

AN ANALYSIS OF NUTRIENT TRADING AS A MECHANISM TO MEETING TOTAL MAXIMUM DAILY  
LOADS FOR NAVAL INSTALLATIONS IN THE CHESAPEAKE BAY WATERSHED

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## **Abstract**

The Department of Defense is one of the largest Federal landholders in the Chesapeake Bay watershed with over 420,000 acres spread among 68 installations. Navy Installations located within the Chesapeake Bay watershed face constraints on construction, training operations and higher facility costs due to their impact on water quality. The Navy manages water quality and nutrient discharge, into the bay through a number of mitigation efforts to include upgrades to waste water treatment plants, adoption of best management practices (BMP's) and changes to land use. Navy installations are required to meet nutrient discharge requirements established in state Watershed Implementation Plans. Nutrient trading, is a new market based tool some states are employing to meet these requirements. Nutrient trading is a form of exchange (buying & selling) of nutrient reduction credits. A nutrient market works by establishing a mandatory cap on the combined pollution loads from multiple sources while allowing users to exchange of pollution allocations between sources. This paper examines the feasibility of nutrient trading by the Navy to meet TMDL requirements. A review of current legal environmental statutes and Department of Defense policies was conducted to determine the barriers, policy, and economic considerations for the Navy to participate in the Virginia Nutrient Credit Exchange. Data was collected from the Naval Surface Warfare Center Dahlgren VA, and Marine Corp Base Quantico VA, and various technical reports to assess the viability of nutrient trading both to meet total maximum daily load (TMDL) and Department of Defense (DoD) environmental requirements. The study found that legal statutes and DoD policy would permit trading between Navy facilities; however, federal statutes and policy changes would be required for the Navy to participate in the Virginia Nutrient Credit Exchange and other state

nutrient markets. Additionally assuming other Federal Agencies and Departments require a similar legislative change to allow the purchase of nutrient offsets, other statutes should be considered to address this issue in a consistent manner for all Federal entities. Trading may not meet the Navy's other environmental requirements for low impact development (LID), and employing best management practices and other regulatory controls to meet TMDL requirements creates additional environmental benefits that should be considered.

## **Introduction**

Widespread pollution from sewage and runoff have led to gradual but marked declines in the water quality and fisheries of the Great Lakes, Lake Champlain, Lake Tahoe, Lake Washington near Seattle and many other bodies of water. The collapse of large scale ecosystems that serve as nutrient sinks such as the Chesapeake Bay and Long Island Sound provide ample evidence that the of the unregulated impact of nutrient runoff. Several mitigation strategies have been put in place to address the problem. Improvements in waste water treatment plants, changing land use, elimination of phosphorous detergents, employing best management practices and the adoption of no-till agricultural all have contributed to reductions in total pollutant loadings. In the Chesapeake Bay watershed nutrient markets are another strategy some states are employing to further reduce and manage nutrient loads.

The Chesapeake Bay watershed is 64,000 square miles and has 11,600 miles of tidal shoreline, including tidal wetlands and islands. The watershed encompasses parts of six states: New York, Pennsylvania, Delaware, Maryland, Virginia, and West Virginia and the District of Columbia. More than 150 rivers and streams drain into the bay and approximately 17 million

people live in the watershed; about 10 million people live along its shores or near them (Chesapeake Bay Program 2001).

Excess nitrogen and phosphorous pollution originating from agricultural activities, storm water runoff, wastewater discharges, and industrial discharges has been a significant problem for the bay. Nutrients can deplete oxygen levels in the water and cause algal/bacterial blooms placing stress on aquatic life. Excess sediment in the water can affect habitats and breeding areas, and can prevent aquatic plants from receiving adequate sunlight. In addition, excess sediment is deposited in navigable waterways, requiring dredging to maintain shipping channels thus affecting naval operations and training (DoD 2008). Non-point sources - in particular agricultural polluters - account for more than 80% of the country's nitrogen and phosphorous discharges (Nishizawa 2003).

