Fort Belvoir 5-2
Table 6-1 Pollution Reduction Requirements 6-1
Table 6-2 First Permit Cycle Reductions 6-2
Table 6-3 Reduction Requirements by Permit Cycle 6-2
Table 6-4 Street Sweeping Reductions 6-3
Table 6-5 Land Use Change Reductions 6-4
Table 6-6 Shoreline Management Reductions 6-6
Table 6-7 Completed Stream Restoration Pollutant Reduction at Fort Belvoir 6-8
Table 6-8 Proposed Stream Restoration Reductions 6-9
Table 6-9 Reductions from Street Sweeping, Shoreline Stabilization, and Land Use 6-10

LIST OF APPENDICES

Appendix A: User's Guide for BMP Database

Appendix B: VADEQ Letter of Approval/Revision Documentation

ATTACHMENTS

Project Disc containing:

- GIS Data
- BMP Database
- Digital Report

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LIST OF ACRONYMS

Best Management Practices ..... BMP, 1-2
Chesapeake Bay Program ..... CBP, 3-1
Chesapeake Bay Program Watershed Model ..... CBPWM, 5-1
Clean Water Act ..... CWA, 1-1
Digital Elevation Modeling ..... DEM, 3-2
Edge of sediment ..... EOS, 5-1
Executive Order ..... EO, 1-1
Geographic Information System ..... GIS, 1-2
Global Positioning System ..... GPS, 4-1
Installation Management Command ..... IMCOM, 1-1
Level 2 ..... L2, 1-1
Light Detection and Ranging ..... LiDAR, 3-2
Municipal Storm Water Sewer System MS4, 1-1
National Pollutant Discharge Elimination System ..... NPDES, 1-1
North American Vertical Datum of 1988 ..... NAVD88, 3-1
Pollutants of concern ..... POC, 1-1
Total Maximum Daily Load ..... TMDL, 1-1
Total nitrogen ..... TN, 1-1
Total phosphorus ..... TP, 1-1
Total suspended solids ..... TSS, 1-1
United States ..... US, 1-1
United States Army Corps of Engineers ..... USACE, 1-1
Universal Transverse Mercator ..... UTM, 3-1
Virginia ..... VA, 6-1
Virginia Department of Environmental Quality ..... VADEQ, i
Virginia Pollutant Discharge Elimination System ..... VPDES, 1-4
Watershed Implementation Plans ..... WIP, 1-1

1 INTRODUCTION

1.1 BACKGROUND AND PURPOSE

The Clean Water Act (CWA) established a basic structure for regulating pollutants in United States (US) waters (USEPA, 1972). Despite efforts to comply with these requirements, the Chesapeake Bay continues to fall short of State water quality standards and CWA goals (CBF, 2014). Additional legislation has since been developed to assure the Bay is "fishable and swimmable". The United States Environmental Protection Agency (USEPA) established the requirements for state Watershed Implementation Plans (WIP) as part of a larger Chesapeake Bay Total Maximum Daily Load (TMDL) accountability framework.

Section 303 of the CWA requires States to: establish water quality standards based on achieving their designated uses for that water (drinking, recreation, etc…), develop lists of impaired waters that fail to meet those standards, and estimate the amount of a pollutant that the waterbody can receive and still meet those standards. The amount of a pollutant a waterbody can carry and satisfy its water quality standards is now known as a Total Maximum Daily Load (TMDL).

CWA Section 402 regulates any point sources discharging pollution into U.S. waters through the National Pollutant Discharge Elimination System (NPDES) program. Municipalities with stormwater conveyance systems are required to obtain a Municipal Storm Water Sewer System (MS4) Phase I Individual or Phase II General Permit for coverage under the NPDES program. The Commonwealth of Virginia has chosen to use these permits to enforce the TMDL requirements.

The Chesapeake Bay Protection and Restoration Executive Order (EO) 13508 (FLCC, 2009) describes the Chesapeake Bay as a "national treasure" and intends to bring more accountability to Bay cleanup efforts. In response to the EO, USEPA published guidance for Federal Facilities describing how to comply with the Federal regulations implemented by the States.

In December 2010, USEPA published a TMDL for all impaired segments of the Chesapeake Bay watershed in order to help the States establish load allocations. They determined that total nitrogen (TN), total phosphorus (TP) and total suspended solids (TSS) are the pollutants of concern (POC), causing the most environmental damage to the Chesapeake Bay. They then required those states within the Chesapeake Bay watershed to submit Watershed Implementation Plans (WIPs) detailing how they will achieve TMDL requirements for nitrogen, phosphorus and sediment. The Phase II WIP presented pollutant load reductions, referred to as Level 2 (L2) scoping run reductions requiring of 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres and 6 percent of TN loads, 7.25 percent of TP loads and 8.75 percent TSS loads be reduced by the end of the third MS4 permit cycle.

United States Army Corps of Engineers (USACE) has been tasked by the Installation Management Command (IMCOM) to provide technical data pertaining to the Chesapeake Bay TMDL for

Fort Belvoir. The technical data collected and/or developed during this investigation includes: existing land use; Best Management Practices (BMP) and stormwater infrastructure locations and conditions; contributing drainage area to each stormwater BMP; and baseline pollutant load computations. Table 1-1 provides additional description of the data collected.

TABLE 1-1 DATA COLLECTED

Data	Applicability
Facility Boundary	The facility boundary is the first piece of information to be collected. The facility boundary is needed to begin collecting land use, BMP, and stormwater infrastructure data.
Land Use	A land use category determines the type(s) of practices conducted on that land area. Different practices yield different types and concentrations of pollutants. For example, agricultural land is typically high in nitrogen, due to certain types of fertilizer use.
BMPs and Drainage to BMP	Drainage areas to BMPs were identified, so new BMPs were not proposed to treat overlapping areas.
Stormwater Infrastructure	Stormwater infrastructure data shows how the stormwater is managed within the facility. It was used to delineate BMP drainage areas.

The data collected and developed were used to conduct an opportunity assessment to determine if stormwater BMP retrofits will be favorable to reduce pollutant loads to the Chesapeake Bay. The database on the attached project disk will provide a mechanism for managing data and assisting the localities and states with implementing WIPs. Current, accurate Geographic Information System (GIS) data used to conduct this assessment will also assist Fort Belvoir with future stormwater BMP maintenance and compliance requirements.

This study will satisfy the MS4 Permit, Chesapeake Bay TMDL Action Plan requirement (Section I C) and will be submitted to the VADEQ for review and acceptance.

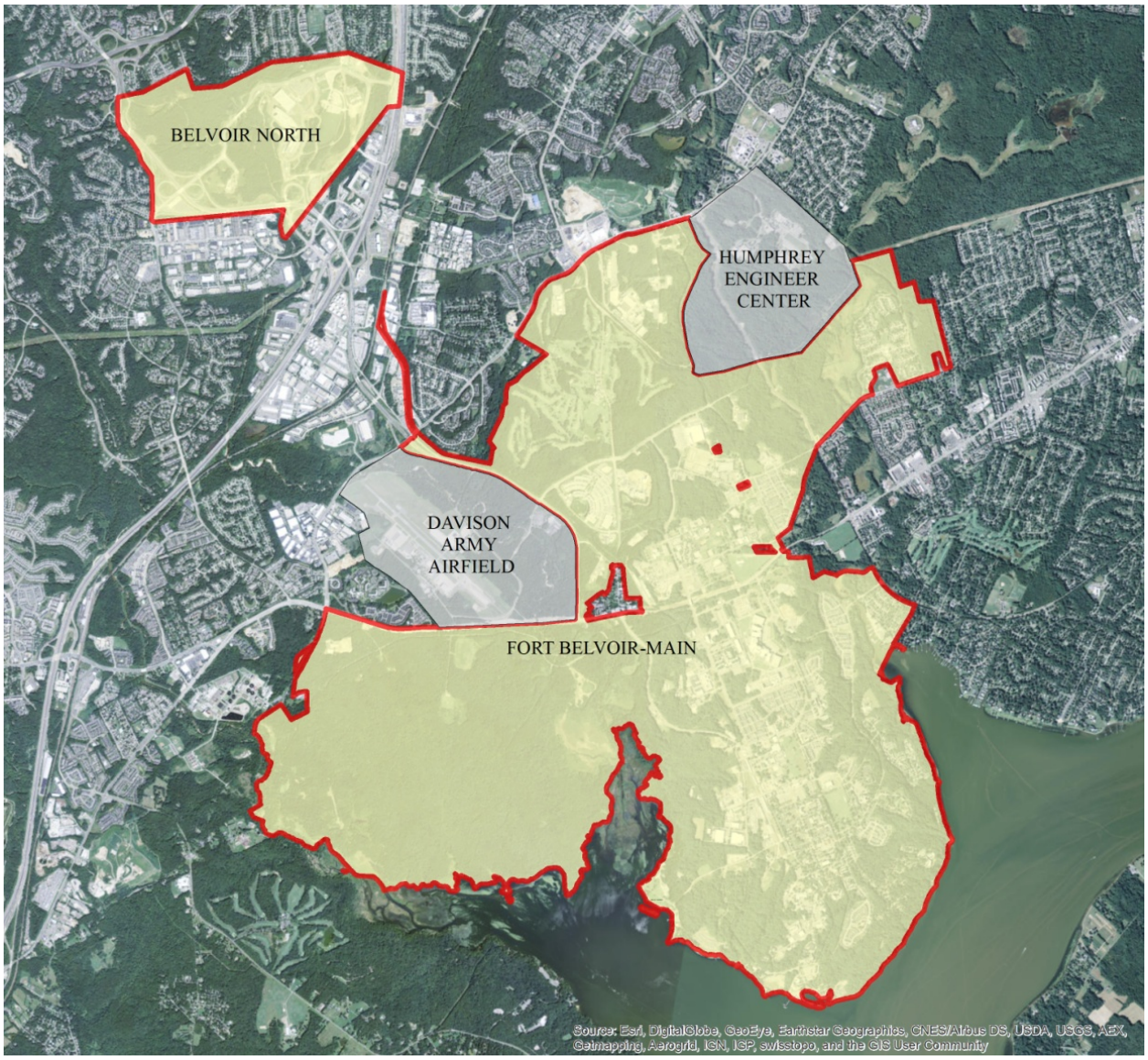
1.2 STUDY AREA

The study area for this investigation is Fort Belvoir, which occupies approximately 9,126 acres in Fairfax County, Virginia. Fort Belvoir is located in the Potomac River watershed, which drains to the Chesapeake Bay (Figure 1-1).

FIGURE 1-1 FORT BELVOIR LOCATION MAP

Approximately 7,840 acres of the Garrison is covered under the Virginia Stormwater Management Program General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4 Permit). Humphrey Engineering Center is owned and operated by USACE, so it is not regulated by the Garrison's MS4 permit. Davison Army Airfield currently is covered under a Virginia Pollutant Discharge Elimination System (VPDES) Industrial Stormwater General Permit #VAR051080 (This General permit will be incorporated into the VPDES Industrial Stormwater Major Permit VAR0092771 once approved by Virginia Department of Environmental Quality.). Therefore, this area is also not considered in this assessment. Belvoir North (805 acres) and the main portion of Belvoir (7035 acres) make up the 7,840 acres regulated by the MS4 permit (Figure 1-2).

FIGURE 1-2 FORT BELVOIR MS-4 REGULATED AREA



1.3 REPORT OUTLINE

The tasks required to complete this study and satisfy General MS4 Permit Section I.C.2.a requirements are described in the following sections of this report. Section 2 reviews the current and future MS4 program and legal authorities (I.C.2.a (1, 2)). Section 3 describes the development of GIS data layers that were used in the calculation of current baseline pollutant loads. Section 4 describes the stormwater BMP database created for Fort Belvoir. Section 5 describes calculation of baseline loads (I.C.2.a (4). Section 6 details the nutrient reduction requirements and a plan to meet those requirements (I.C.2.a (3, 5, 6, 7, 8, and 10). Section 7 explains the costs to complete the reduction requirements (I.C.2.a. (11). Section 8 includes conclusions from this study, which includes details for making this report available for public comment (I.C.2.a. (12)) (Commonwealth of Virginia, 2013).

TABLE 1-2 RELATING MS4 PERMIT TO THIS REPORT

General MS4 Permit Section I.C.2.a subsection*	Section in this report addressing the permit requirement
1,2	Section 2
3,5,6,7,8,10	Section 6
4	Section 5
11	Section 7
12	Section 8

*Subsection 9 is not addressed in this report because it simply states, "The operator shall address any modification to the TMDL or watershed implementation plan that occurs during the term of this state permit as part of its permit reapplication and not during the term of this state permit."

2 MS4 PROGRAM, LEGAL AUTHORITIES AND GRANDFATHERED PROJECTS

The following legal authorities are applicable to Fort Belvoir:

- Clean Water Act
- Virginia Stormwater Management Act
- Virginia Stormwater Management Program Regulations
- Energy Independence and Security Act
- Virginia Department of Environmental Quality Virginia Pollution Discharge Elimination System (VPDES) General Permit for Stormwater Discharges Associated with Industrial Activity, Permit No. VAR051080
- General Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4s), Permit No. VAR040093
- VADEQ POC (Kelsey Brooks) communicated through email on 8/19/2014 that Fort Belvoir "is not subject to Special Condition Requirements 7 and 8 because, as a federal facility, any construction projects completed after June 30, 2009 should have met the construction GPs design standards for post-development stormwater management facilities (.45 lbs P/ac/yr). Essentially, installations do not have grandfathered project.
- MS4 plan Minimum Control Measure #4: Construction Site Stormwater Runoff Control

Sufficient authorities are in place to meet the TMDL requirements. The provisions contained in the MS4 Permit and associated regulations will be enforced through Fort Belvoir policy memorandums and standardized procedures for project review and implementation. An installation-wide stormwater policy is currently being developed to address compliance with the MS4 Permit, the industrial stormwater permit and other stormwater regulations. The policy will outline proper protocols for minimizing stormwater pollution during activities that directly and indirectly impact water quality of the receiving waters. We anticipate full implementation in calendar year 2016. In addition, there are sufficient provisions incorporated into the Army funding process when projects are proposed for funding. Projects directly associated with legal requirements are given a higher priority ranking in the funding request than projects with no legal requirements.

3 DATA COLLECTION AND MAPPING

GIS was used to create, analyze and plan all geographically related information. These data were created as shapefiles, which can be used to accurately measure the spatial area needed to perform land use and load reduction calculations. Each data set is in Universal Transverse Mercator (UTM) Zone 18 North American Vertical Datum of 1988 (NAVD88) horizontal coordinate system.

3.1 LAND USE

Accurate land use data is essential for baseline and reduction load calculations. Considerable effort was made to collect and develop the most accurate data and categorize it in two different ways for multiple uses. Virginia TMDL Guidance classification was necessary for Action Plan calculations; Chesapeake Bay Program (CBP) classifications will be used for model runs.

Land use polygons were attributed with land uses relevant to Virginia Guidance calculations (i.e. regulated urban impervious and regulated urban pervious). The polygons were also attributed using the same categories of land cover as those used by the CBP and their watershed model (construction, forest, hay, hay with nutrients, high intensity impervious urban, high intensity pervious urban, low intensity impervious urban, high intensity pervious urban, unfertilized grass, and water). In addition, USEPA and VADEQ requested historic land use data as part of the "Historic Data Call" in order to update the CBPWM for the jurisdictional (VADEQ) progress run and eventually feed into the 2017 CBPWM interim run. The Chesapeake Bay Land use group established revised land use categories in 2015 and all the land use polygons were assigned the proper category under Historic Data Call land use (see Table 3-1).

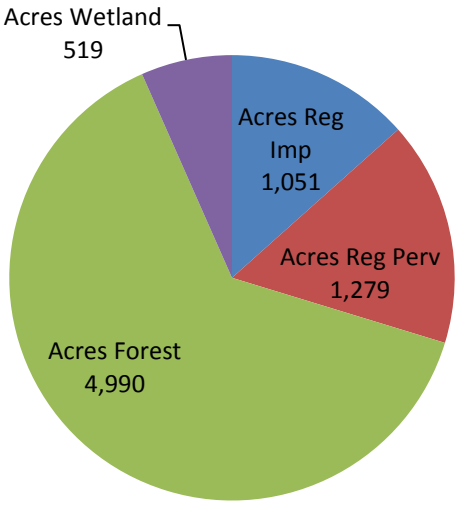
USEPA required each state to submit guidance for how to achieve the goals set forth in the WIP. Virginia Department of Environmental Quality provided draft guidance to USACE in 2013, which provided instructions to permittees for estimating pollutant source loads as of June 30, 2009 (DEQ, 2015). Before guidance was released setting 2009 as the baseline year, land use layers were developed using the most up to date information at the time (2013 aerial imagery). In response to that draft guidance, existing land use was digitized using the 2009 aerial imagery. As a result, land use layers were developed for both 2009 and 2013 conditions and will be provided in the attached project disk. The digitized imagery was used to calculate baseline load rates and the baseline load rates were then used to establish L2 reductions (see Section 5-1).

TABLE 3-1 LAND USE CLASSIFICATIONS

VA Land Use	CBP Land Use	Historic Data Call Land Use	General Description
Regulated Urban Impervious	High/Low Intensity Impervious Urban	Regulated Impervious Developed	Building, road, parking
Regulated Urban Pervious	High/Low Intensity Pervious Urban	Regulated Pervious Developed	Beach, gravel, lawn, shrubs
N/A	Construction	Regulated Construction	Bare earth
N/A	Forest	Forest	Forest, wetland
N/A	Hay	Hay without nutrients	Row crops, not fertilized
N/A	Hay with nutrients	Hay with nutrients	Row crops, fertilized
N/A	Unfertilized grass	N/A	Brush
N/A	Water	Water	Water
		Non-regulated impervious developed	Building, road, parking
		Non-regulated pervious developed	Beach, gravel, lawn, shrubs

Although Belvoir has approximately 7,840 regulated acres, only urban impervious and urban pervious land uses contribute to pollutant load rates. Approximately 13 percent of Fort Belvoir's 7,840 regulated acres is categorized as urban impervious land cover. This includes building rooftops, parking areas, sidewalks, and recreational courts. An estimated 16 percent is categorized as regulated urban pervious land cover, or beach, gravel, lawn, or shrubs. Forest and wetlands comprise 71 percent of regulated land on the Garrison, but does not contribute to baseline load rates (Figure 3-1 Land Use Summary for Fort Belvoir).