To address pollution in the bay, revisions of The Clean Water Act, were enacted in 2010, through Executive Order 13508 which required states to develop Total Maximum Daily Load (TMDL) standards for the Chesapeake Bay. Conceptually, the TMDL is the level of pollution load a water body can receive and remain healthy. TMDL standards are established and codified in watershed implementation plans prepared by the states that are contiguous to the bay, Delaware, District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. The goal of the Chesapeake Bay TMDL is to ensure that all pollution control measures needed to fully restore the Bay and meet TMDL standards are in place by 2025, with at least 60 percent of the actions completed by 2017(Pomeroy 2011).

### *Nutrient Trading Overview*

Nutrient trading is a new market based tool some states are employing to meet TMDL requirements. Nutrient trading is a form of exchange (buying & selling) of nutrient reduction credits. A nutrient market works by establishing a mandatory cap on the combined pollution loads from multiple sources. In the Chesapeake Bay, caps are established for nitrogen and phosphorous discharge and defined as waste load allocations in the states watershed implementation plans. Nutrient markets permit the trading of individual loads among individual sources to determine where and how the load reductions occur to meet the cap. Trading takes advantage of the fact that the multiple sources face different costs when seeking to accomplish the load reductions. Credits have a monetary value that may be paid to the seller for implementing Best Management Practices (BMPs) to reduce nitrogen or phosphorous export. Trading allows those sources with relatively low costs to generate “nutrient credits” by reducing loads by more than is required. The generator of the credits can then sell these credits to relatively high-cost sources, allowing the purchaser to de facto “reduce” its load at less cost. As a market-based approach, increased efficiency and cost-effectiveness are achieved by letting the market determine price and by encouraging reductions in sectors that can easily achieve them .

Trading can produce several advantages over regulatory approaches to include; reducing costs for individual sources contributing to water quality problems; allowing dischargers to take advantage of economies of scale and treatment efficiencies that vary from source to source; reducing overall cost of addressing water quality problems in the watershed and creating market demand for new innovative technologies.

Trading programs can involve exchanges between different point sources and nonpoint sources. A “point source” is typically associated with discharges from wastewater treatment plants. A “nonpoint source” includes the nitrogen and phosphorus runs off from land agricultural land is the largest source of nonpoint source run off. Non point sources also can include nitrogen and phosphorous from other groundwater sources and septic systems.

Point source and non point source trading programs have different monitoring and verification regimes. Point source trading can be self monitored. Participants’ can monitor nutrient levels from the discharge of waste water treatment plants instantaneously and precisely.

Land use and employed best management practices (BMPs) are used to estimate run off and generate nutrient credits from non point sources. Non point source controls require inspections to ensure the control is properly sited, the materials and plans satisfy established quality specifications, and the installation job meets performance standards. Non point source controls should be subject to an annual on-site assessment by a qualified inspector to ensure proper functionality (e.g., look for signs of sedimentation and erosion to identify inefficient BMPs).

## **Methods and Materials**

The Navy currently does not have the legal authority or policy framework in place to participate in nutrient trading markets established by states in the Chesapeake Bay watershed. This study examines: the governance structure, barriers, policy, and economic considerations relevant to potential Navy participation in the Virginia Nutrient Trading Market. Specifically the

study examined current legal and Department of Defense policy barriers and potential legislative authorities the Navy could use to participate in nutrient trading programs, conditions when trading would be advantageous with current navy regulations, and economic and environmental considerations for trading. Data was collected from the Naval Surface Warfare Center Dahlgren VA, and Marine Corp Base Quantico VA, and various technical reports to assess the viability of nutrient trading to meet both total maximum daily load (TMDL) and DoD environmental requirements . For these installations, a simple cost comparison was performed to illustrate the potential benefits of trading between Department of Defense facilities.

## **Background**

The Department of Defense (DoD) maintains 68 installations within the Chesapeake Bay watershed. The Navy operates 40 of the 68 installations and has the most impact on the watershed and the bay of any of the DoD components. These installations cover approximately 420,000 acres of land and make up 1% of the Bay watershed (DoD 2008). As a result, DoD is one of the largest federal landholders in the watershed (DoD 2008). The installations vary widely in uses and functions. Some reside in urban areas and are intensely developed, like Fort Myer, Naval Support Facility Carderock, and Andrews Air Force Base. Other installations are largely undeveloped, such as Fort A.P. Hill, Marine Corps Base Quantico, and Fort Indiantown Gap.

To mitigate nutrient runoff into the bay, all Department of Defense facilities located in the Chesapeake Bay watershed are required to establish nutrient and sediment loads, evaluate existing storm water Best Management Practices (BMPs) to calculate load reductions, and work

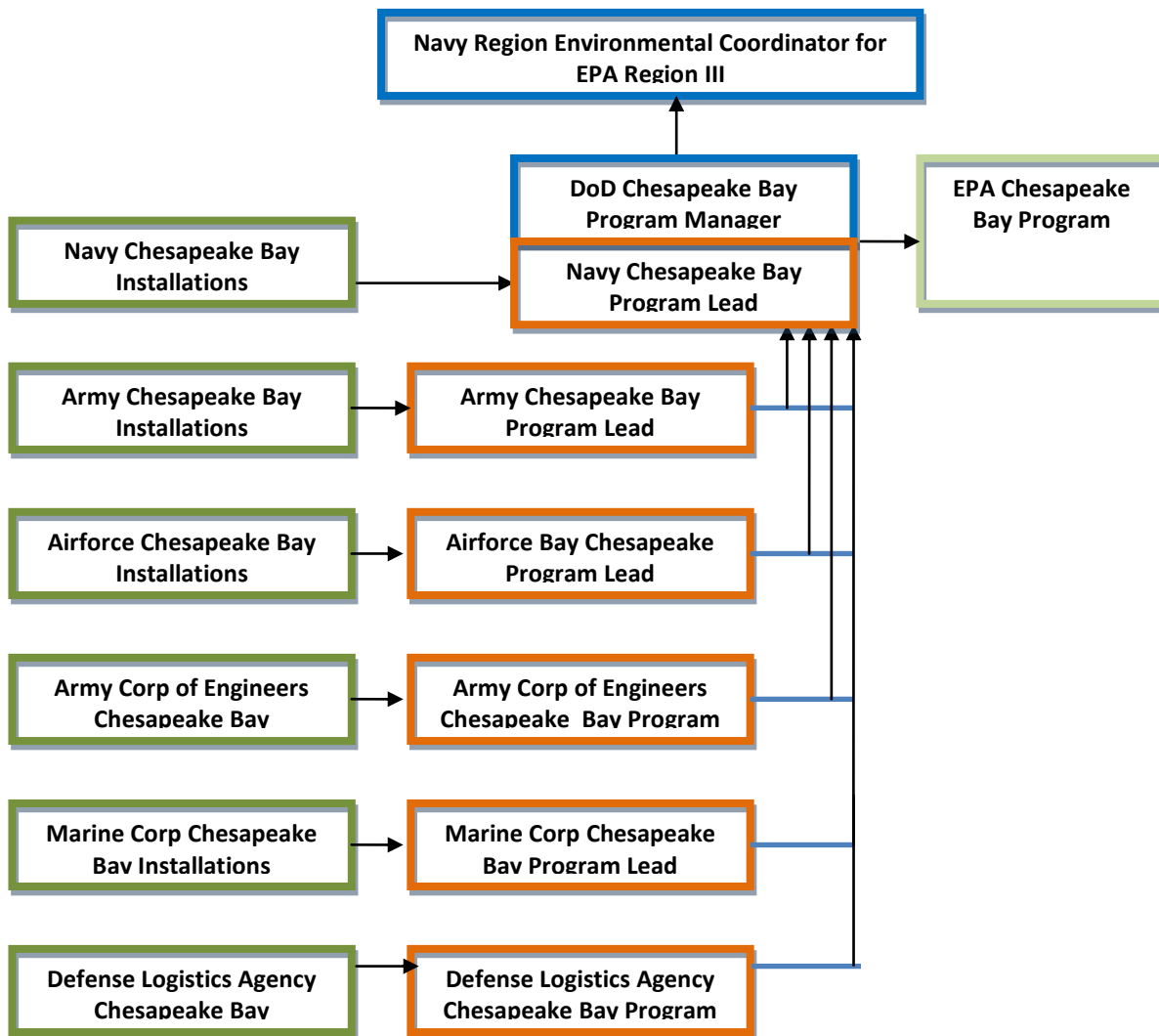
with regulators to determine their individual allocations. These allocations are used to set maximum pollutant loads associated with existing and future permits for point sources, including wastewater treatment plants and septic systems, and nonpoint sources, including urban storm water runoff, construction projects, fertilizer applications, and deposition of air emissions.