FIGURE 3-1 LAND USE SUMMARY FOR FORT BELVOIR



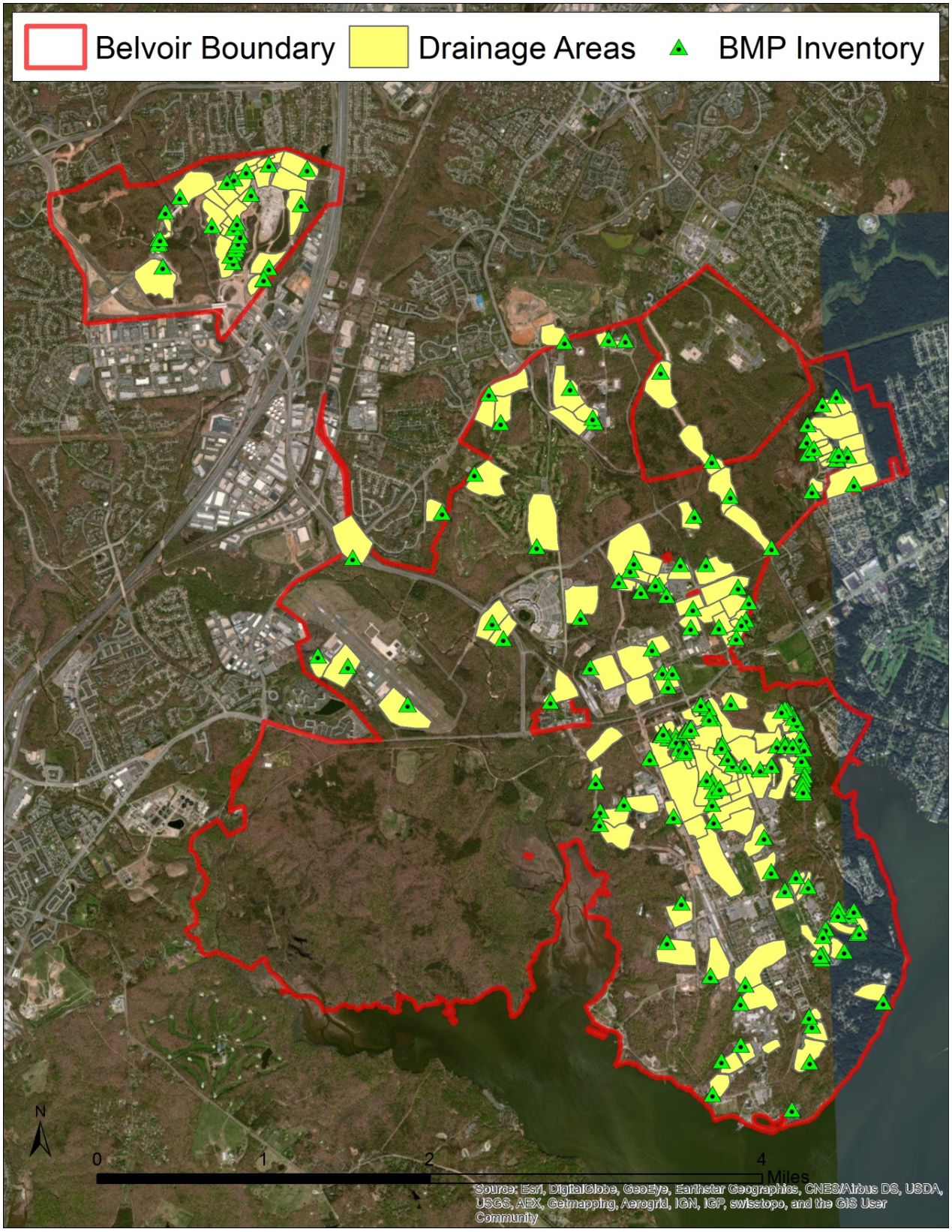
3.2 DRAINAGE AREAS

Drainage areas were delineated using light Detection and Ranging (LiDAR) data, Digital Elevation Modeling (DEM), topographic contours and 2009 aerials. BMPs were delineated to include all stormwater conveyed to them through existing infrastructure. These areas were portrayed as polygons in GIS (Figure 3-2 Fort Belvoir BMP Drainage Areas). Once these individual watersheds were identified, they were excluded from consideration for new BMP treatment opportunities.

3.3 STORMWATER INFRASTRUCTURE

The stormwater layers used for this investigation were prepared by Stantec and provided by the Garrison. Separate shapefiles were created for stormwater lines, points and BMPs. Storm lines were categorized as either piped lines or open drainage. Storm points were categorized as inlets or discharges. All GIS data created for this project and its analyses are included on the attached project disk.

FIGURE 3-2 FORT BELVOIR BMP DRAINAGE AREAS



4 FIELD INVESTIGATION

Two contractors, Paciulli, Simmons and Associates and Stantec performed BMP inventories and inspections between 2010 and 2014.

4.1 STORMWATER BMP INVENTORY AND INSPECTION

Several pieces of data were compiled for each stormwater BMP. A field team documented the type of BMP installed and the geographic location, using Global Positioning System (GPS) technology. Visual assessments of the condition of the BMPs were performed using The Virginia Stormwater Management Handbook (DCR, 1999). Digital photographs were also taken to document the location and condition of the BMP at the time of the inventory and assessment.

The end product of the stormwater BMP inventory and inspections is the Fort Belvoir BMP database, which is discussed in Section 4.2. Based upon the results of the field inspections, an overall rating was assigned to each stormwater BMP. A description of the stormwater BMP ratings are provided in Table 4-1 Stormwater BMP Rating Description. These ratings will assist the Garrison in prioritizing maintenance and improvement activities for each stormwater BMP.

TABLE 4-1 STORMWATER BMP RATING DESCRIPTION

Rating	Description
A	The BMP is functioning as designed with no problem conditions identified. No signs of impending deterioration.
B	Minor problems are observed, however BMP is functioning as designed with no problem conditions in critical parameters.
C	Minor problems are observed, however BMP is functioning as designed with no problem conditions in critical parameters, but BMP performance is being compromised.
D	Major problems are observed and BMP is not functioning as designed with problem conditions in several critical parameters. Conditions have compromised the BMP performance.
E	Major problems are observed and BMP is not functioning as designed with problem conditions in several critical parameters. Conditions have compromised the BMP performance. BMP shows signs of impending failure.

The location and type of BMPs were recorded for 230 stormwater BMPs that were identified within the study area (Table 4-2 BMP Inventory Results). Stantec inspected 106 of those BMPs in March and April of 2014 and assigned ratings based on their condition. A description of these ratings is shown in Table 4-3 BMP Inspection Rating Results. The BMPs inspected before 2014 will need to have updated inspections performed.

TABLE 4-2 BMP INVENTORY RESULTS

BMP type	Number
Bioretention	37
Cistern	1
Extended Detention Basin	5
Dry Basin	34
Filter Strip	1
Green Roof	6
Hydrodynamic Device	2
Infiltration Basin	75
Other	5
Permeable Pavers	4
Pipe Detention	13
Sand Filter	3
Grassed Swale	1
Tree Box Filter	24
Wet Basin	19

TABLE 4-3 BMP INSPECTION RATING RESULTS

Rating	Number
A	54
B	57
C	17
D	7
E	1

4.2 STORMWATER BMP DATABASE

The data collected from the field assessments was used to create the Fort Belvoir BMP Database. The BMP Database serves as a tracking and record keeping tool, and can also be used to determine the pollutant reductions provided by implementing various BMPs. The BMP Database can be used to create a map of all BMP locations within the Garrison, by exporting to a GIS shapefile. The database is in a Microsoft Access format, with forms containing all the inspection results and a digital photograph of each BMP. Should the Garrison implement any additional stormwater BMPs, the database can be expanded so Garrison staff can use it to manage their stormwater program over time. A brief user's guide for the BMP Database is located in Appendix A. In addition, USEPA and VADEQ requested historic BMP data as part of the "Historic Data Call" in order to update the CBPWM for the jurisdictional (VADEQ) progress run and eventually feed into the 2017 CBPWM interim run. All stormwater BMP data was submitted using the appropriate VADEQ provided spreadsheet format. The stormwater BMP spreadsheet has been incorporated into the Fort Belvoir BMP Database as an export function.

5 ESTABLISHMENT OF BASELINE POLLUTANT LOADS

Knowledge of baseline (existing) loading conditions for TN, TP and TSS is needed to guide the facilities in their management and implementation of stormwater BMPs to meet the overall Chesapeake Bay TMDL pollution reduction requirements. The Chesapeake Bay Program Watershed Model (CBPWM) is a macro-scale model that did not use the high level detail land use and Garrison boundary data that was collected in this study. Therefore, independent calculations of baseline pollutant loads, using the best data available, was needed to better understand the actual baseline pollutant contribution from Fort Belvoir and what level of improvements, if any, are needed to meet overall Chesapeake Bay TMDL goals.

5.1 METHODOLOGY

Tables provided in the Virginia TMDL Guidance were used to calculate pollutant load rates from Fort Belvoir (VADEQ, 2014). This approach uses tables with established "Edge of Stream" (EOS) loading rates for pervious and impervious land uses in each of the four regional river basins within the Chesapeake Bay watershed – James River, Potomac River, Rappahannock River, and York River. The total existing acreage for each site is then input into the appropriate table and multiplied by the 2009 EOS loading rate to determine the estimated baseline loads.

5.2 RESULTS

Fort Belvoir's regulated area falls within the Potomac River watershed. Figure 5-1 shows the "Calculation Sheet for Estimating Existing Source Loads for the Potomac River Basin" from the VA TMDL Guidance completed with the total existing acres of regulated urban impervious and pervious land uses served by Fort Belvoir's MS4 permit and the resulting POC loads calculated by applying the rates provided by VADEQ in the fourth column (DEQ, 2015).

TABLE 5-1 BASELINE CALCULATIONS FOR FORT BELVOIR

	Pollutant	Total Existing Acres Served by MS4 (06/30/09)	2009 EOS Loading Rate (lbs/acre)	Estimated Total POC Load Based on 2009 Progress Run
Regulated Urban Impervious	Nitrogen	1,050.73	16.86	17,715.31
Regulated Urban Pervious		1,279.20	10.07	12,881.54
Regulated Urban Impervious	Phosphorus	1050.73	1.62	1,702.18
Regulated Urban Pervious		1279.20	0.41	524.47
Regulated Urban Impervious	Total Suspended Solids	1050.73	1,171.32	1,230,741.06
Regulated Urban Pervious		1279.20	175.8	224,883.36

Table 2 b: Calculation Sheet for Estimating Existing Source Loads for the Potomac River Basin (Based on Chesapeake Bay Program Watershed Model Phase 5.3.2) (VADEQ, 2014)

6 POLLUTANT LOAD REDUCTIONS

L2 scoping run reductions, presented in the Phase II WIP and enforced through the MS4 permit equate to a reduction of 9 percent of TN loads, 16 percent of TP loads, and 20 percent of TSS loads from impervious regulated acres and 6 percent of TN loads, 7.25 percent of TP loads and 8.75 percent TSS loads beyond 2009 progress loads for pervious regulated acreage by the end of the third permit cycle - 2027 (see Table 6-1). Virginia (VA) TMDL Guidance provides flexibility in the implementation of specific management technologies employed to meet the required reductions, while stipulating standards and/or objectives. MS4 operators will be able to adjust the levels of reduction between pervious and impervious land uses within their service area, provided the total load reduction for each pollutant is met (DEQ, 2015).

BMPs accepted as methods of reducing pollutant loads for TMDL requirements include: street sweeping, urban stream restoration, shoreline restoration, land use change, structural BMPs, urban nutrient management, and nutrient trade. Street Sweeping is credited based on lane miles swept per year. Permittees may receive credit for urban stream restoration, based on linear footage of restoration completed. Shoreline restoration efficiencies are in review by CBP. The methodology under review is based on linear footage of shoreline restored and was used to calculate reductions in this report (Drescher, 2014). Conversion of land use from impervious to pervious or forest land may also receive POC reductions credits based on the acreage changed and type of change. Urban nutrient management plans developed for unregulated, public land smaller than one acre where nutrients are applied may be considered for credit, but have not been developed at Fort Belvoir. Permittees may also offset pollutant loads trading non-point source nutrients in accordance with Virginia Code (DEQ, 2015).

Offsets for new sources of POCs initiating construction after 2009 are also required in VA TMDL Guidance. No new sources of POCs should occur on Fort Belvoir because The Energy Independence and Security Act of 2007 requires that development on a federal facility should be designed to return the area of construction to predevelopment hydrological conditions.

TABLE 6-1 POLLUTION REDUCTION REQUIREMENTS

Pollutant	Regulated Acreage % Load Reduction Target	
	Impervious	Pervious
TN	9%	6%
TP	16%	7.25%
TSS	20%	8.75%

Table 6-2 shows the first permit cycle reductions utilizing the "Calculation Sheet for Determining Total POC Reductions Required during the Permit Cycle for the Potomac River Basin" provided in the VA TMDL Guidance completed with total existing acres served by Fort Belvoir's MS4 permit for regulated urban impervious and pervious land uses and the resulting reduction required by applying the reduction loading rate provided in the fourth column (DEQ, 2015).

TABLE 6-2 FIRST PERMIT CYCLE REDUCTIONS

Subsource	Pollutant	Total Existing Acres Served by MS4 (06/30/09)	First Permit Cycle Required Reduction in Loading Rate (lbs/acre/yr)	Total Reduction Required First Permit Cycle (lbs/yr)[8]
Regulated Urban Impervious	Nitrogen	1,050.73	0.08	84.06
Regulated Urban Pervious		1,279.20	0.03	38.38
Regulated Urban Impervious	Phosphorus	1050.73	0.01	10.51
Regulated Urban Pervious		1279.20	0.001	1.28
Regulated Urban Impervious	Total Suspended Solids	1050.73	11.71	12,304.05
Regulated Urban Pervious		1279.20	0.77	984.98

Table 3 b: Calculation Sheet for Determining Total POC Reductions Required During the Permit Cycle for the Potomac River Basin (*Based on Chesapeake Bay Program Watershed Model Phase 5.3.2)

Using 2009 progress run, estimated pollutant loads were applied to the load reduction targets to calculate pollutant load reductions required for each of the three permit cycles at Fort Belvoir, shown in Table 6-3.

TABLE 6-3 REDUCTION REQUIREMENTS BY PERMIT CYCLE

Pollutant	First Permit Cycle Reductions (lbs) 5% by 2017	Second Permit Cycle Reductions (lbs) 35% by 2022	Third Permit Cycle Reductions (lbs) 100% by 2027
TN	122.44	857.04	2,448.68
TP	11.79	82.51	235.73
TSS	13,289.03	93,023.04	265,780.12

6.1 STREET SWEEPING

Fort Belvoir has an existing street sweeping program executed by a contractor already in place. The Garrison POC provided aggregate square yardage of street and parking area swept per year, the schedule, and the type of equipment used. The Qualifying Street Lanes Method was used to calculate the pollutant reductions.

Fort Belvoir has an operations and maintenance contractor using a regenerative vacuum sweeper to conduct street sweeping for roads and parking lots monthly. The contract specifies that 6,168,127 square yards of roadway and 6,832,433 square yards of parking lots being swept annually or a total of 13 million square yards. This equates to 2,686 acres per year. The VA TMDL Guidance provides a pre-sweeping annual nutrient load of 15.4 lbs/impervious acre/yr for TN, 2 lbs/impervious acre/yr of TP, and 1,300 lbs/impervious acre/yr for TSS. The pickup factors for this type of sweeper are 0.05 lbs per year of TN, 0.06 lbs per year of TP and 0.25 lbs per year of TSS. Impervious acres swept per year were multiplied by the pre-sweeping annual nutrient load rates (where provided), then by the pickup factors supplied in the guidance to get the reductions per year shown in Table 6-4 Street Sweeping Reductions (DEQ 2015).

TABLE 6-4 STREET SWEEPING REDUCTIONS

Pollutant of Concern	A. Acres/Year Swept	B. Pickup Factors*	C. Pre-Sweeping Annual Nutrient Load**	Reductions in lbs/yr (A x B x C)
TN	2,686	0.05	15.4	2,068.22
TP	2,686	0.06	2.0	322.32
TSS	2,686	0.25	1300***	872,950

*Chesapeake Stormwater Network (CSN) Technical Bulletin #9
**CSN Technical Bulletin #9
***Per email dated 2/26/2016, VADEQ determined after additional conversations with the Bay Program that the estimated TSS loading rate for the qualifying street lanes method should be 1,300 lbs TSS/acre/year.

6.2 LAND USE CHANGE

There are nine sites on Belvoir North and seven sites on main portion of the Garrison where land use change can be counted for pollution reduction credits (Figure 6-1 Land Use Change Sites). Several areas of disturbed land associated with a large development project on Fort Belvoir North Area were planted with pine seedlings at a rate of 500 trees per acre in 2013, which counts for a pervious to forest land use conversion. Road segments in both the main portion of the Garrison and Belvoir North which were no longer needed due to Base Realignment and Closure (BRAC) activities and as a result these road segments were converted to a pervious land use between 2010 and 2013. At Belvoir North, the road segments were planted with a 300 seedling per acre concentration. This does not meet the density requirements to count for reforestation, so impervious to pervious land use change

reductions were used. Road segments in the main portion of the installation were planted with grass and counted as an impervious to pervious land use change (Table 6-5 Land Use Change Reductions). Land use change conversion efficiencies from the VA TMDL Action Plan Chesapeake Bay TMDL Special Condition Guidance were used to calculate the reductions in Table 6-5.

TABLE 6-5 LAND USE CHANGE REDUCTIONS

		Conversion Efficiencies			Reductions		
Area (AC)	Type	TN	TP	TSS	TN	TP	TSS
2.88	impervious to grass	12.56	1.34	623.28	36.17	3.86	1,795.05
1.65	impervious to pervious	6.75	1.42	1119.05	11.14	2.34	1,846.43
23.71	pervious to forest	7.16	0.38	132.96	169.76	9.01	3,152.48
TOTAL LAND USE CHANGE REDUCTIONS					**217.07**	**15.21**	**6,793.96**

FIGURE 6-1 LAND USE CHANGE SITES

6.3 SHORELINE MANAGEMENT

Pollutant load reductions from shoreline restoration were calculated using research submitted to the CBP expert panel for review in August 2015 (Drescher, 2014). No approved rates were provided in the VA TMDL Guidance. Protocol #1 from CBP Shoreline Restoration Expert Panel Report was used to determine the appropriate loading rates. In cases when the shoreline management parameters are unavailable for the protocols recommended by the panel, such as in some planning efforts, historic projects and/or noncomforming projects, the Water Quality Technical Working Group (WTWG) recommends that default reduction values be used. For Total Suspended Solids (TSS), the default loading rate of 42 lbs/yr was used to determine reductions.[1]

Protocol 1: Prevented Sediment - This protocol provides an annual mass nutrient and sediment reduction credit for qualifying shoreline management practices that prevent tidal shoreline erosion that would otherwise be delivered to near shore/downstream waters. The pollutant loads are reduced for sand content and bank instability. The following loading rates were used (lbs/yr): TN = 0.075, TP= 0.068, TSS = 42. Figure 6-2 shows 500 linear feet of shoreline restoration was completed at Gunston Cove in Summer 2010.[2] The linear footage (500) was multiplied by the loading rates to capture the reduction values. This project reduces TN deposition by 37.5 lbs per year of TN, 34 lbs per year of TP and 21,000 lbs per year of TSS. Shoreline management reductions are summarized in Table 6-6.

TABLE 6-6 SHORELINE MANAGEMENT REDUCTIONS

Pollutant of Concern	A. Shoreline Restoration LF	B. Loading Rate*	Reductions in lbs/yr (A x B)
TN	500	0.075	37.5
TP	500	0.068	34
TSS	500	42	21,000

*Chesapeake Bay Expert Panel on Shoreline Management Report dated July 13, 2015.[3]

[1] Language clarifying use of default loading rate for TSS added on September 27, 2016. (Brooks, 2016)
[2] Language clarifying date the shoreline stabilization was completed was added on September 27, 2016. (Brooks, 2016)
[3] Language clarifying where loading rates were obtained was added on September 27, 2016. (Brooks, 2016)

FIGURE 6-2 GUNSTON COVE SHORELINE MANAGEMENT

6.4 STREAM RESTORATION

Streams are periodically evaluated for stability and potential impacts to essential infrastructure. Based on the evaluations, the streams are then ranked. Streams where rapid erosion is occurring and/or is potentially adversely impacting vital infrastructure (i.e. water and wastewater lines, roads, facilities and other utilities) are ranked higher than other streams. The evaluation includes photographic documentation of the stream systems, evaluation of watershed influences, if applicable, and identification of potential impacts to vital infrastructure. Potential future development impacts, including stormwater management issues, contamination issues, and constructability are also being taken into account when ranking the stream systems for potential and priority for restoration. For streams that are candidates for restoration, the U.S. Environmental Protection Agency Rapid Bio assessment Protocol is being used for further evaluation. Since 2013, Fort Belvoir has also used the Bank Assessment for Non-point source Consequences of Sediment (BANCS) method to quantitatively predict streambank erosion rates for each stream evaluation. Future projects listed in Table 6-7 as Totten Road and Dewitt utilized the BANCS method during the evaluation. Based on all available information, priorities are re-evaluated and then submitted for design funding and construction.

The nature of the degradation for all projects listed in this study consisted of severe down cutting and widening of the stream bed because of severe erosion. Down cutting often

exposes buried utility lines and stream widening threatens and undermines existing infrastructure.

Natural stream design is being employed and takes into consideration the site conditions and any known proposed changes in flows. All of the completed projects qualified for Nationwide Permit 27, Aquatic Habitat Restoration, Establishment and Enhancement Activities.

Fort Belvoir POCs provided information on stream restoration projects completed between 2009 and 2015. A USACE stream restoration specialist and the installation POCs provided information on the proposed stream restoration projects not yet implemented. Fort Belvoir provided data for three stream restoration projects completed since the 2009 CBPWM progress run. In 2009, restoration was completed for a 2,671 linear foot stream site near a hospital on the Garrison. In 2011 1,200 linear feet of stream restoration was completed at the North Area, known as the North Area Infrastructure Roads site. In 2015, 695 linear feet of street restoration was completed at Meade Road. Together, 4,566 linear feet of stream restoration has been completed at Fort Belvoir since the 2009 CBPWM progress run (Figure 6-3). Using the table provided in the Virginia TMDL Guidance and removal rates for restoration in the coastal plain (TN Removal Rate = 0.075; TP Removal Rate = 0.068; TSS Removal Rate = 15.13), the 4,566 linear feet of stream restoration completed at Fort Belvoir resulted in a reduction of 342 lbs of TN, 310 lbs. of TP and 69,084 lbs of TSS, as shown in Table 6-7 (VADEQ 2014).

TABLE 6-7 COMPLETED STREAM RESTORATION POLLUTANT REDUCTION AT FORT BELVOIR

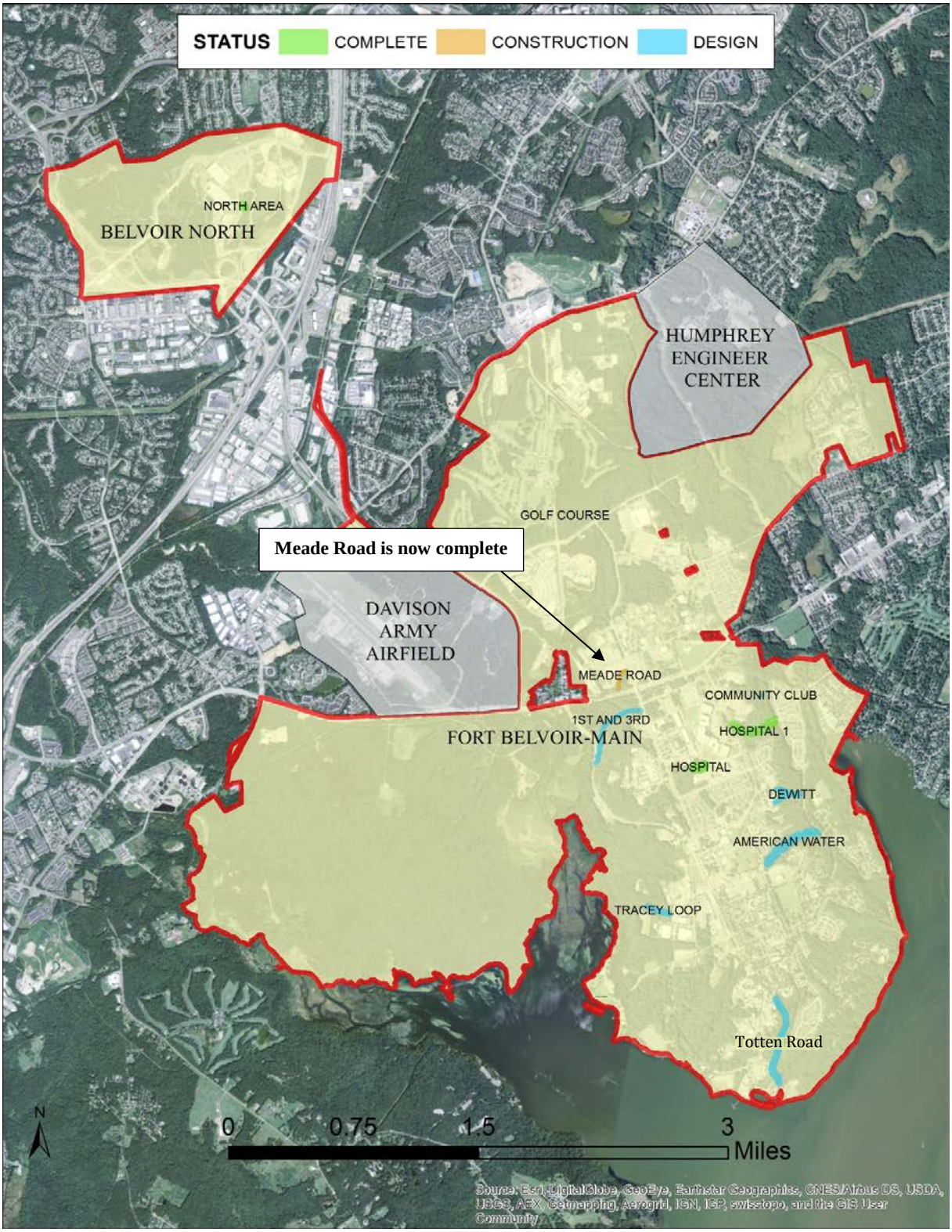
		Reductions from Completed Stream Restoration (lbs/yr)		
Site	Segment Length (lf)	TN	TP	TSS
Hospital	2,671	200.33	181.63	40,412.23
North Area	1,200	90.00	81.60	18,156.00
Meade	695	52.13	47.26	10,515.35
Total	**4,566**	**342**	**310**	**69,084**

In addition to the stream restoration already completed at Fort Belvoir, eight new sites where stream restoration is needed have been identified and are in the preliminary stages of design. The proposed stream restorations listed in Table 6-7 are contingent upon availability of funds since not all of the proposed stream restorations are required to meet pollutant load reductions by the end of the third permit cycle in 2027. The eight sites identified total more than 21,000 linear feet of stream restoration. Implementation of these projects will result in the following reductions: 1,585 lbs per year of TN, 1,437 lbs per year of TP and 319,768 lbs per year of TSS (Table 6-8).

TABLE 6-8 PROPOSED STREAM RESTORATION REDUCTIONS

		Reductions from Proposed Stream Restoration (lbs/yr)		
Site	Segment Length (lf)	TN	TP	TSS
Totten Road	3,780.31	283.52	257.06	57,196.03
American Water	2,192.67	164.45	149.10	33,175.10
Hospital	407.49	30.56	27.71	6,165.28
Dewitt	3,148.41	236.13	214.09	47,635.41
First and Third	2,809.63	210.72	191.05	42,509.70
Tracey Loop	1,486.36	111.48	101.07	22,488.63
Community Club	1,525.07	114.38	103.70	23,074.31
Golf Course	5,784.77	433.86	393.36	87,523.57
Total	**21,134.70**	**1,585.10**	**1,437.16**	**319,768.03**

FIGURE 6-3 STREAM RESTORATION SITES



6.5 IMPLEMENTATION SCHEDULE

VA TMDL Guidance provides a timeline for when these pollutant load reductions must be implemented, as described in Table 6-8.

Of the total reductions required by 2027, the street sweeping program implemented satisfied 84% of the TN requirements, 136% of the TP requirements, and 328% of TSS requirements. Stream restoration completed satisfies 14% of the TN, 131% for the TP and 26% of the TSS required. Land use change satisfies 9% of the TN requirements, 6% of the TP requirements, and 3% of the TSS requirements. Shoreline management satisfies 2% of the TN requirement, 14% of the TP requirement, and 8% of the TSS requirement. Shoreline Stabilization and proposed stream restoration are above and beyond the required pollution reduction requirements. Overall reduction goals are summarized in Table 6-9.

TABLE 6-9 REDUCTIONS FROM STREET SWEEPING, LAND USE CHANGES, SHORELINE STABILIZATION AND STREAM RESTORATION

Cumulative Load Reduced / Required			Percent of Total Goal		
TN	TP	TSS	N	P	TSS
2,665 / 2,449	682 / 236	969,828 / 265,780	**109%**	**289%**	**365%**

7 COSTS

Since the projects needed to satisfy the first and second permit cycles are already complete, planning level costs are not necessary and are not included in this report. Costs for the completed projects were part of a larger effort and itemized costs for the part of the project relevant to the pollution reduction efforts mentioned in this report were not available per the Garrison POC.

8 CONCLUSIONS

The purpose of this study is to provide technical data pertaining to the Chesapeake Bay TMDL Action Plan for Fort Belvoir. This was executed by locating, inventorying, and assessing the condition of existing stormwater BMPs, quantifying source loads for TN, TP, and TSS within the Garrison boundary and identifying opportunities to reduce pollutant loads to the Chesapeake Bay.

The results of this investigation concludes that approximately 30,600 lbs of TN, 2,200 lbs of TP and 1.46 million lbs of TSS are loaded into waterways from Fort Belvoir per year, based on 2009 land use data. Fort Belvoir must reduce their nutrient loads by approximately 2,500 lbs of TN, 236 lbs of TP and 265,800 lbs of TSS by the end of the third MS4 permit cycle in 2027.

The completed/implemented projects far exceed the L2 reduction requirements through 2027 for TN, TP and TSS. Therefore, no additional BMPs are required to be implemented to meet pollutant reduction goals.

The Fort Belvoir stormwater BMP database was created to store and organize data collected from the BMP inventory and inspection conducted as a part of this study; it also provides the Garrison with a tool to track L2 reduction progress and generate annual progress reports.

The installation Point of Contact (POC) posted this document on the Fort Belvoir Home Page (http://www.belvoir.army.mil/environdocs.asp) on October 19, 2015. A Notice of Availability was posted on the Fort Belvoir DPW stormwater Facebook page on the main Fort Belvoir Facebook page November 10, 2015 and the Notice of Availability for the document was published in the Fort Belvoir newspaper, the Belvoir Eagle, on November 5, 2015. The public review period closed on December 5, 2015. There were no public comments received.

The POC is Mr. Felix M. Mariani, Chief, Environmental and Natural Resources Division, at 703-806-3193 or email: felix.m.mariani3.civ@mail.mil. Technical POC is Ms. Pamela Couch, Stormwater Program Manager, Environmental and Natural Resources Division, at 703-806-3406 or email: Pamela.j.couch2.civ@mail.mil.

USEPA and VADEQ requested historic land use, boundary and BMP data as part of the "Historic Data Call" in order to update the CBPWM for the jurisdictional (VADEQ) progress run and eventually feed into the 2017 CBPWM interim run. All data has been submitted to VADEQ using the appropriate spreadsheets provided by VADEQ and approved by USEPA.

APPENDIX A

User's Guide for BMP Database

STORMWATER BMP DATABASE USER GUIDE

TABLE OF CONTENTS

1.0 INSTALLATION AND BACKUP INSTRUCTION 3

1.1 DATABASE STORAGE AND INSTALLATION 3

1.2 PHOTO STORAGE 3

2.0 SWITCHBOARD 4

2.1 SWITCHBOARD FORM 4

3.0 INVENTORY 5

3.1 INVENTORY FORM 5

3.1.1Background Data for "non-basin" BMPs: 6

3.1.2 General Data for "Basin" BMPs: 8

3.1.3 Locational and Cost Information: 9

3.1.4 Adding Photo or other Documents: 9

3.1.5 TMDL Information: 10

3.1.6 Other Inventory Functions: 11

3.1.7 Inventory Summary: 11

4.0 INSPECTION FORM 12

4.1 INSPECTION FORM 12

4.1.1 Creating a BMP Inspection: 12

4.1.2 Conducting an Inspection: 13

4.1.3 Maintenance Section: 14

4.1.4 Other Inventory Functions: 15

4.1.5 Inspection Summary: 15

5.0 TMDL FORM 16

5.1 TMDL FORM 16

5.1.1 Getting Started: 17

5.1.2 Modeling Data Input: 17

5.1.4 VADEQ TMDL ACTION PLAN L2 % REDUCTION: 19

6.0 REPORTS AND RESOURCES 20

6.1 REPORTS 20

6.2 RESOURCES 21

6.3 LINKS 22

6.4 REPORTS AND RESOURCES SUMMARY 22

7.0 BMP DEFINITION LIST 23

7.1 FILTRATION: 23

7.2 INFILTRATION: 28

7.3 MANUFACTURED: 31

7.4 MISCELLANEOUS: 33

7.4 BASIN: 35

1.0 INSTALLATION AND BACKUP INSTRUCTION

1.1 DATABASE STORAGE AND INSTALLATION

The BMP database should be placed in a single centralized location. Ideally, the database will be stored on a server, rather than on a local computer's hard drive. Users should take care to make sure that multiple versions of the database do not exist. If a user must work on the database off of the network the following steps should be taken:

- Download the database to the computer that will be used offline.
- Verify that no users will be editing the database during the time that the user is working offline with the database.
- Upon finishing the offline editing, copy the database back to the server, overwriting the current database stored on the server.
    - Prior to overwriting the database the user may wish to copy the database into a backup folder. This may not be necessary if data is automatically backed up by the network administrators.

1.2 PHOTO STORAGE

Access databases are limited to a maximum storage size of 2 gigabytes (GB). The attachment field, which is where the photos and other documents can be stored, is the field most likely to impact the size of the database. In instances where it is likely that the total size of the database will exceed 2 GB the following steps should be taken to separate the photos from the database itself.

- Set up a location on a centralized server where the photos will be stored.
- Apply a standardized process for naming photos, for example the names for all photos for a BMP with SWMID ABC12 begin with ABC12.
- Create a field within the database and corresponding field within the forms that will hyperlink to the photos on the servers (Corps will create a separate field to input the hyperlink).

2.0 SWITCHBOARD

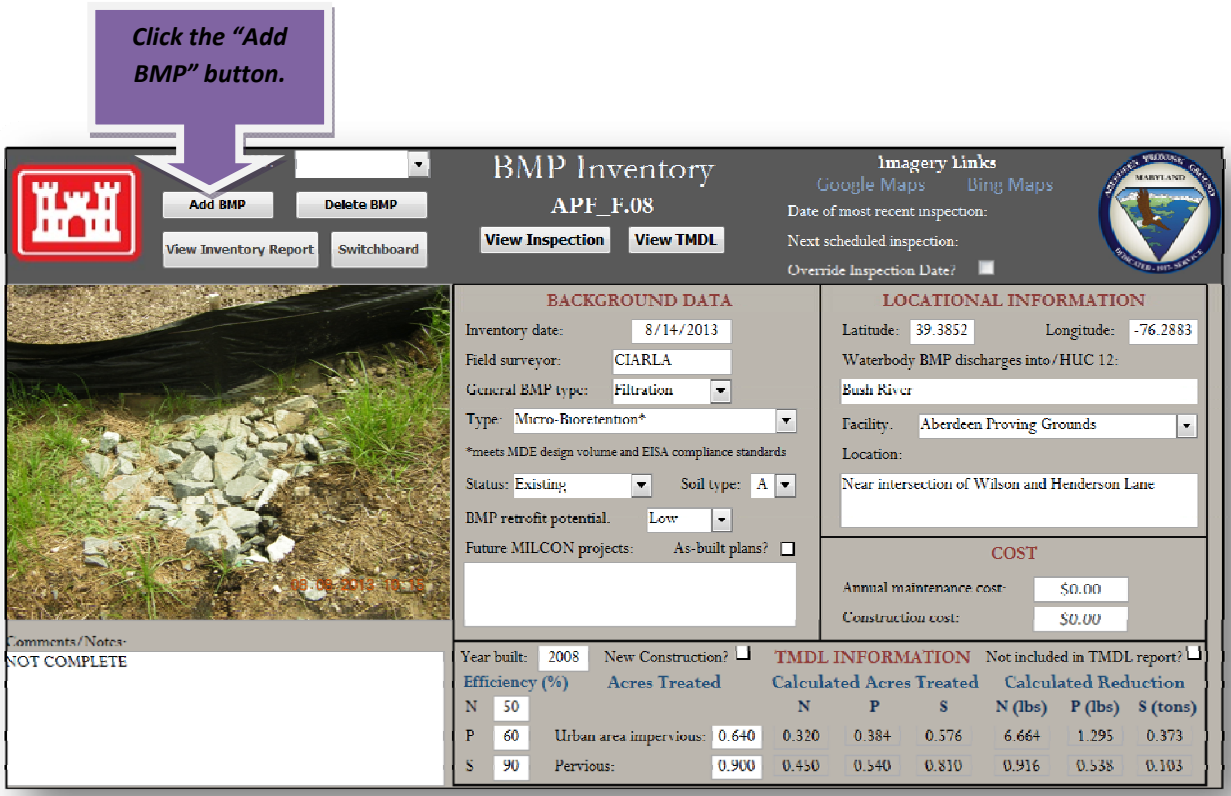
2.1 SWITCHBOARD FORM

Upon opening the database users will come to a switchboard. The switchboard enables users to navigate between forms, view applicable resources, and produce BMP inventory and TMDL reports specific to the installation or facility. The dropdowns (Resources, Links and Reports) on the switchboard will be explained in more detail later in this tutorial.