#### *Department of Defense and the Chesapeake Bay Program Governance Structure*

The Department of Defense is an active participant in the Chesapeake Bay Program, a regional partnership that has led the restoration and protection efforts for the Chesapeake Bay since 1983. Other Bay Program partners include the states of Maryland, Pennsylvania; and Virginia; the District of Columbia; the Chesapeake Bay Commission; the federal government; universities; and participating citizen advisory groups.

Commander Navy Region Mid-Atlantic, the Navy Commander responsible for all shore facilities in the mid-Atlantic region, serves as the Navy Regional Environmental Coordinator and the Department of Defense Executive Lead Agent for the Chesapeake Bay Program (Figure 1). The Regional Environmental Coordinator organizes the implementation of program goals and initiatives throughout all military services. Each military service also has a Chesapeake Bay Program Coordinator. The service coordinators provide natural resources guidance and facilitate research and restoration projects at the military installations located within the Chesapeake Bay watershed.

Figure 1. Chesapeake Bay Program Governance Structure



The Chesapeake Bay Program partners established nutrient trading principles and guidelines in 2001. These principles include:

- Trades must not impair water quality or violate water quality standards or criteria, or adversely affect living resources and habitat;
- Trading can occur only within each major Bay tributary;

- Any trading program must be consistent with federal, state, and local laws and regulations
- Traders must be in substantial compliance with all local, state, and federal environmental laws, regulations, and programs. (Chesapeake Bay Program 2001)

Under the agreements in place with the Chesapeake Bay Program partners, the Navy would be required to meet the key principles agreed upon by the Bay partners before participating in a nutrient trading program.