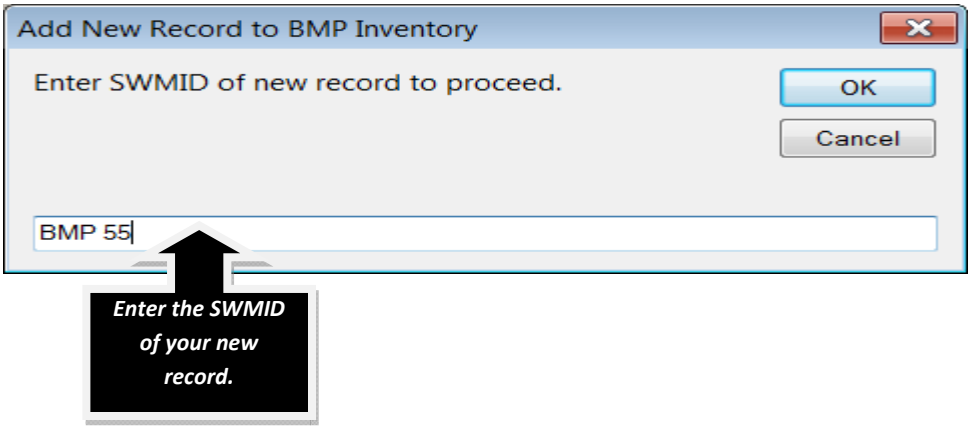
3.0 INVENTORY

3.1 INVENTORY FORM

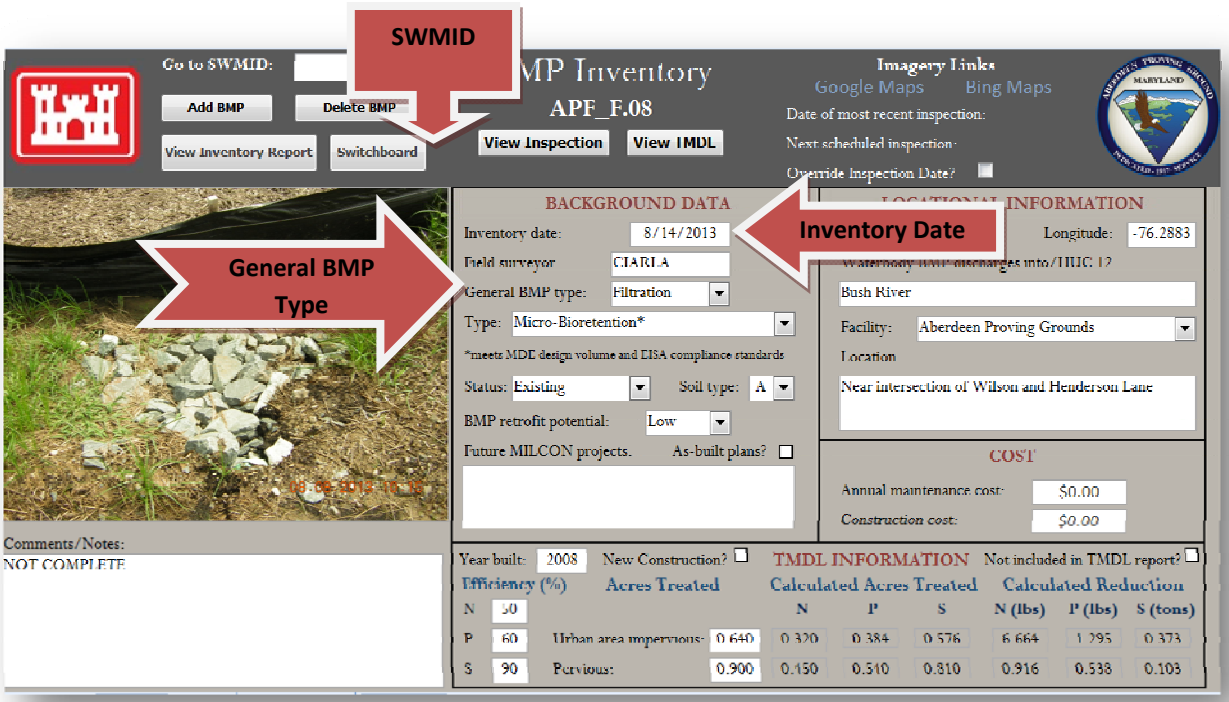
Individual BMPs are entered into the database through the inventory form. Inspection, Maintenance and TMDL data cannot be updated until a BMP has been entered into the inventory. Once a BMP has been entered into the inventory and a unique ID has been established, multiple inspections and annual maintenance can be archived for that individual BMP.



Clicking the "Add Record" button will bring up this prompt:



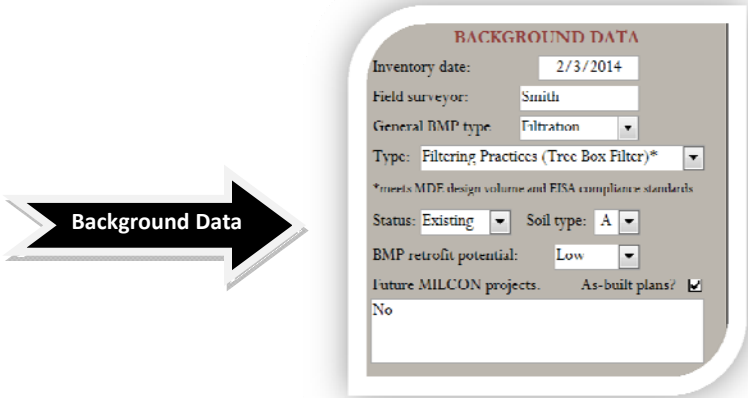
A new record will be created and the SWMID will be populated. Enter information in the form, starting with the "Inventory Date" located under the "Background Data" heading (Field Surveyor, General BMP type, etc.). Your selection for "General BMP Type" will determine what fields must be populated in the area, so be sure this field is accurately filled out.



Adding information to Inventory by heading:

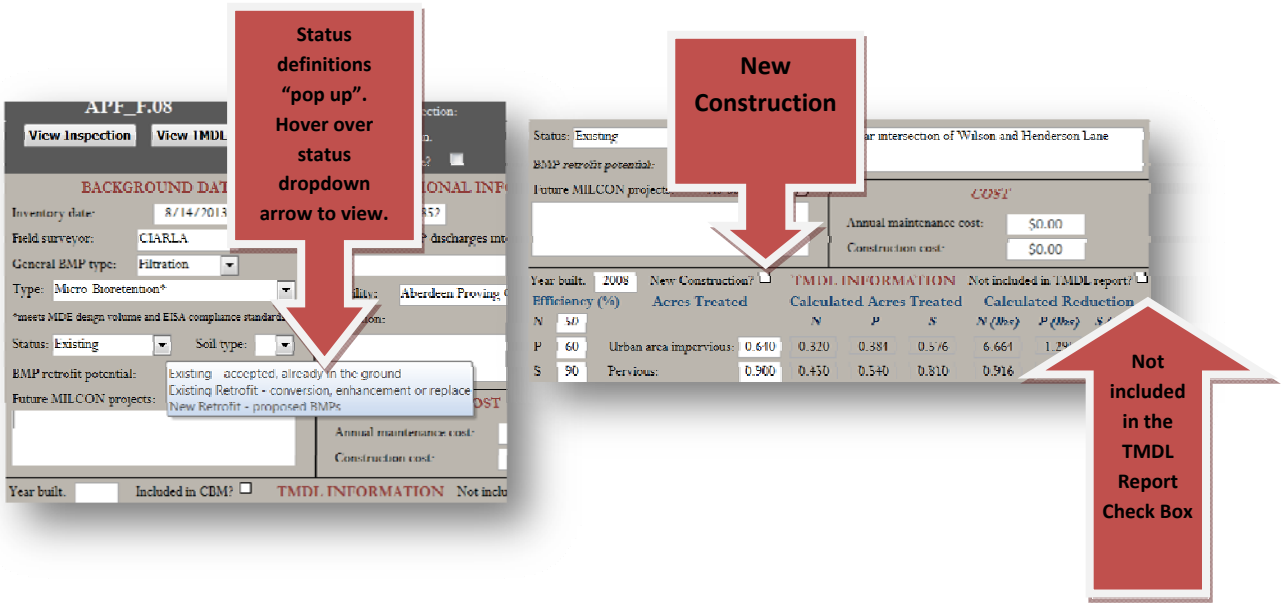
3.1.1 Background Data for "non-basin" BMPs:

Field Name	Data Entered
Inventory Date	Date inventory created
Field Surveyor	Name of field surveyor
General BMP Type	Select from Dropdown
Type	Specific "Type" of BMP
Status	Select from Dropdown
Soil Type	Select from Dropdown (dominant soil type of drainage area).
As-built Plans?	Are as-builts available to upload to this database?
Future MILCON projects	Are future MILCON projects planned for area?



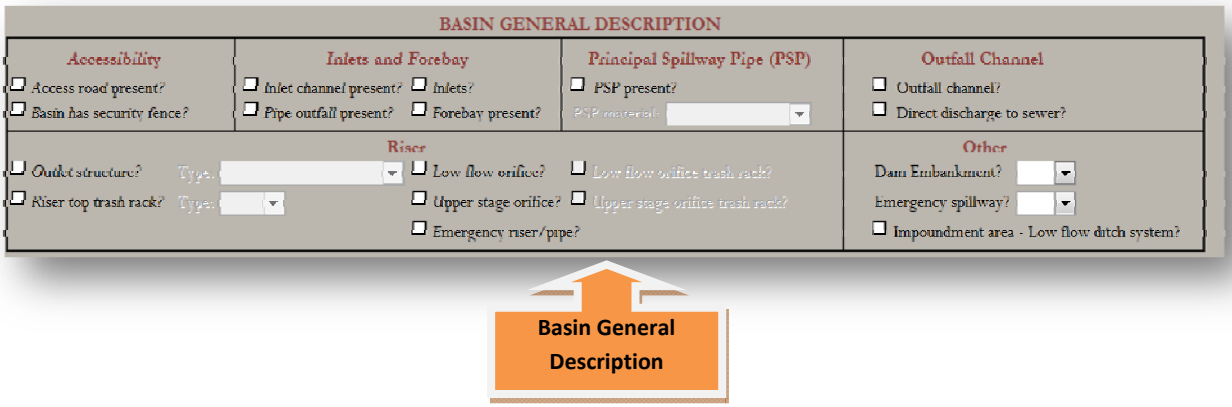
Status Dropdown:

- **<u>Status = "Existing":</u>**
  - The "Existing" designation is for BMPs already in the ground at the time of this report and have been incorporated into the baseline calculation of the TMDL form.
  - For Virginia, "Existing" BMPs constructed before 2009 is included in the baseline load calculation (as per VADEQ TMDL guidance, 2009 is used because the loading rates are based on the 2009 CBM run).
  - For Virginia, "Existing" BMPs constructed after 2009 will count towards TMDL L2 reductions. BMPs that fit the post-2009 criteria will count towards the "VADEQ Current %" section on the TMDL form. The ultimate TMDL % goal to be achieved for Pervious and Impervious is shown under "Reduction Goal 2024%" in the TMDL form.
- **<u>Status = "Existing Retrofit and New Retrofit":</u>**
  - The purpose of this designation is to show the effect of proposed BMPs to the L2 reduction goals.
  - When the "Existing Retrofit" or "New Retrofit" designation is selected for a BMP, the reduction only counts towards the "VADEQ Proposed %".
  - Does not apply to the baseline load calculations in the TMDL Form, in order to disable proposed BMPs to the baseline loading calculations, the user must check the "Not included in the TMDL report box (see figure below for location).
  - **<u>Status = "Existing" and "New Construction" Tab:</u>** When "Existing" status is selected and the "New Construction" check box (see figure below) is checked in the TMDL section of the inventory, the reductions from the BMP count towards the ***"VADEQ Current %" instead of "VADEQ Proposed %"***. This is used when you include new BMPs that weren't part of the original BMP inventory.



3.1.2 General Data for "Basin" BMPs:

When a Basin is selected for a BMP, additional data is required because "Basins" typically have numerous structural components in comparison to other BMPs. The "Basin General Description" fields only show up when Basin is selected, this section will not show up for all other BMPs under "General BMP Type".

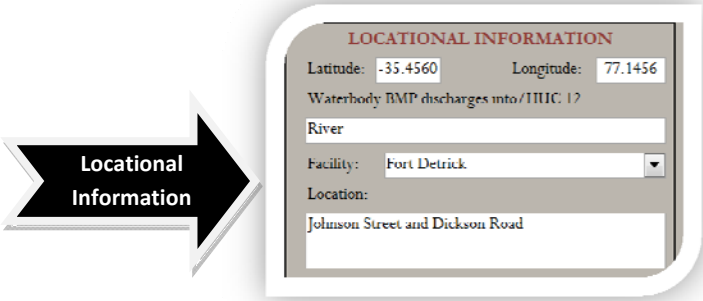


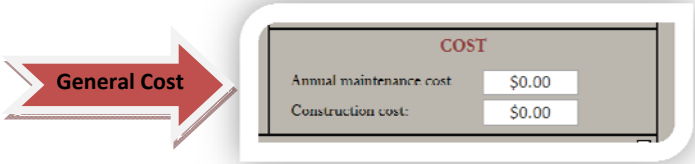
	Data Entered
Accessibility	Check appropriate box if necessary
Inlets and Forebays	Check appropriate boxes. If inlet is selected, additional fields will appear below that require more specific information for the individual inlet.
Principal Spillway Pipe (PSP)	Does PSP exist? List material from dropdown
Outfall Channel	Does a channel extend from BMP or does it discharge directly into sewer/stream (checkbox).
Riser	Fill out appropriate information about Riser. Additional fields will appear for fields that require more information.
Other	Does the Basin have a dam embankment, emergency spillway, impoundment area?

3.1.3 Locational and Cost Information:

It is also important to correctly input the locational section of the inventory sheet with the GPS position coordinates, the watershed discharged into, and the location. The "Cost" information is optional for existing BMPs more than a year old but should be populated if the BMP was constructed in the previous year or is a proposed BMP. The cost information will help the user with various reporting requirements including TMDL milestone reporting.

Field Name	Data Entered
Latitude/Longitude	Enter lat/long. Next to SWM ID, this field is the most important in order to spatially reference to be used in other software (GIS or CAD)
Waterbody BMP Discharges into/HUC 12	Populate with name of HUC 12 waterbody and HUC 12 Code
Facility	Name of facility or installation
Location	Any other information to help locate BMP (Road intersection, building #, etc.)
Annual Maintenance Cost	If available, what is the cost to maintain BMP per year?
Construction Cost	If available, what was cost of construction?

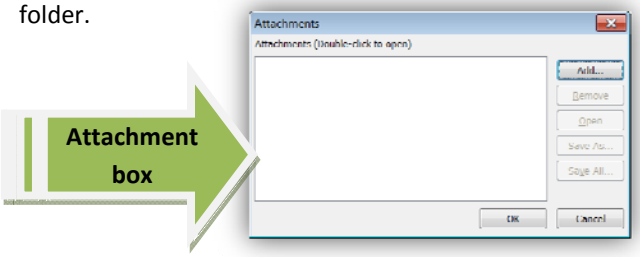


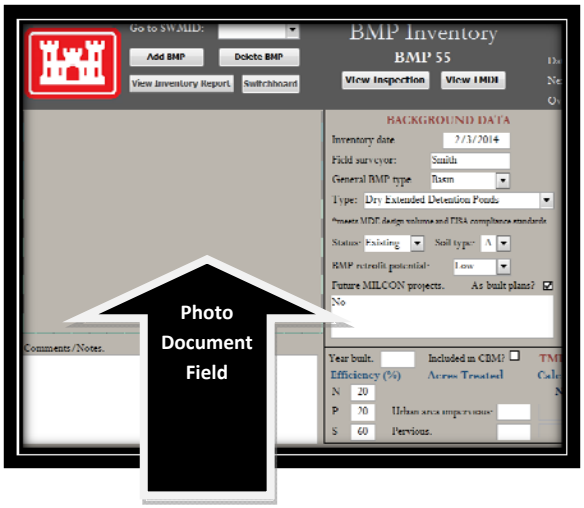


3.1.4 Adding Photo or other Documents:

Photos and documents can be imbedded into the database by clicking inside the box indicated in adjacent figure.

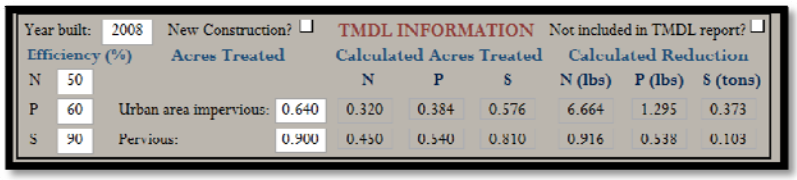
Once clicked, an attachment management box will appear as shown below. Add data by clicking "Add" and find the file in the appropriate folder.





3.1.5 TMDL INFORMATION:

The TMDL information section shown below should be filled out in order to calculate the affect of the individual BMPs with regards to WLAs (Wasteload Allocations) or special conditions within a stormwater permit (such as an MS4 permit). The table below will explain each field of the "TMDL Information" section.



Year built: 2008 New Construction? ☐ TMDL INFORMATION Not included in TMDL report? ☐

Efficiency (%)		Acres Treated		Calculated Acres Treated			Calculated Reduction		
				N	P	S	N (lbs)	P (lbs)	S (tons)
N	50								
P	60	Urban area impervious:	0.640	0.320	0.384	0.576	6.664	1.295	0.373
S	90	Pervious:	0.900	0.450	0.540	0.810	0.916	0.538	0.103

Field Name	Data Entered
Year Built	Year BMP was constructed; if proposed, enter the projected year to be constructed.
Included in CBM?	Optional checkbox field; if the BMP was included in the latest Chesapeake Bay Model run, please indicate.
Not included in TMDL report	Check this box if you don't want to include the BMP in the TMDL form calculations for the facility. This checkbox option is mainly to remove BMPs from the TMDL Baseline Loads calculations on the TMDL Form. This is usually used for BMPs that are structurally damaged limiting the efficiencies, BMPs that are not recognized as water quality BMPs by the regulating entity, and ***proposed BMPs***.
Efficiency %	This field will automatically be populated once a BMP is selected but can be adjusted based on inspection results. VADEQ efficiencies were pre-loaded for nitrogen, phosphorus and sediment. The efficiency in combination with the acres treated and the load per acre field in the TMDL form are used to calculate the "Calculated Acres Treated" and "Calculated Reduction" fields.
Acres Treated	Use the drainage area and landuse to populate the impervious acres treated (i.e. rooftop, pavement, compacted stone, etc.) and pervious acres treated (i.e. grass, mulch areas). The values entered in these fields are the most important segment in calculating TMDL reductions.
Calculated Acres Treated	These values are not entered, they are a result of the efficiency and acres treated fields. These values are ultimately tabulated in the overall installation TMDL form to show aggregate results towards TMDL related requirements.
Calculated Reduction	These values are not entered, they are a result of the efficiency, acres treated, and load per acre (from TMDL form) values. These values are ultimately tabulated in the overall installation TMDL form to show aggregate results towards TMDL related requirements. The "Calculated Reduction" is different than the "Calculated Acres Treated" because the results of the equation show the reduction in quantity not area.

3.1.6 Other Inventory Functions:

The fields located at the top of the inventory form shown below are used to navigate between forms, delete existing BMP entry, and view inspection date information. The table below describes each field.

3.1.7 Inventory Summary:

The inventory form of the database is used to document all BMPs with information that can be used for multiple purposes. Once the BMP is entered into the inventory, all associated inspection and maintenance actions can be archived for the individual BMP to view progress. The inventory form can also be used in combination with the TMDL form to meet TMDL regulatory requirements by giving the user the option of inputting proposed TMDLs to estimate if the required TMDL reductions can be achieved. TMDL milestone progress can be presented to the regulatory entity using the data from the inventory in combination with the TMDL form through various reports located on the switchboard of this database.

Field Name	**Data Entered**
"Add BMP" and "Delete BMP"	The "Add BMP" button is used to add a BMP to the database. The "Delete BMP" button is used to delete the BMP from the database (this action will delete all associated inspections as well).
"View Inventory Report" and "Switchboard"	Click this button to view the individual BMP report. Use the "Switchboard" button to navigate back to the switchboard.
"View Inspection" and "View TMDL"	Click on the "View Inspection" button to create an existing inspection, view a current inspection or add an inspection as part of an annual inspection program. Click on "View TMDL" button to navigate to the TMDL form where the overall facility TMDL information can be viewed.
Imagery Links	Use the Google Maps and Bing Maps links to view the aerial photos of the BMP. The latitude and longitude field need to be populated in order for this function to work.
Inspection Date Fields	These fields show the "Date of the most recent inspection" and "Next scheduled inspection". The next scheduled inspection is based on a yearly annual inspection which is the default but can be adjusted to meet specific facility inspection program criteria. Use the "Override Inspection Date" checkbox to manually adjust inspection date from the default value.

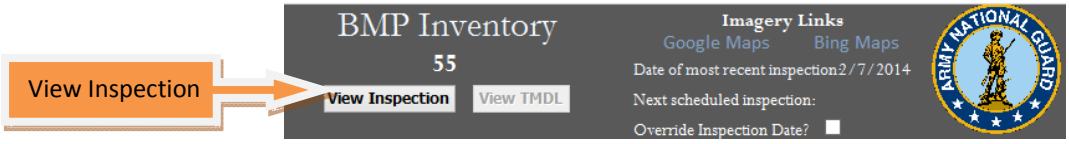
4.0 INSPECTION FORM

4.1 INSPECTION FORM

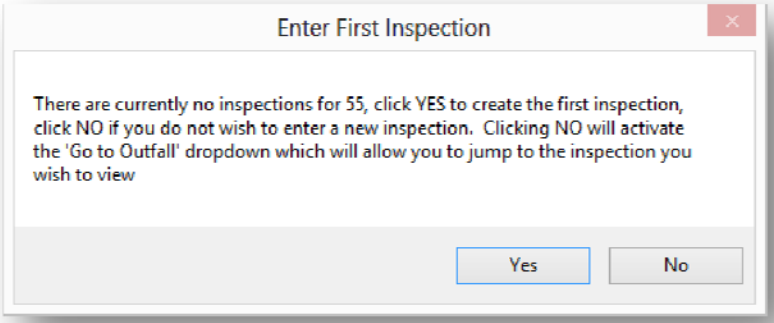
The inspection form is used to evaluate the condition of the individual BMP at a given point in time. The inspection form is linked to the established BMPs unique ID (SWM ID) which was given during the initial inventory of the BMP (you must create a BMP inventory before you conduct an inspection). The inspection form also includes a maintenance section that will be discussed later in this section.

4.1.1 CREATING A BMP INSPECTION:

From the inventory form the user will click the inspection button which will take them to the inspection form.



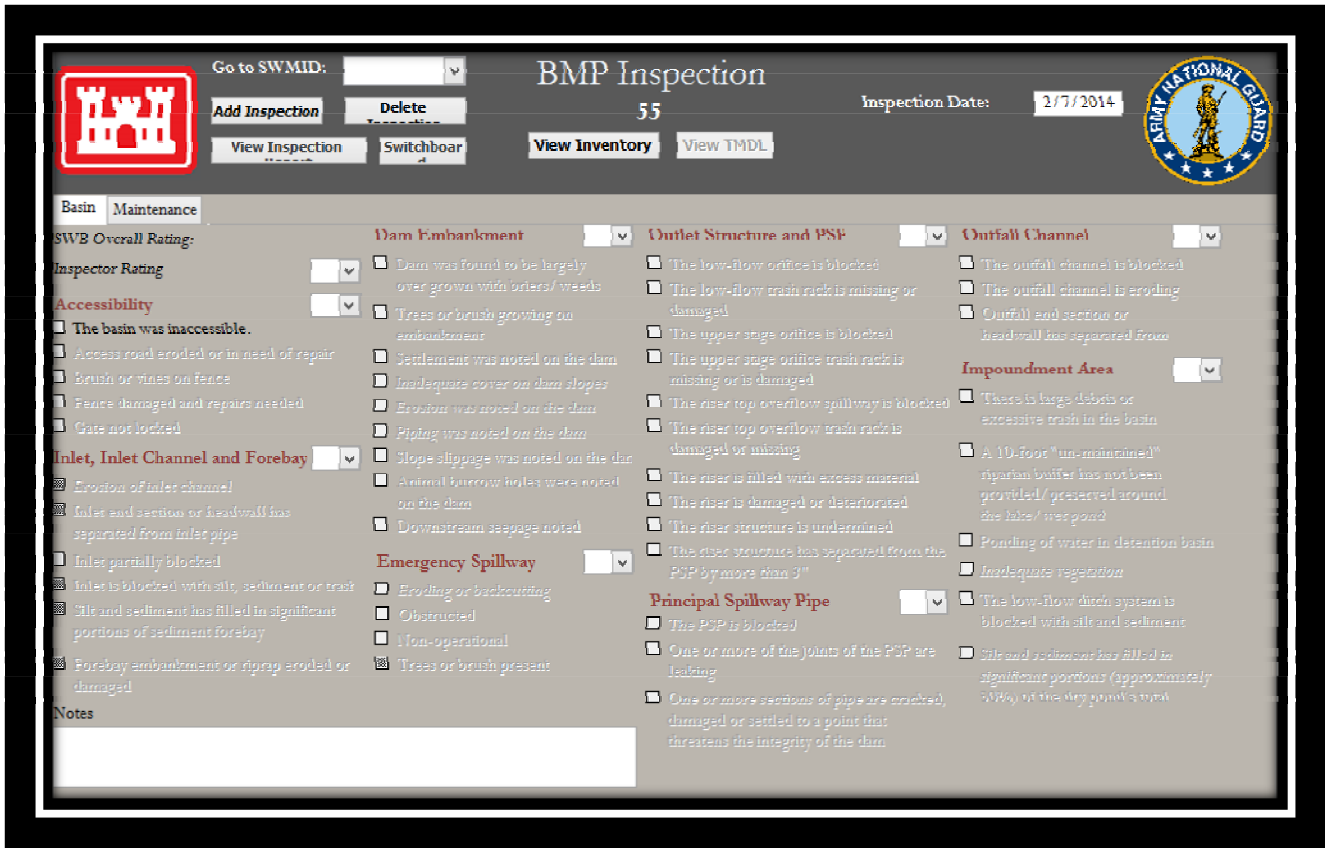
If this is the initial inspection, the box shown to right will appear and the user will click "yes".



Once the user clicks yes, the database will prompt you to populate the "Inspection Date". You cannot start an inspection until you populate a date.

4.1.2 Conducting an Inspection:

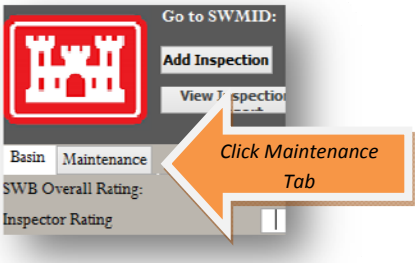
Once the inspection date has been entered, the user will fill out the form shown below. BMP inspectors will need to be qualified to conduct the inspection, as the inspection categories below are standard. The fields change based on the BMP selected in the inventory.

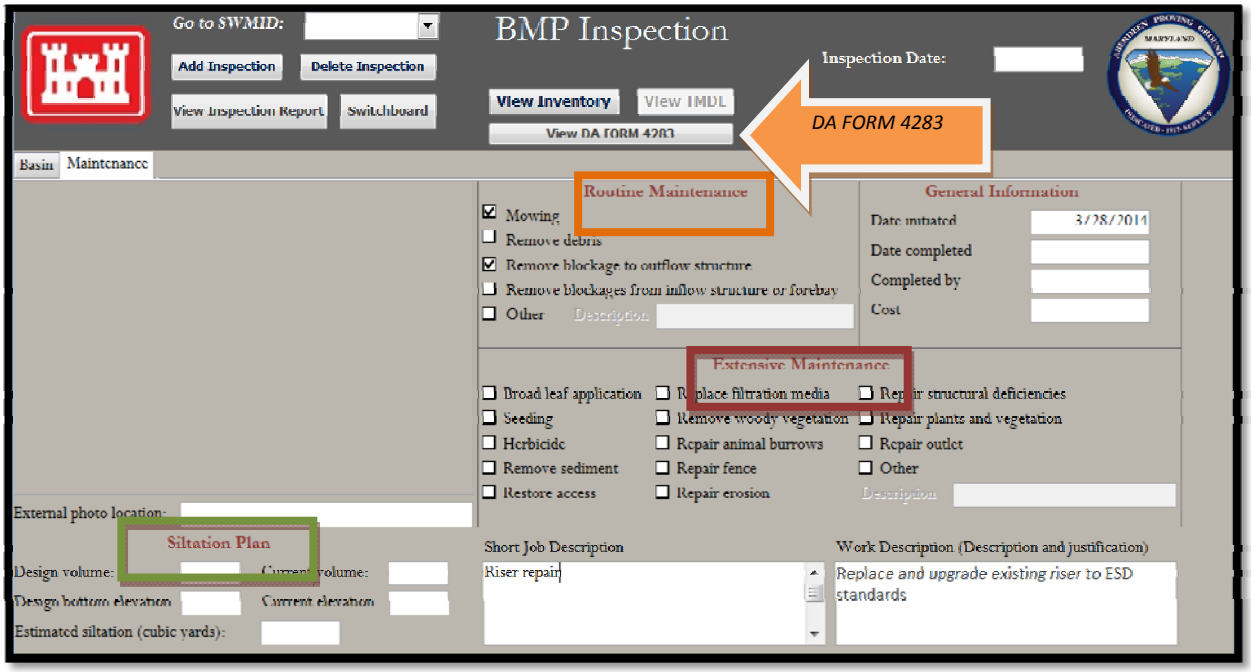


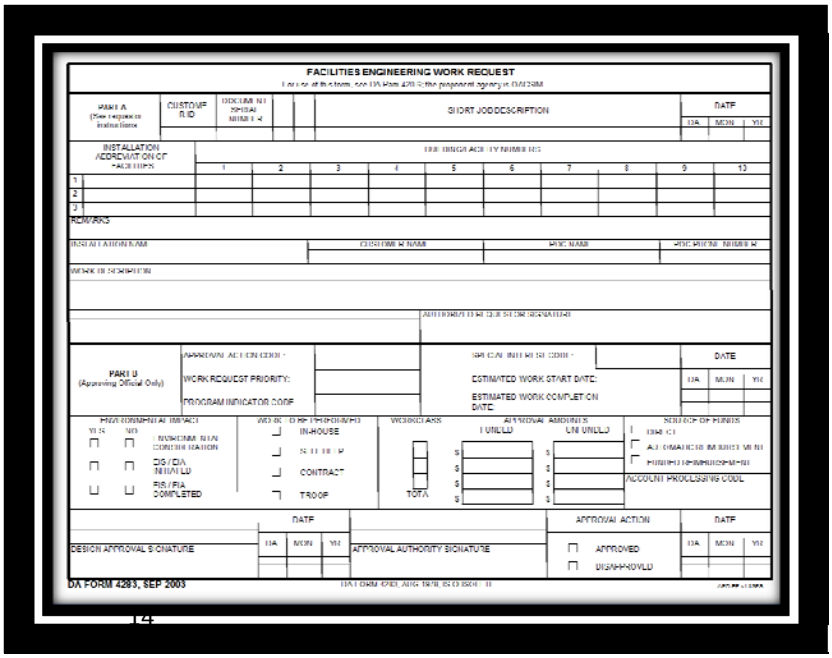
The checkbox's that require data are highlighted based on what is selected on the inventory form, all other inspection fields are grayed out. Each inspection section has a rating dropdown of 1-5, qualified inspectors will determine the rating of the inspection category based on field inspection.

4.1.3 Maintenance Section:

If maintenance is required on the BMP based off the inspection or possibly as part of a routine maintenance plan, then click on the maintenance tab shown in the adjacent figure. Once the maintenance tab has been selected you have the option to fill out multiple sections such as "Routine Maintenance", "Extensive Maintenance" and "Siltation Plan" (see figure below). A report can be produced for the maintenance section for maintenance crews or funding request using a replicated version of the ***"FACILITIES ENGINEERS WORK REQUEST"*** form **(DA FORM 4283).**







- **SILTATION PLAN**

If the BMP has a specific siltation plan associated with the original design specs, annual information regarding depth and volume can be documented in this section. This section can be used to monitor siltation over time.

- **ROUTINE MAINTENANCE**

This section can be used to document routine maintenance for specific BMPs. The categories shown in the current "Routine Maintenance" section are typical for stormwater basins and may not apply to other Low Impact Development (LID) BMPs. Use the comments section to add specific maintenance tasks if needed. The user can also input cost of the routine maintenance in order to track total annual cost for documentation and annual funding request.

- **EXTENSIVE MAINTENANCE**

This section can be used when major structural issues are found with the BMP. The categories shown in the current section are typical; all other extensive maintenance issues can be documented in the comments section.

- **GENERAL INFORMATION**

If repairs or routine maintenance are required based on the inspection or scheduled maintenance, the "***date initiated***" will need to be populated. The other information can be updated after the BMP repair has been made.

- **DA FORM 4283**

When a work request is required based on a BMP repair or routine maintenance as a result from an inspection, Click the "View DA FORM 4283" button to show a replicated version of the official form. This form is automatically populated from input information in the maintenance section. The date initiated, job description, and work description automatically populate some of the fields. All other fields are project specific and require manual input before being sent to approving official.

4.1.4 Other Inventory Functions:

The fields located at the top of the inspection form shown below are used to navigate between forms, delete existing BMP entry, and view inspection date information. These fields are explained in section 3.1.6.

4.1.5 Inspection Summary:

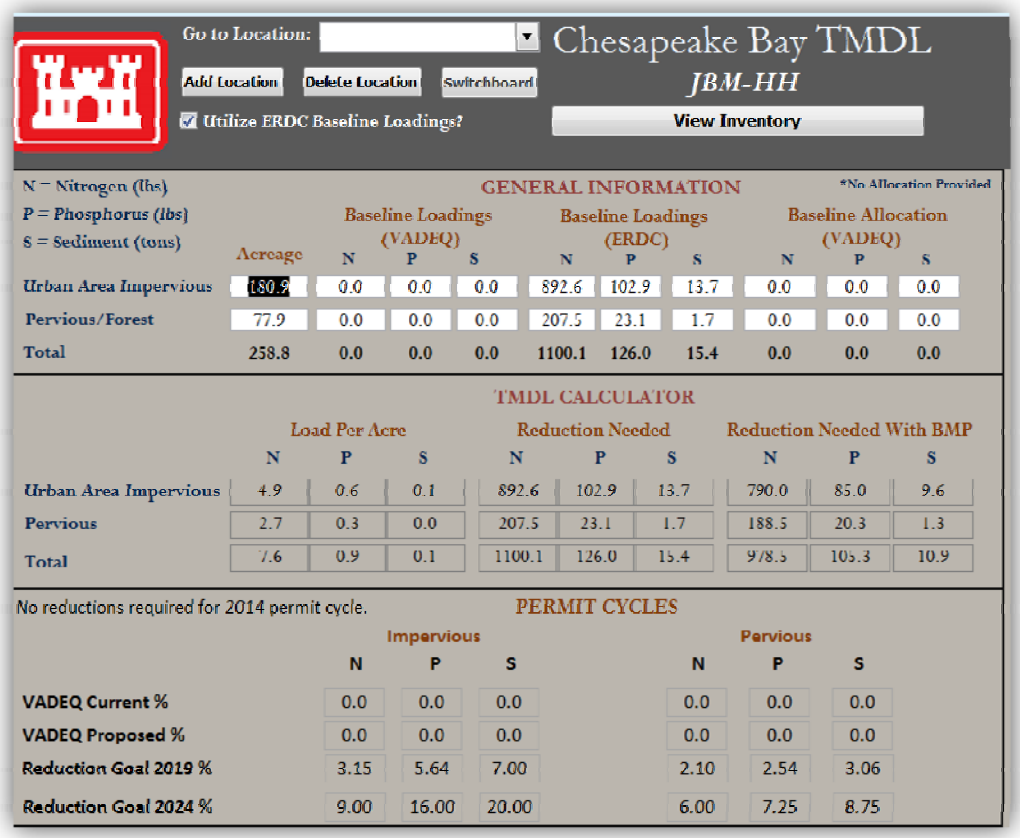
The inspection of the database is used to archive all inspections for each BMP. Much of the new MS4 permits that are written require inspection records. The inspection form can produce a report for the individual inspection, historic report of all inspection of a particular BMP or a list of the latest inspection dates for all the BMPs. The user can use the maintenance section to document all repairs and routine maintenance for the BMP. The overall inspection report for the entire installation can be found on the switchboard of the database under "reports".

5.0 TMDL FORM

5.1 TMDL FORM

The TMDL form is used to track progress towards specific TMDL goals for a given installation. The TMDL form for Virginia (VA) installations is specific to VA TMDL implementation set by the Virginia Department of Environmental Quality (VADEQ). VADEQ has incorporated the TMDL requirements into the new MS4 permit and most VA installations fall under the VA MS4 general permit based on certain criteria.

VADEQ is requiring each installation to reduce pollutant loads by certain percentages (referenced under "Reduction Goal 2019 and 2024") called L2 reductions, which are based on 2009 baseline modeling results. The reduction goals are divided into MS4 permit cycles but the end % goal for pervious and impervious is shown in "Reduction Goal 2024%".



Go to Location:

Add Location | Delete Location | Switchboard

Utilize ERDC Baseline Loadings?

Chesapeake Bay TMDL

JBM-HH

View Inventory

N = Nitrogen (lbs)
P = Phosphorus (lbs)
S = Sediment (tons)

GENERAL INFORMATION

*No Allocation Provided

	Acreage	Baseline Loadings (VADEQ) N	P	S	Baseline Loadings (ERDC) N	P	S	Baseline Allocation (VADEQ) N	P	S
Urban Area Impervious	180.9	0.0	0.0	0.0	892.6	102.9	13.7	0.0	0.0	0.0
Pervious/Forest	77.9	0.0	0.0	0.0	207.5	23.1	1.7	0.0	0.0	0.0
Total	258.8	0.0	0.0	0.0	1100.1	126.0	15.4	0.0	0.0	0.0

TMDL CALCULATOR

	Load Per Acre N	P	S	Reduction Needed N	P	S	Reduction Needed With BMP N	P	S
Urban Area Impervious	4.9	0.6	0.1	892.6	102.9	13.7	790.0	85.0	9.6
Pervious	2.7	0.3	0.0	207.5	23.1	1.7	188.5	20.3	1.3
Total	7.6	0.9	0.1	1100.1	126.0	15.4	978.5	105.3	10.9

No reductions required for 2014 permit cycle.