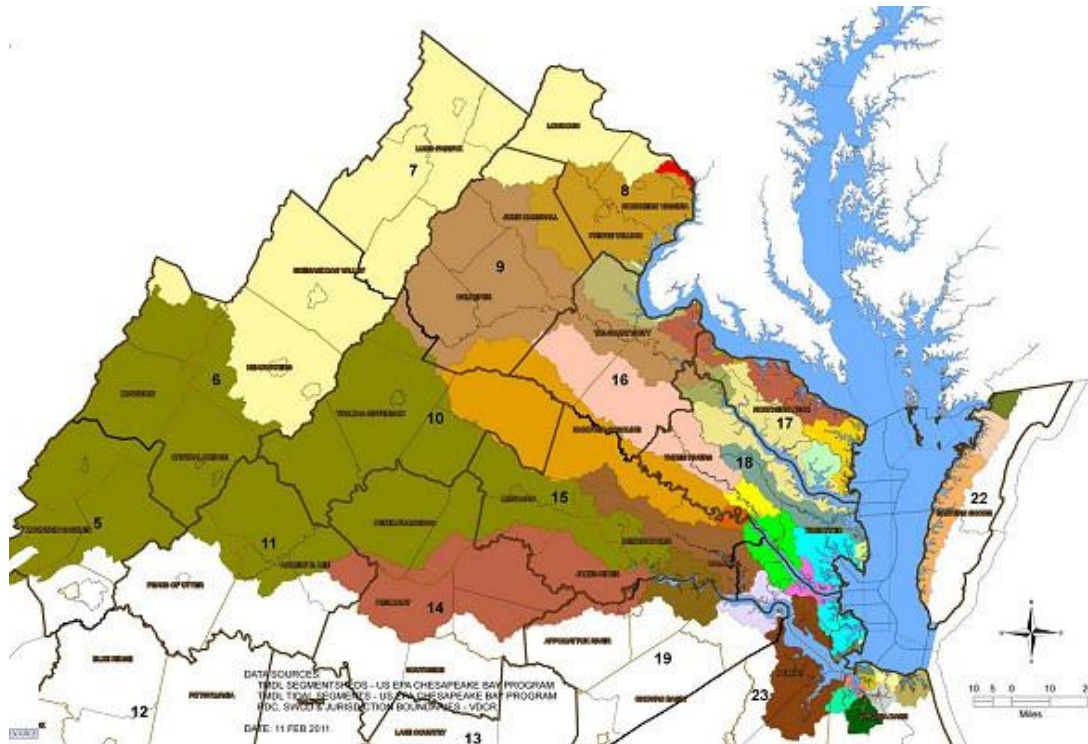
#### *Watershed Implementation Plans*

Navy installations located within the Chesapeake Bay watershed are included in the watershed implementation plans (WIP) of their respective states. In particular, the WIPs define specific annual load limits (i.e., allocations) for individual point sources and for nonpoint source sectors located in the Bay watershed, or in the unique case of Pennsylvania, aggregate allocations for each source sector by river basin. In general terms, the word load refers to the total amount of pollutants entering a water body from one or multiple sources, measured as a rate, as in weight per unit time or per unit area. Loading capacity is the greatest amount of a pollutant that a body of water can assimilate and still meet water quality standards. Some WIPs include nutrient credit trading among the strategies for achieving the states' pollution allocation. For the purposes of developing a watershed implementation plans, the Chesapeake Bay's tidal waters have been divided into 92 tidal water segments. There are 35 segments controlled by Virginia and another 5 Maryland owned segments that include Virginia drainage areas. It specifies annual nitrogen and phosphorus load limits for each of these 92 segments. The states' plans for achieving these 184 (92 x 2) limits are detailed in their Watershed

Implementation Plans (WIPs). The different water segments are determined by their varying degrees of salinity. Upstream segments that are primarily fresh water are much larger (For example, all of the Upper and Middle James drain to the "tidal fresh" segment just above Richmond), segments closer to the bay have salinities change more frequently, which accounts for the smaller segments. Figure 2 illustrates the 23 of the 35 water segments, the different colors on the map represent the Virginia lands that drain to each of those tidal segments Virginia (VDEQ 2012).

Watershed Implementation Plans (WIP's) establish the Total Maximum Daily Load (TMDL) requirements for landowners, including Naval Installations, within the boundaries of the WIP. The TMDL represents the sum of all allowed point and non-point source pollutants of a single contaminant. TMDL is calculated by adding the individual waste load allocations (WLAs) for point sources, load allocations (LAs) for nonpoint sources and natural background, and a margin of safety (MOS). TMDLs can be expressed in terms of mass per time, toxicity, or other appropriate measures that relate to a state's water quality standard. Mathematically TMDL can be expressed as  $TMDL = MOS + WLA + LA$ .

**Figure 2: Virginia Watershed Implementation Plans**



Colors on the map represent the Virginia lands that drain to each of the 35 tidal segments

To meet TMDL standards for point sources water quality-based effluent limitations (WQBELs) are developed and incorporated into discharge permits for these sources. The permits are issued by EPA and state agencies under the National Pollutant Discharge Elimination System (NPDES). Each DoD Installation is assigned its own NPDES permit.

### *Current Policy Framework*

Environmental markets were identified as part of the May 2010 Executive Order (EO) 13508 Strategy for Protecting and Restoring the Chesapeake Bay Watershed as an emerging and innovative approach to natural resource management that can accomplish environmental goals, encourage new technologies, improve efficiencies, reduce costs and help manage

growth. Under EO 13508 The United States Department of Agriculture (USDA), has the lead, in coordination with EPA and other federal agencies, in establishing an environmental market infrastructure in support of meeting water quality goals (TMDLs) to reduce nutrients and sediment. Collaboration across federal agencies is facilitated by the Environmental Markets Team (EMT) chartered to improve and address some of the challenges associated with transparency, accountability, and consistency.

In accordance with the EMT charter, USDA leads the Environmental Markets Team (EMT) to assess existing and emerging environmental markets, explore areas of new market opportunities, and use the knowledge obtained to improve effectiveness and efficiencies (USDA 2012). In December 2010, the EMT prepared “Considerations for Baseline Eligibility Applied to Water Quality Credit Programs Implemented Under a Chesapeake Bay Total Maximum Daily Load (TMDL).” The document discusses how baselines are established and how those decisions impact source sectors to generate and sell nutrient reduction credits. It provides wide-ranging background on environmental markets and water quality trading.