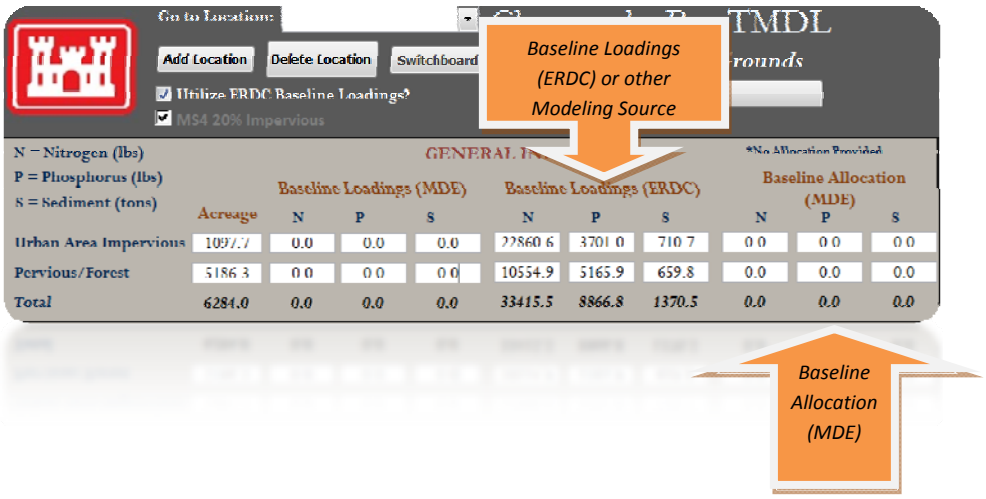
PERMIT CYCLES

	Impervious N	P	S	Pervious N	P	S
VADEQ Current %	0.0	0.0	0.0	0.0	0.0	0.0
VADEQ Proposed %	0.0	0.0	0.0	0.0	0.0	0.0
Reduction Goal 2019 %	3.15	5.64	7.00	2.10	2.54	3.06
Reduction Goal 2024 %	9.00	16.00	20.00	6.00	7.25	8.75

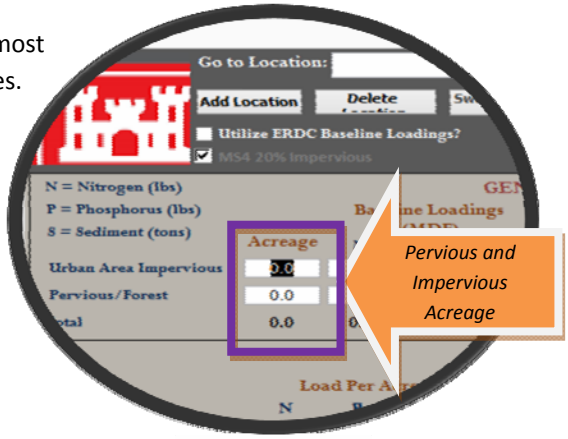
TMDL L2 Reduction Goals

5.1.1 Getting Started:

Calculation shown as the two checkbox's in the adjacent figure. Select the "Utilize ERDC Baseline Loadings" if you want to compare TMDL "Baseline Allocations" from the regulatory body to "Baseline Loadings" from another modeling source. If this box is not checked the resulting "TMDL Calculation" will come directly from the "Baseline Loadings (VADEQ)". See figure below for locations of above mentioned sections.



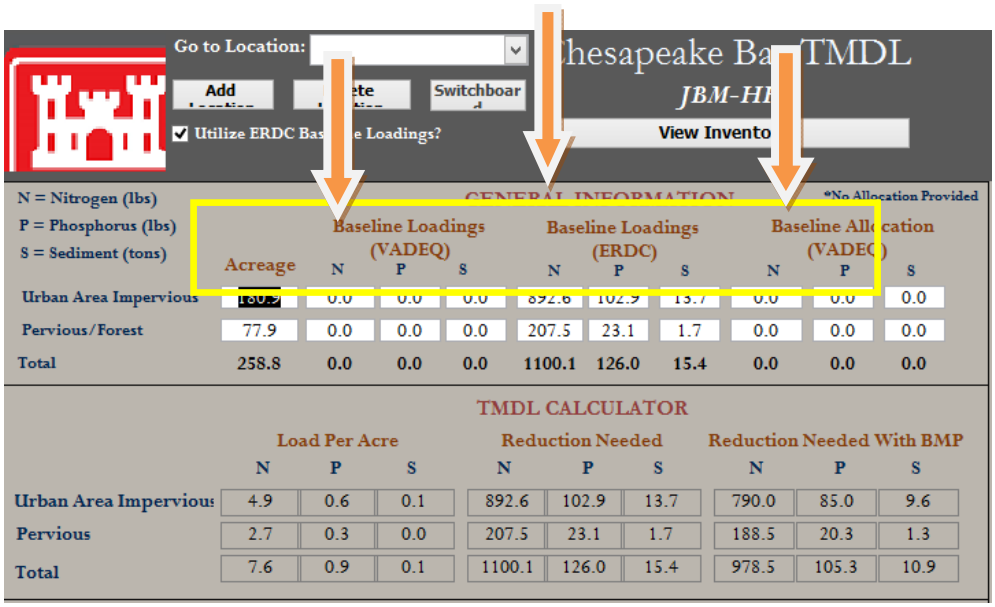
After the appropriate checkbox has been selected, the most important input data field is the impervious and pervious acreages. This data will likely be calculated already but may need to be updated due to new construction or land purchase. This data is typically calculated spatially in GIS. If this data is not populated, no calculations can be made regarding the TMDL.



5.1.2 Modeling Data Input:

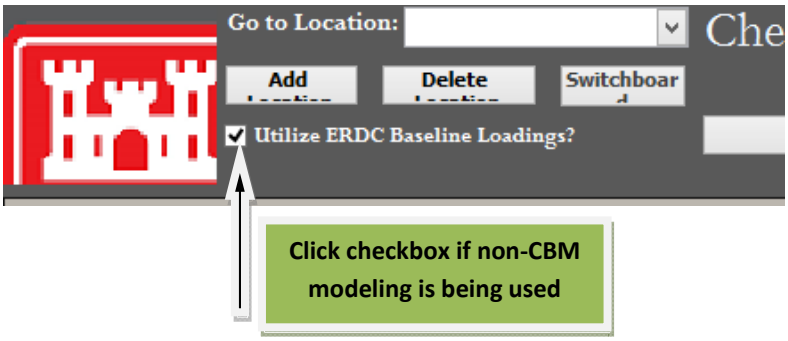
Once the impervious and pervious acreages have been populated the modeling data can be populated (if needed). For Virginia installations, the focus of the MS4 permit is to meet the L2 reductions outlined in the VADEQ TMDL Action Plan Guidance (this will be discussed later in this section). The modeling section has 3 types of entry sections. The first is for VADEQ Loadings which is where you want to enter the baseline loading results using a combination of impervious and pervious surface areas along with loadings rates established by the VADEQ TMDL guidance. The VADEQ Loadings section is the only data that is used in the L2 % reductions section (this section will be discussed in the next section). The second modeling field section is for outside or independent modeling data, this is for comparison purposes and reductions using this data can be shown in the TMDL section below the baseline loading section (Both VADEQ and the Independent modeling can

use the TMDL calculator by simply checking the "Utilize ERDC Baseline Loadings" which activates the independent modeling and when this checkbox is not checked it will automatically default to the VADEQ modeling data. The third modeling section is the "Baseline Allocation" section and this is populated by the user and can be used if the facility is located outside an MS4 area and TMDL reductions are required with specific allocation goals.

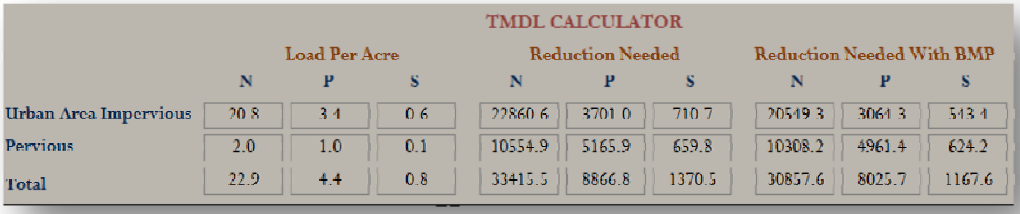


5.1.3 TMDL Calculation:

Once the modeling data has been populated in the above section along with the installation impervious and pervious acreage breakdown, the user must select which modeling results are to be used in the TMDL calculation. Simply select the "Utilize "model x" Baseline Loadings?" if you do not want to use the CBM (which is the default).



Once the appropriate modeling has been selected all the calculations results will be shown in the "TMDL CALCULATION" tables. All formulas are hidden and everything is based what is in the BMP inventory. It is unclear what BMPs were originally included in the Chesapeake Bay Model, but it does appear most individual BMPs were not incorporated for many federal installations so it was assumed that any BMP built after 2002 would be credited towards the nutrient load reduction. The table below breaks down each

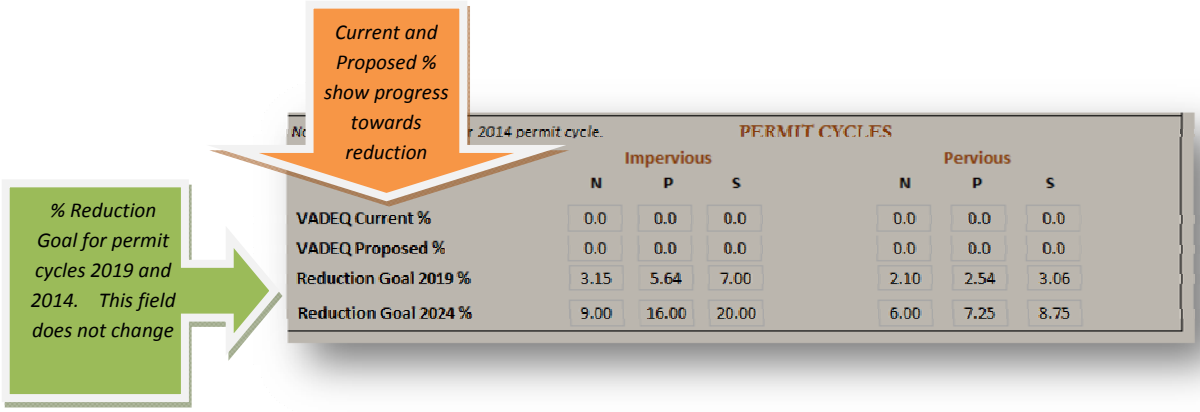


sub-section of the TMDL calculation. Remember, this information cannot be edited, the numeric values shown in the fields is the resultant of a background calculation between the modeling results, acres treated, and BMPs from the inventory.

Sub-Section Name	Explanation
Load per Acre	Depending on what baseline modeling results used (either the regulator or independent modeling), those values are divided by the total acres of impervious and pervious giving a "Load per Acre". This value is used as a multiplier for all BMP efficiency calculations. These fields are for information purposes only and are used in background calculations.
Reduction Needed	This is simply the difference between the baseline modeling and the allocation (if given). The resultant value is the quantity of a given nutrient that needs to be reduced to meet the allocation.
Reduction Needed with BMPs	This is the same calculation as "Reduction Needed" accept that it takes into account qualified BMPs. If BMPs exist that were not accounted for in the CBM, then the value should be lower than the "Reduction Needed" value because the BMPs reduce the nutrient contribution. It's possible that this value is negative if extensive treatment was implemented, in which case nothing would need to be done.

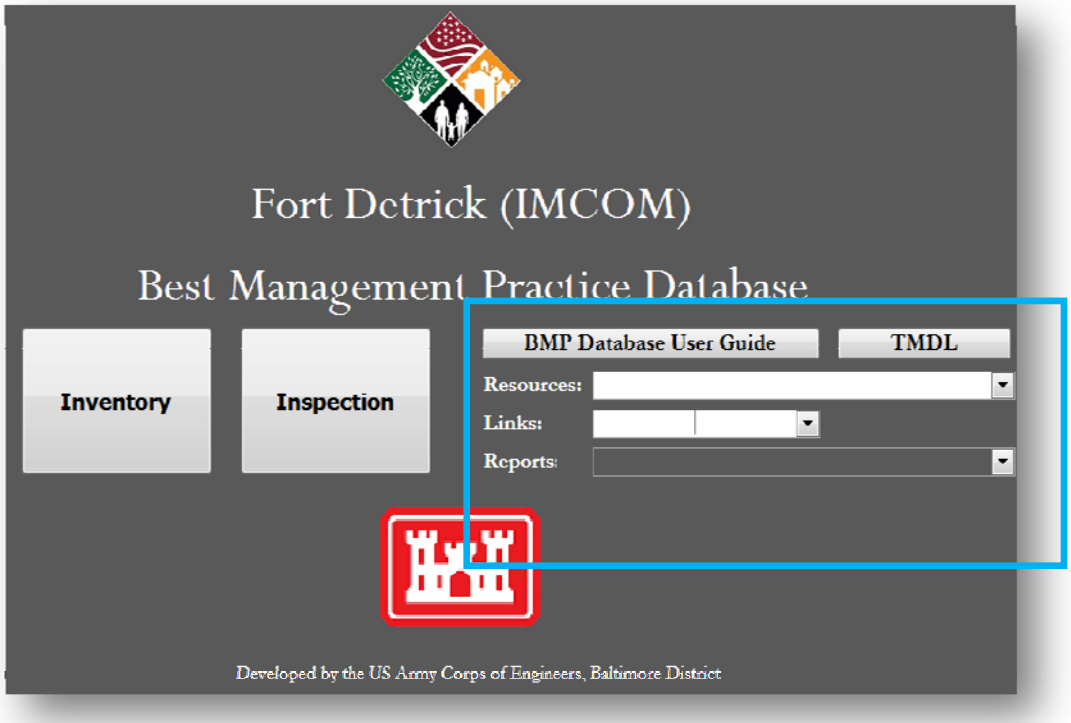
5.1.4 VADEQ TMDL ACTION PLAN L2 % REDUCTION:

The VADEQ "TMDL Action Plan Guidance" should be used to estimate the baseline loads that will need to be put into the "Baseline Loading" section below for VADEQ. Once the baseline loadings have been established the database will calculate any changes that occur towards the L2 reductions outlined in VADEQ guidance document. When BMPs are entered in the inventory and dependent on the phase (proposed, existing etc..), the BMP efficiencies and acres treated will be calculated towards the % reduction required towards the L2 reductions. This will help track progress towards those reductions. The L2 % reductions are based on permit cycles starting in 2014 (no % reduction required for 2014, only action plan to outline strategy to meet overall L2 reductions. The 2019 and 2024 permit cycles are based on the 5-year MS4 permit cycle (all percentages taken from the TMDL Action Plan Guidance).



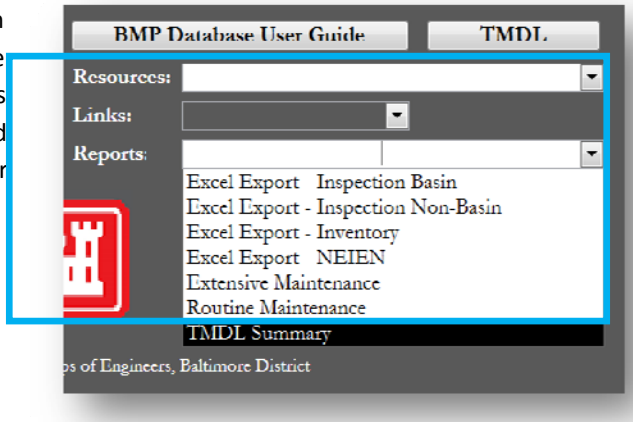
6.0 REPORTS AND RESOURCES

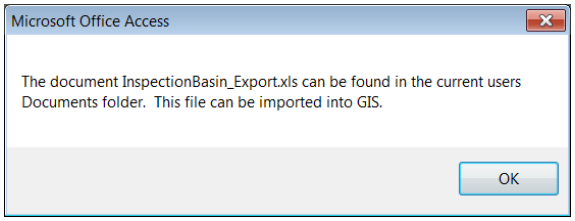
All reports and TMDL related resources can be found on the Switchboard. In addition, the "Links" dropdown has a link to the Low Impact Development (LID) user guide. This tutorial can also be accessed on the switchboard by clicking on the "BMP Database User Guide" button. All reports, resources, and links will be explained in more detail in this section.



6.1 REPORTS

Use the reports dropdown (see figure below) on the switchboard to create specific reports. The table below will explain each report. The reports that are Excel exports are automatically exported to the documents folder and when a particular report is selected the pop-up below will appear.

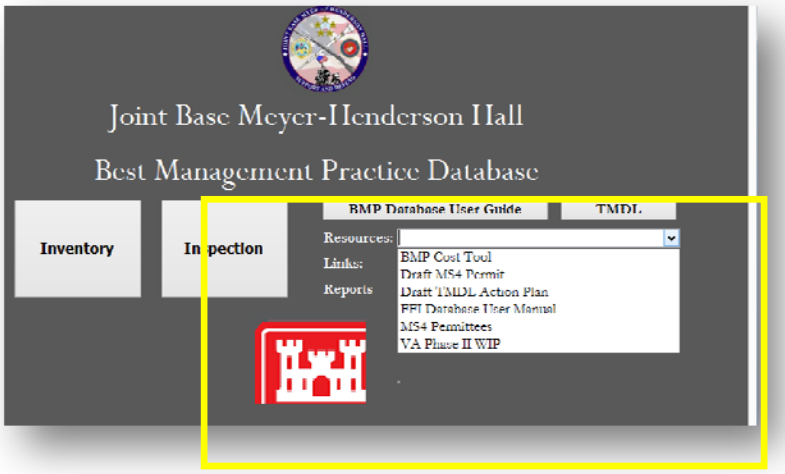




Report Name	Explanation
Inspection Basin	List of latest inspection for all “Basin” BMPs. This can be used if inspection reporting is required through the MS4 permit.
Inspection Non-Basin	List of latest inspection for all “non-basin” BMPs. This can be used if inspection reporting is required through the MS4 permit.
Inventory	List of the Inventory of all BMPs collectively.
NEIEN	The National Environmental Information Exchange Network (NEIEN) is a database run by EPA that collects various types of data including BMP information. EPA requires States in the Chesapeake Bay Watershed to report BMPs with some basic information. Each State may choose to add additional information fields to help other reporting requirements outside the NEIEN. The report output for the BMP database has been customized to match each states NEIEN report.
Extensive Maintenance	All BMPs that have extensive maintenance associated with the most recent inspection. The information will only show up if boxes are checked in the maintenance section.
Routine Maintenance	All BMPs that have routine maintenance associated with the most recent inspection. The information will only show up if boxes are checked in the maintenance section.
TMDL Summary	Summary Report of all the TMDL data shown on the TMDL Form.