The EMT has identified the following common opportunities for generating Nutrient Credit:

- Performing nutrient removal at a Wastewater Treatment Plant (WWTP) at a higher level than required by permit,
- Exceeding post construction nutrient reduction for development and redevelopment,
- Exceeding baseline agricultural Best Management Practice (BMP) implementation on farmland,
- Converting land use,

- Completing restoration projects not required for nutrient reduction associated with a permit, regulation or TMDL, or
- Implementing innovative nutrient reduction technologies.

The following are common opportunities for the use of Nutrient Credits:

- When a WWTP is unable to meet reductions required by its permit,
- Supplementing post construction nutrient reduction requirements if BMPs alone will not meet the necessary reduction,
- Substituting a portion of urban storm water management retrofit requirements in an MS4 permit,
- Substituting a portion of industrial storm water nutrient reduction required in a National Pollutant Discharge Elimination System (NPDES) permit, or
- Needing to meet any nutrient reduction requirements other than above that may be required by a TMDL.

To participate in Nutrient Credit Trading programs, Navy must consider requirements for both point and non-point source discharges. Under the EMT guidelines the Navy can generate Nutrient Credits by:

- Upgrading WWTPs where the plant consistently exceeds permit required nutrient reductions thus generating credits for point source nutrient credits
- Exceeding post construction nutrient control requirements in State construction storm water permits while meeting Navy LID Policy and/or Section 438 of the Energy

Independence and Security Act (EISA) requirements for development/redevelopment post construction storm water management control<sup>1</sup>

- Converting land to a lower nutrient generating use practice; for example converting farmland to meadow, developed land to managed turf, or meadow or forest, etc.

Navy may wish to use Nutrient Credits when:

- Upgrading WWTPs and the plant is unable to meet permit requirements by the compliance deadline (point source credits)
- Expanding a WWTP or building a new WWTP to offset the additional or new load (non-point source credits)
- Developing or redeveloping projects in highly developed areas where Navy LID Policy or Section 438 of EISA requirements cannot be met
- Installing retrofits in accordance with the Bay TMDL where cost prohibitive
- Meeting nutrient reductions in Industrial storm water permit.

### **Feasibility of Navy Participating in the Virginia Nutrient Trading Market**

In order to determine feasibility and whether an immediate opportunity exists for the Navy to participate in state administered nutrient markets the following items were considered; the legal purchase authority required to participate in state run markets, an examination of the

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<sup>1</sup> EISA requires Federal Agencies to develop and redevelop facilities in a manner that maintains or restores predevelopment hydrology using LID/Green infrastructure practices to the maximum extent technically feasible. More specifically, EISA 438 is intended to ensure receiving waters, aquatic biota, stream channel stability and historical aquifer recharge rates are not negatively impacted by changes to runoff temperature, volumes, durations

current and expanding Virginia nutrient credit trading program, construction permit/compliance requirements, and cost viability.

### *Legal Considerations*

Currently, no authority has been identified that would allow Navy, DoD and possibly other Federal Agencies and Departments, to participate in Virginia's water quality based nutrient trading program. For DoD, an existing statute, preferably 10 U.S.C. § 2694, could be amended to permit military installation participation (see below). The following legislative authorities were reviewed as potential authorities to participate in nutrient trading programs under conditions specified in each statute.

#### Conservation Banking Program, 10 U.S.C. § 2694c

Conservation mitigation banks are permanently protected public or private lands used as tools to offset adverse impacts to protected (or pending protection) species or their habitat, under any applicable provision of law. This statute authorizes payment into a conservation banking program or approved "in-lieu-fee" mitigation sponsor under specific conditions listed in the statute. Activities covered under the program include military testing, operation, training, or other military activity; or military construction. Payments made to a conservation-banking program or "in-lieu-fee" mitigation sponsor for military construction are eligible program costs of MILCON projects. Operation & Maintenance; Military Construction (MILCON); and Research, Development, Test, and Evaluation (RDT&E) funds may be used. This statute specifically applies to conservation banking programs, and would not apply to, nor would it authorize participation in the Virginia Nutrient Market offset program.

Wetland Mitigation Banks, 10 U.S.C. § 2694b

Wetland mitigation banks are used for the restoration, creation, enhancement, and in exceptional circumstances, the preservation of wetlands, and/or other aquatic resources “expressly for the purpose of providing compensatory mitigation in advance of authorized impacts to similar resources.” This provision authorizes payment into a wetland mitigation banking program or “in-lieu-fee” mitigation sponsor, when activities may or will result in the destruction or adverse impact to wetlands. Payments into the program are treated as eligible program costs for MILCON projects. Similar to the provision above, the wetland mitigation statute would not authorize participation in the Virginia Storm water non-point source nutrient offset program, which is a nutrient program based on water quality.

Clean Water Act, section on Effluent limitations, 33 U.S.C. § 1311(b)(1)(C), and others

This provision could provide a potential authority for participation in a point source nutrient offset/trading program. This provision was reviewed in conjunction with Clean Water Act §§ 303(d) and 402(b). Although a DoD Study identified Clean Water Act requirements as a potential basis for federal participation in a water quality based nutrient trading program, it is unclear whether a separate authorization would still be necessary before participating in the program. This would require a formal legal ruling by the Navy Judge Advocate. A similar circumstance existed for the federal government before passage of 10 U.S.C. § 2694b above. The current analysis is that CWA requirements cannot be used as a basis for participation in a water quality based nutrient trading program.

The most viable means to include the Navy in the Virginia Nutrient Trading Market is to amend 10 U.S.C. § 2694, by adding a specific provision for DoD participation in state nutrient

trading programs. Amending this section offers symmetry in that Congress has already authorized the wetland mitigation and conservation banking Programs under this statute. Assuming other Federal Agencies and Departments require a similar legislative change to allow the purchase of nutrient offsets, other statutes should be considered to address this issue in a consistent manner for all Federal entities.

#### *Navy Policy Considerations*

Storm water management on Naval facilities is not only evaluated using Virginia Storm Management Program (VSMP) regulations, but must also comply with the Navy's LID Policy and provisions of Energy Independence and Security Act (EISA) Section 438 ( EISA 438). The Navy LID Policy requires "no net increase in storm water runoff volume and sediment or nutrient loading" and EISA 438 requires "maintaining or restoring, to the maximum extent technically feasible (METF), the predevelopment hydrology with regard to temperature, rate, volume, and duration of flow". Where the Navy LID Policy requirements cannot be met, a waiver is required. If after finalizing such a waiver and the Virginia storm water post construction nutrient reduction requirements cannot be met, the purchase of offsets would be acceptable under the Navy LID Policy. However, simple reliance on offsets for nutrient reduction requirements would not meet the other requirements of the LID policy and therefore the Policy would need to be revised to allow this approach. EISA Section 438 allows for off-site options. Each project must be evaluated with regards to both legal and policy drivers.

### *Economic Considerations*

Table 1 provides estimated average construction costs for various Low impact development best management practices (LID BMPs) to remove one pound of phosphorus per year in Virginia. These costs were developed from: an October 2011 University of Maryland Center for Environmental Science Draft Technical Report, "Costs of Storm water Management Practices in Maryland Counties" (Cost of BMP to treat an impervious acre); 2010 Center for Watershed Protection data (BMP costs), an April 2008 "Technical Memorandum: Runoff Reduction Method" from the Center for Watershed Protection (TP removal efficiencies); and the Virginia Runoff Reduction Method spreadsheet (TP from impervious acre). The BMP costs were normalized to account for the relative differences in phosphorus removal efficiencies. It was assumed that if a BMP was 100% efficient at Phosphorus removal, that 2.17 pounds of phosphorus generated in storm water runoff from an acre of impervious land cover would be removed. See Appendix 1, for details on cost calculations. The costs are for isolated construction of a BMP and will vary based on site-specific design, mobilization, and material/transportation cost considerations. Costs do not consider the potential to scale up the BMPs already being constructed for a project to meet Navy's LID Policy and comply with EISA Section 438 requirements this could potentially reduce the marginal costs of direct load reduction. Costs do not consider that federal government project costs are typically higher than private sector project costs. Costs would increase for construction in highly urbanized areas.