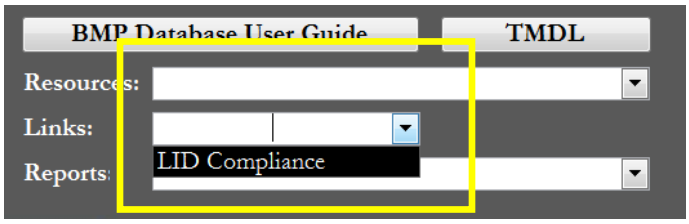
6.2 RESOURCES

The data in the “Resources” dropdown is imbedded in the database unlike the links. Most of the resources are State specific guidance. The table below explains each resource.



Report Name	Explanation
BMP Cost Tool	USACE BMP Cost Tool. Can be used to estimate cost of future BMPs
VA Phase II MS4 Permit	MS4 Permit Document
VADEQ TMDL Action Plan Guidance	Guidance for state and federal jurisdictions to meet State TMDL goals within the MS4 permit.
FFI Database User Manual	The Federal Funding Inventory (FFI) is used to centrally identify what activities have been done using federal funds in a given Fiscal Year. This information is usually requested through HQ level command and then dispersed to installation level. This User Manual goes along with the database (see links dropdown on switchboard) which is required to be populated annually.
MS4 PERMITTES	General Information on Phase II MS4 Permit Holders
VA Phase II WIP	Watershed Implementation Plan (WIP) for State Chesapeake Bay TMDL Allocations

6.3 LINKS



The "Links" dropdown has a hyperlink to the LID Compliance website. The LID Compliance website needs to be referenced for new construction in order to meet Federal EISA requirements. In most cases, when EISA requirements are met, EPA and State requirements are met (although any State design manual should still be referenced since they are the regulators).

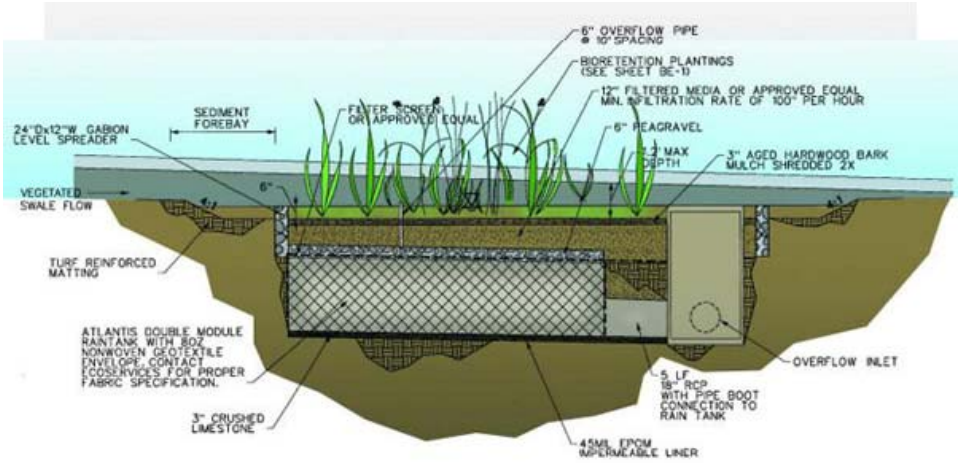
6.4 REPORTS AND RESOURCES SUMMARY

When reports are required either Federal or State, reference the switchboard dropdowns and look for the appropriate report. When designing BMPs for new development or to help meet TDML requirements, all the necessary State and Federal design criteria and guidance can be found under one of the dropdown menus.

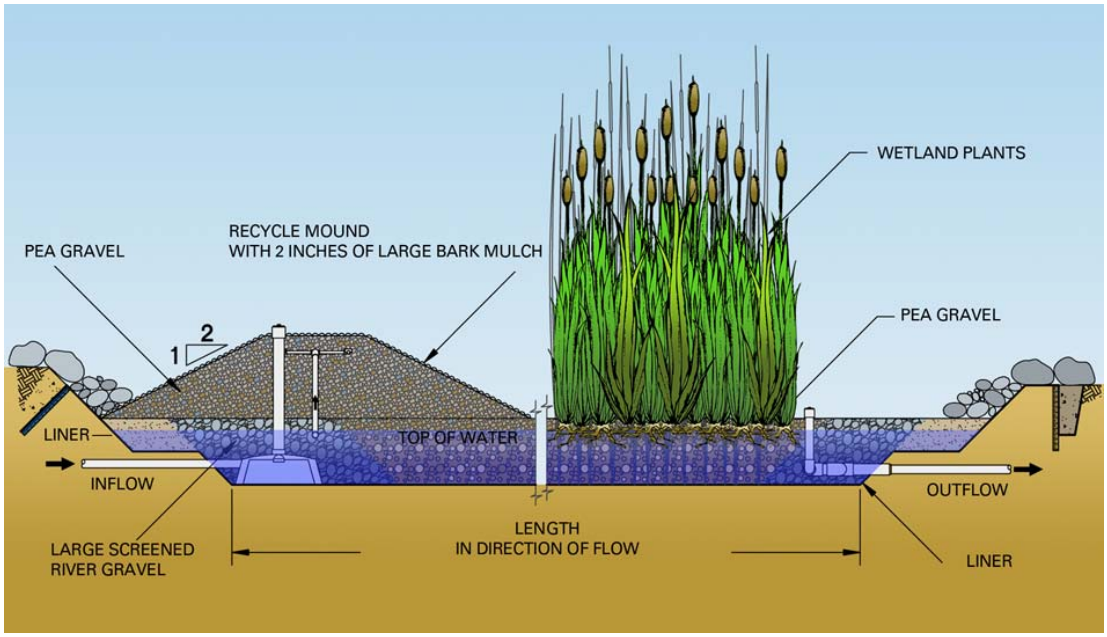
7.0 GENERAL BMP DEFINITION LIST

7.1 FILTRATION:

Bioretention: Bioretention is a flat-bottomed, shallow landscaped depression or basin used to collect and hold stormwater runoff, allowing pollutants to settle and filter out as the water infiltrates into the ground or to an underdrain, depending on soil conditions. Stormwater runoff enters the basin, where it temporarily ponds within the shallow depression and subsequently filters down through the various layers in the bioretention area.



Constructed Wetlands: Constructed wetlands are shallow marsh systems planted with emergent vegetation to treat stormwater runoff.



Filter Strips: Filter strips, or vegetated filter strips, are densely vegetated strips of gently sloping area that receives runoff from an adjacent impervious area as sheet flow. This filter strip slows the velocity of the runoff and allows for removal of sediment and other pollutants as the runoff flows through the filter strip.

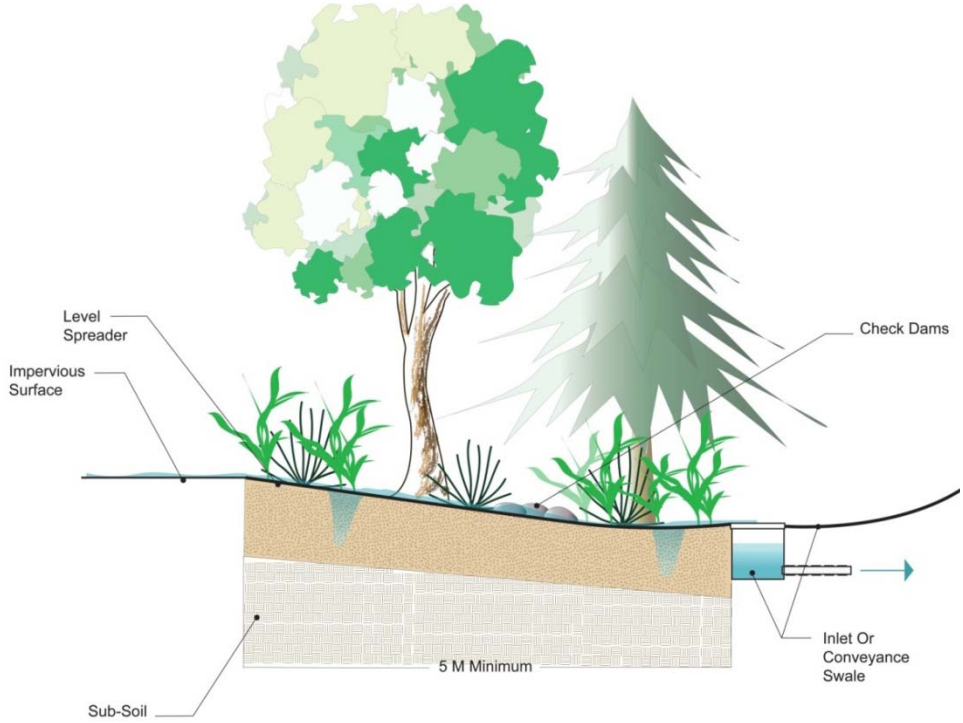
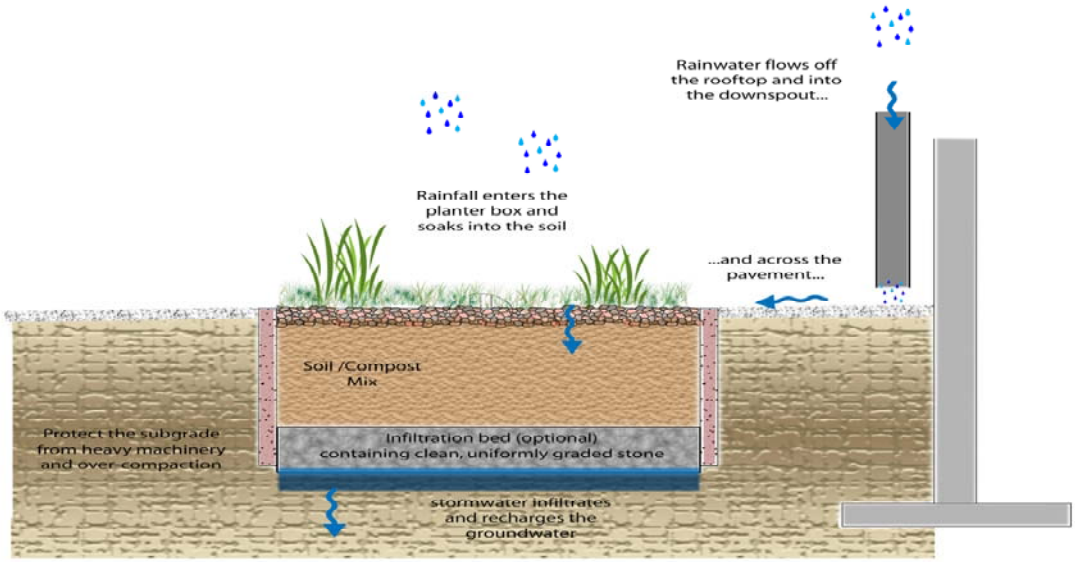


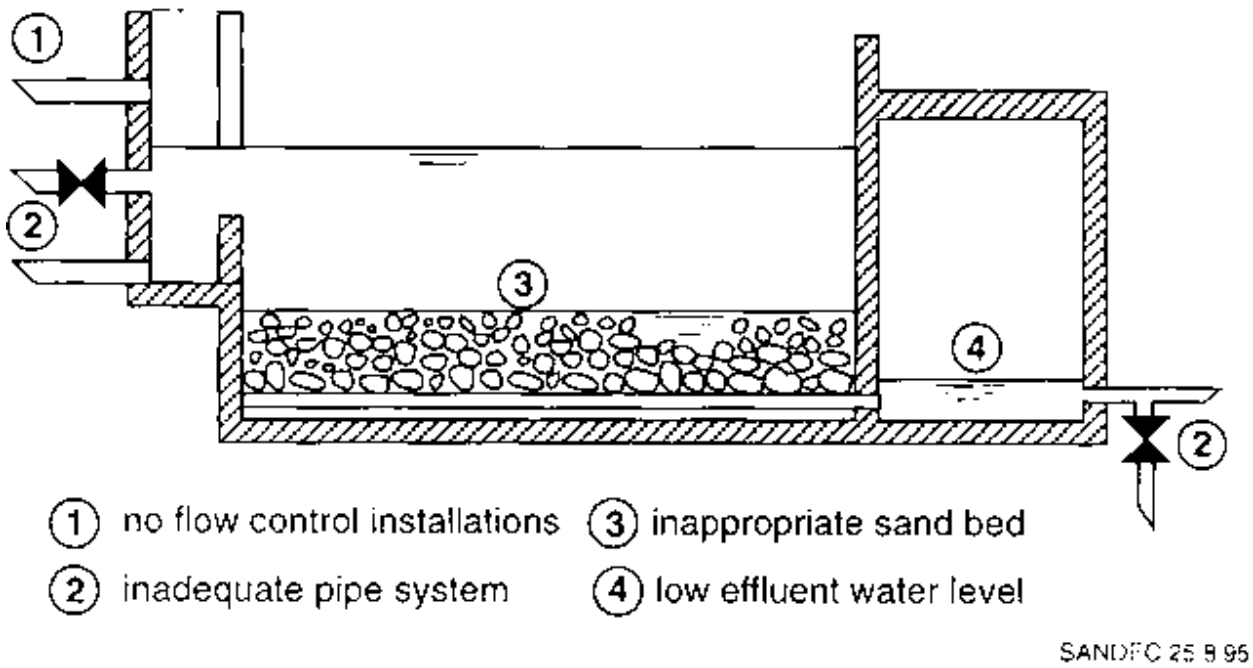
Figure 2-10
Vegetated Filter Strip
(Source: Landmark Design Group)

Green Alley: A green alley is an alley in which water is allowed to infiltrate into the soils through permeable pavement or infiltration basins, instead of being directed into a sewer system.

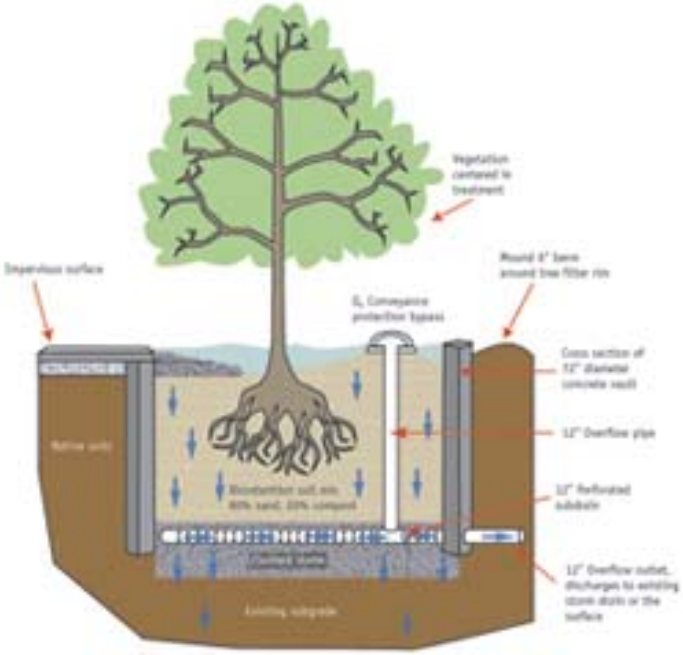
Planter Box: A planter box is a constructed box with vegetation designed to receive runoff from rooftops and filtrates the stormwater runoff.



Sand Filter: A sand filter is a device used to filter stormwater through a layer of sand to an underdrain system that conveys the stormwater to a detention facility or discharge point.



Tree Box Filter: A tree box filter is another type of bioretention filter in which stormwater runoff is directed to a box underneath a tree where the water is treated by vegetation and soil before entering an underdrain system.



Vegetated Buffer: Vegetated buffers are areas of natural or established vegetation maintained to protect water quality. Buffer zones slow stormwater runoff, provide an area where runoff can permeate the soil, contribute to ground water recharge, and filter sediment.

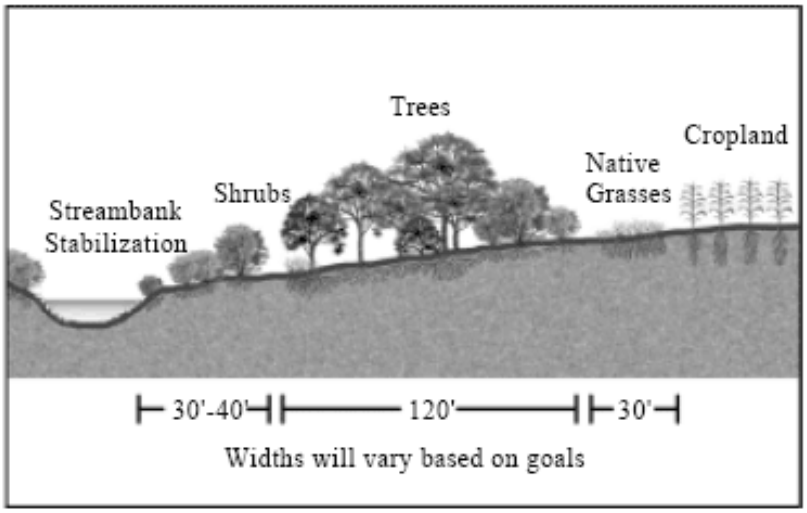
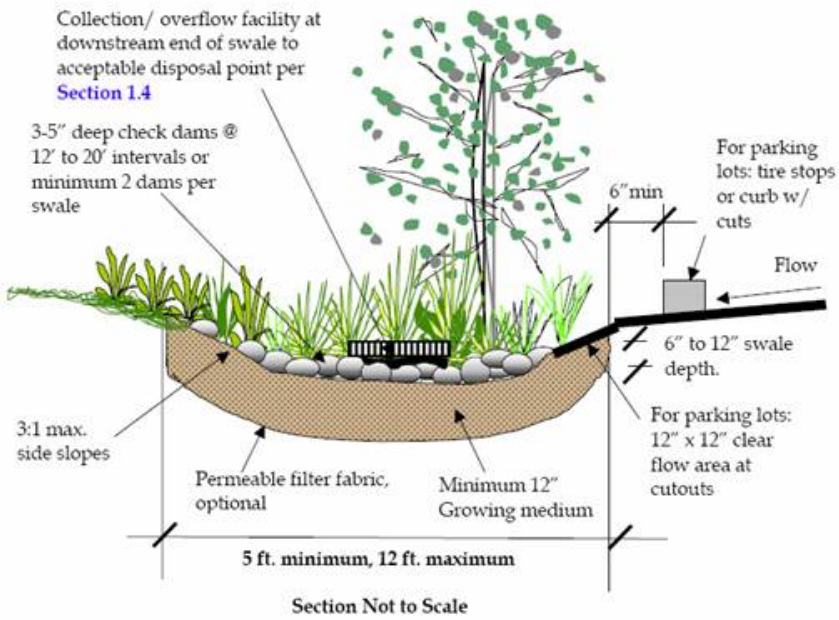


Figure 1. Cross section of an alternative buffer design.

Vegetated Roof: Vegetated (or green) roofs are made up of a layer of vegetation installed on top of a conventional flat or slightly sloped roof that absorbs rainwater in the soil media to be transpired by vegetation or discharged to another BMP or stormwater system.

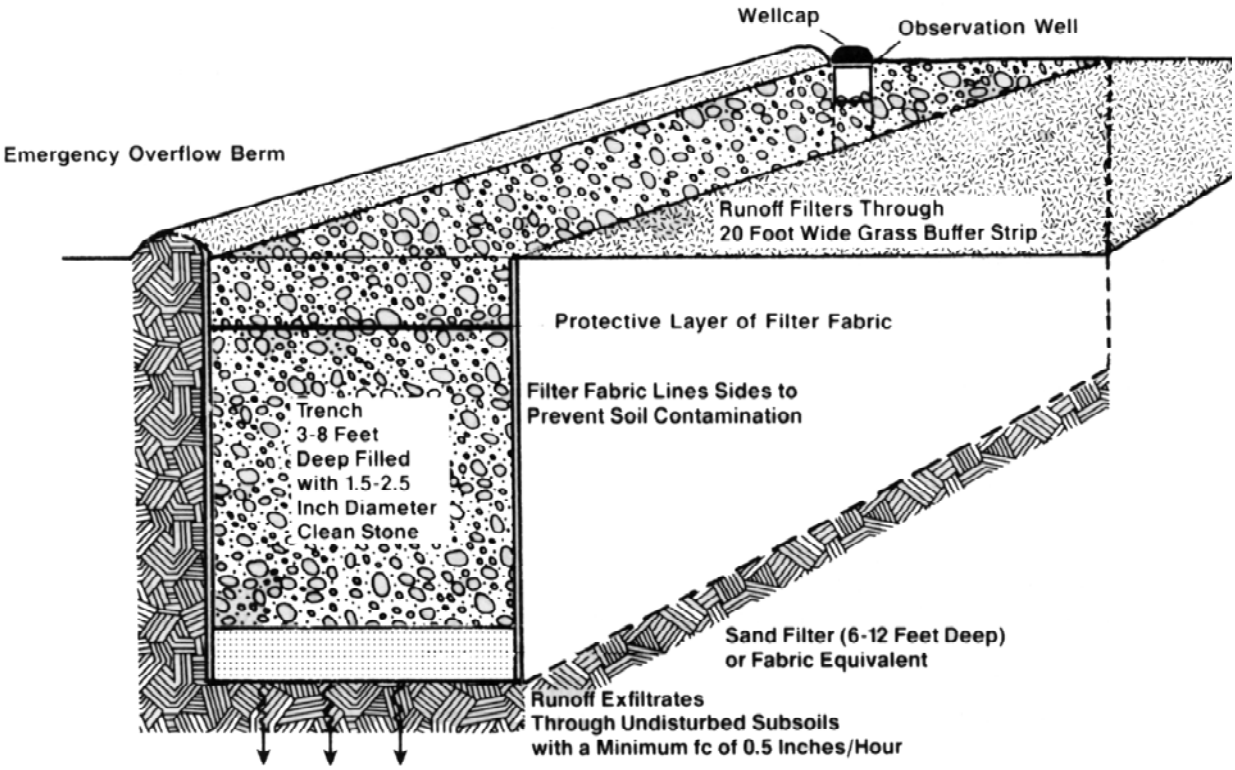
Vegetated Swales: Vegetated swales are gently sloping depressions planted with dense vegetation or grass that treat stormwater runoff from rooftops, streets, and parking lots. As the runoff flows along the length of the swale, the vegetation slows and filters it and allows it to infiltrate into the ground.



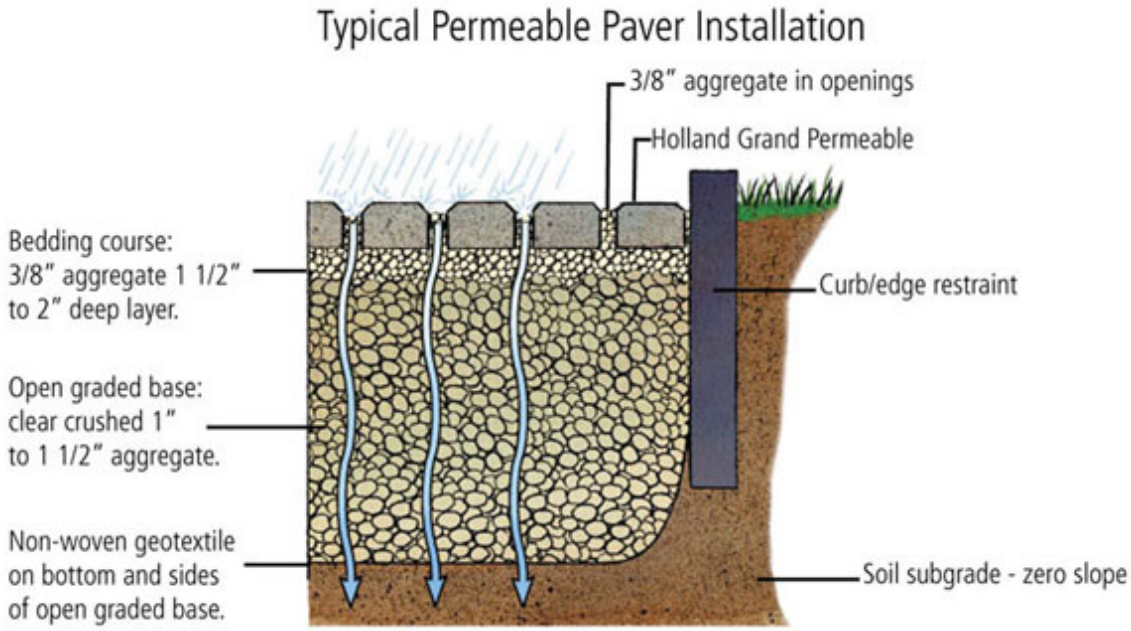
7.2 INFILTRATION:

Infiltration Basin: An infiltration basin is either a natural or constructed shallow surface impoundments that often include a flat, density vegetated floor situated over naturally permeable soils.

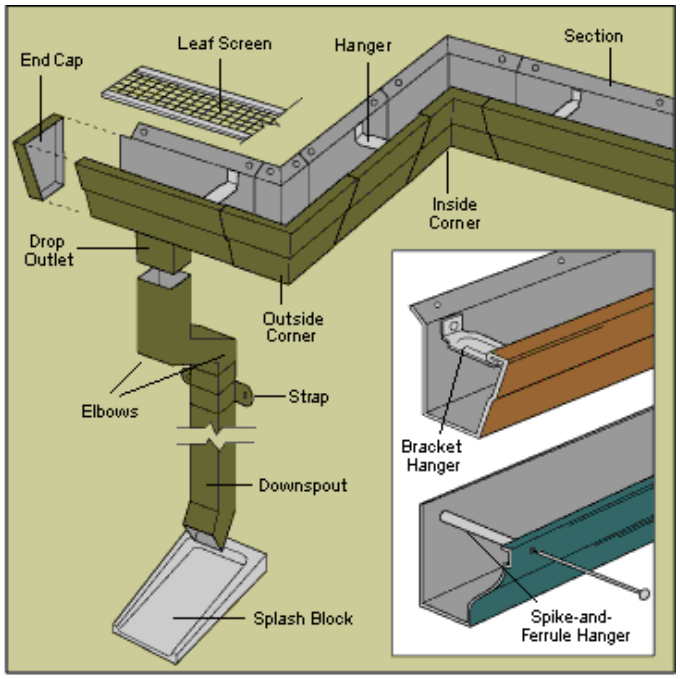
Infiltration Trench: Infiltration trenches are shallow excavations that are lined with filter fabric and filled with stone to create underground reservoirs for stormwater runoff.



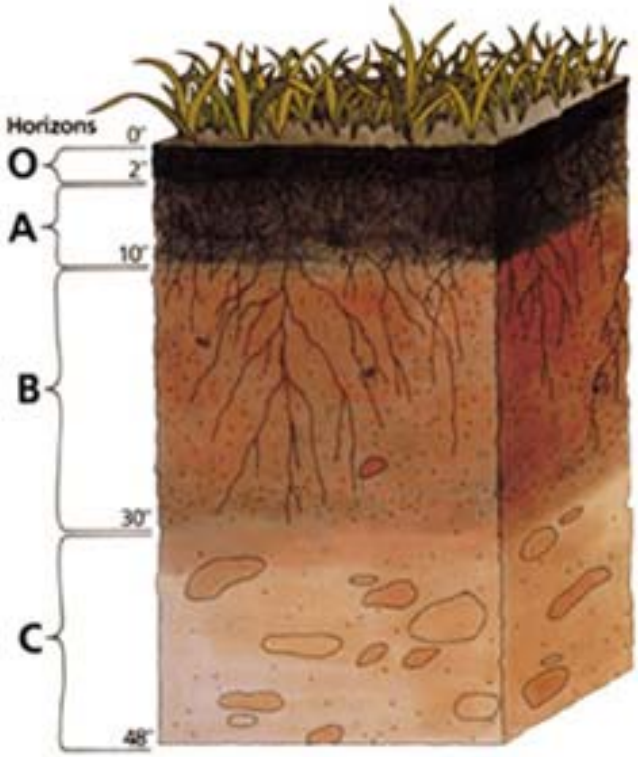
Permeable Pavers: Permeable pavers are similar to conventional pavement, but have pores or voids that allow stormwater runoff to filter through the pavement surface into an underlying stone reservoir.



Roof Downspout System: Downspout dispersion BMPs are splashblocks or gravel-filled trenches that serve to spread roof runoff over vegetated pervious areas.

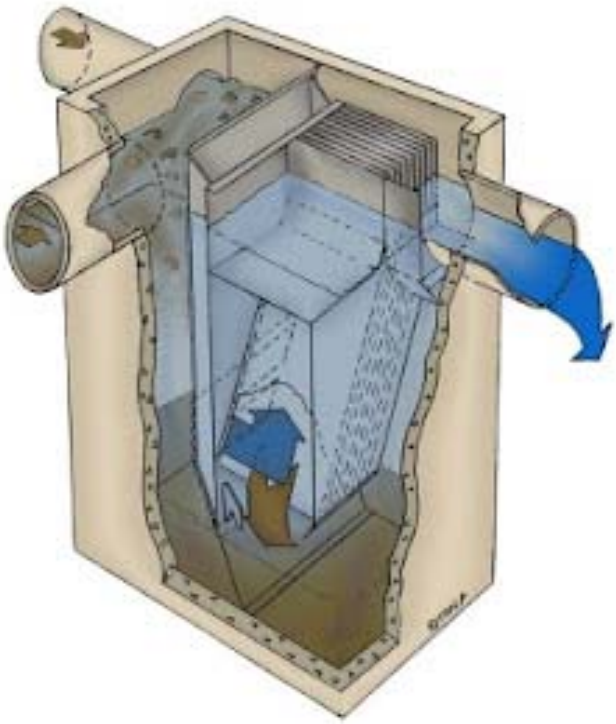


Soil Amendments: A soil amendment is a material added to a soil to improve its water retention, permeability, reduce erosion, and degrade pollutants.

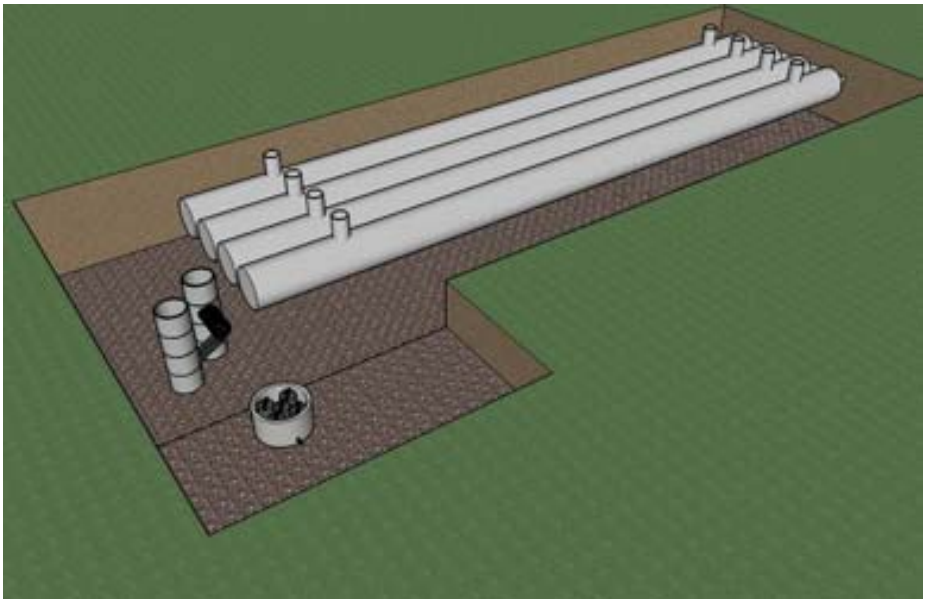


7.3 MANUFACTURED:

Proprietary: Proprietary stormwater BMPS are manufactured systems that use proprietary settling, filtration, absorption/adsorption, vortex principles, vegetation, and other processes to regulate stormwater management.



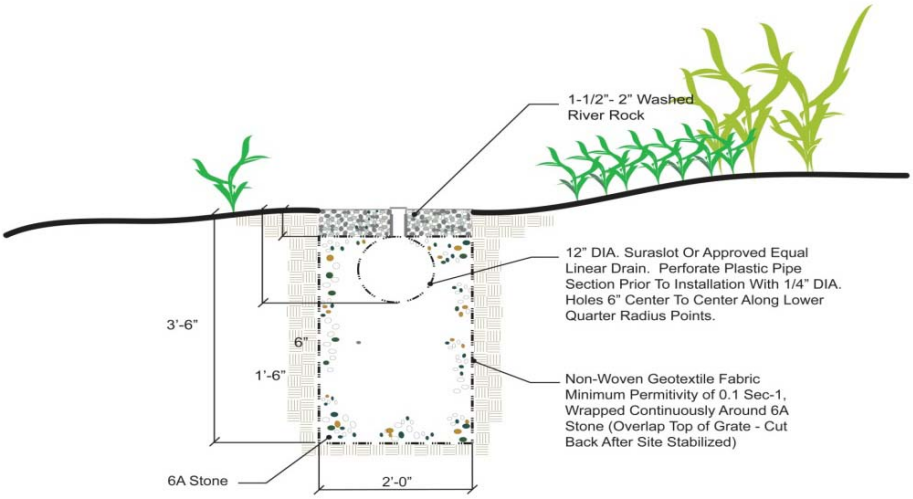
Pipe Detention: Pipe detention systems are underground pipe systems used for storing stormwater runoff.



Parking Lot Storage: A parking lot storage unit is a specialized detention basin used primarily to reduce the peak discharge of stormwater from the surrounding area.

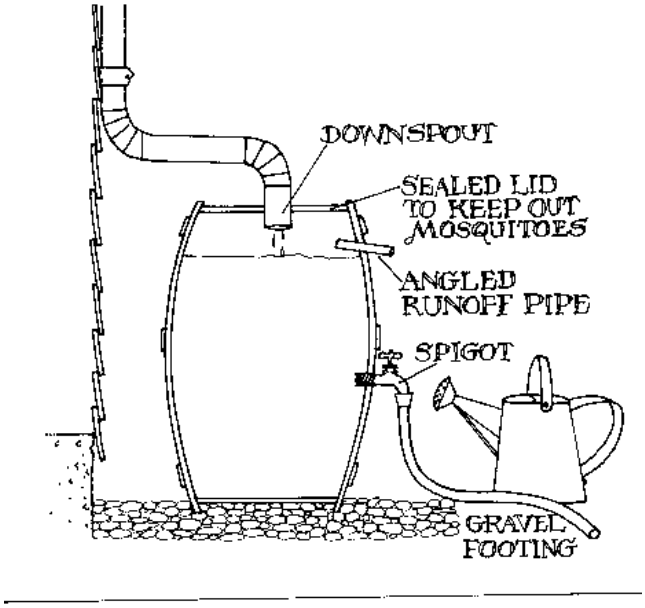
7.4 MISCELLANEOUS:

Level Spreader: A level spreader is an erosion control measure that is designed to mitigate the impact of high-velocity stormwater surface runoff, and can also serve to increase infiltration and reduce water pollution.



Check Dam: Check dams are small, temporary structures built across a swale or a channel with the primary purpose of reducing erosion and sediment level in flowing stormwater.

Stormwater Reuse (Rainbarrel): Stormwater reuse involves the collection and storage of rainwater for future use from rooftops or parking lots.



7.4 BASIN:

Acting as Sediment Basin: A sediment basin is a temporary pond built to capture eroded or disturbed sediment as it is washed away by stormwater.

Dry Basin/Pond: A dry basin is a detention pond used next to rivers, streams, or lakes to prevent from flooding by storing water for a limited period of time. They are called dry ponds because no permanent pool of water exists.

Extended Detention Dry Basin: An extended detention dry basin is a dry basin that is designed to retain excess storm water for an extended period of time.

Wet Basin: A wet basin is a detention pond that is designed as an artificial lake with vegetation around the perimeter that is used for water quality improvement, groundwater recharge, flood protection, or aesthetic improvement.

APPENDIX B
VADEQ Letter of Approval

COMMONWEALTH of VIRGINIA

DEPARTMENT OF ENVIRONMENTAL QUALITY
Street address: 629 East Main Street, Richmond, Virginia 23219
Mailing address: P.O. Box 1105, Richmond, Virginia 23218
www.deq.virginia.gov

Molly Joseph Ward
Secretary of Natural Resources

David K. Paylor
Director

(804) 698-4000
1-800-592-5482

March 22, 2016

Bill Sanders
Director of Public Works
Fort Belvoir
9820 Flagler Road, Suite 213
Fort Belvoir, VA 22060

Transmitted electronically: william.l.sanders34.civ@mail.mil

RE: Virginia Pollutant Discharge Elimination System (VPDES) MS4 Permit VAR040093, Fort Belvoir, Chesapeake Bay TMDL Action Plan Approval

Dear Mr. Sanders:

The Department of Environmental Quality (DEQ) has reviewed the Chesapeake Bay TMDL Action Plan received on September 30, 2015 in accordance with Section I.B of the General VPDES Permit for Discharges of Stormwater from Small Municipal Separate Storm Sewer Systems (MS4). Additional information was received on January 8, 2016, March 14, 2016, and March 18, 2016.

As submitted, the action plan will result in the following annual reduction of pollutants of concern in the Potomac River Basin:

Pollutant of Concern	**Annual Load Reduction (lb/yr)**	**Percentage of L2 Reduction Achieved After Implementation**
Total Nitrogen	2,664.79	109%
Total Phosphorus	681.53	289%
Total Suspended Solids	969,828	365%

The Chesapeake Bay TMDL Action Plan is hereby approved and is an enforceable part of the MS4 Program Plan. The approved action plan is based on the 2000 Urbanized Area as designated by the U.S. Census Bureau; and reductions were calculated based on land use data from 2009.

Please note any modifications to the Chesapeake Bay TMDL Action Plan shall be made in accordance with the Program Plan Modification Section of the MS4 General Permit (Section II.F).

As provided by Rule 2A:2 of the Supreme Court of Virginia, you have thirty (30) days from the date you received this decision within which to appeal this decision by filing a notice of appeal in accordance with the Rules of the Supreme Court of Virginia with the Director, Virginia Department of Environmental Quality.

Please contact Kelsey Brooks at (804) 698-4321 or at kelsey.brooks@deq.virginia.gov if you have any questions.

Sincerely,

Allan Brockenbrough II

Allan Brockenbrough II, P.E.
Manager, Office of VPDES Permits

Copies: File
Pamela J. Couch (pamela.j.couch2.civ@mail.mil)