**Table 1: Estimated BMP Construction Costs to Remove One Pound of Phosphorus in Virginia**

<b>BMP</b>	<b>Cost</b>
Vegetated Open Channel	\$43,000
Bio-swale	\$28,000
Bio-retention	\$58,000
Infiltration Practice	\$39,000
Permeable Pavers	\$221,000
Green Roof	\$709,000

The current price for a pound of phosphorous offset on the Virginia Nutrient Trading market is estimated to cost between \$14,000 and \$21,000, and appears at face value to be the lowest cost option. However, the use of nutrient credits in Virginia may fall short in meeting volume, temperature, rate of runoff, and nitrogen removal requirements under Navy LID Policy and provisions of Section 438 of EISA. In addition, there may be other benefits to the installation and use of a BMP, such as a green roof contributing energy conservation. On the other hand, the Navy does not need to maintain a credit purchased from a nutrient credit bank. Bottom line, the above general capital cost estimates do not allow a good life cycle cost comparison. More work needs to be done to compare actual projects to the above costs to determine what is the true cost of the BMP and its phosphorus removal (in pounds), exclusive of the other storm water controls required for the project (i.e. infrastructure).

### *Implementation Options*

There are several instances when nutrient trading could complement existing Navy Regulations. Site-specific technical constraints such as poor draining soils, high water table, contaminated soils, minimal use for harvested water, intense development restricting space for BMPs, etc. - can prevent full conformance with the LID Policy goal and the EISA 438 requirement for post-construction storm water management. Under these circumstances, the Best Management Practices (BMPs) installed to partially meet Navy/EISA drivers may also not fully meet Virginia post-construction phosphorus control requirements. In this situation, a nutrient credit purchase would provide an opportunity to satisfy the remaining Virginia requirement. Other examples where nutrient credit purchasing could prove beneficial are for projects:

- Defined strictly as redevelopment. The Navy LID Policy and the DOD policy for implementing EISA 438 only require maintaining pre-project hydrology and nutrient loading. However, Virginia requires a percent reduction from the pre-project phosphorus loading.
- Required to meet MS4 storm water retrofit requirements.

### **Virginia's Current and Expanding Nutrient Credit Trading Program**

The most mature nutrient trading market the Navy could participate in is the Virginia Nutrient Credit Trading Program run by the Virginia Department of Environmental Quality. Virginia has operated a nutrient credit exchange program since 2005. The current program allows nutrient credits generated by point sources (WWTPs) to be used by other WWTPs and

limited non-point nutrient credit exchanges. The 2012 General Assembly passed legislation to amend the existing nutrient trading program. The expansion is part of Virginia’s plan to implement the Chesapeake Bay TMDL, allowing more non-point source exchanges to provide additional opportunities for regulated entities to meet allocations for nutrient reduction requirements as required in their NPDES permits. The table below illustrates the differences between the existing and expanded programs (VDEQ 2012).

**Table 2 : Virginia Current and Expanding Nutrient Credit Exchange Program**

Existing Program		Expanding Program	
Wastewater	Buy/Sell PS <sup>1</sup> to PS	Wastewater	Buy/Sell PS to PS
Forest Land – New	Sell to PS	Forest Land – New	Sell to PS or NPS
Agriculture	Sell to PS	Agriculture	Sell to PS or NPS
Storm water- New Development	Buy from NPS <sup>2</sup> credit broker	Storm water- New & Existing Development <sup>3</sup>	Buy/Sell NPS to NPS

<sup>1</sup> Point Source

<sup>2</sup> Non-point source

<sup>3</sup> Includes MS4 storm water retrofit requirements

Under the Virginia Storm water Management Program (VSMP) and pursuant to Virginia Code § 10.1-603.8:1, VSMP permit applicants are eligible to use offsets to meet post construction (not during construction) water quality requirements resulting from a development/redevelopment project. Projects qualify for nutrient offset use, and permit issuing authorities shall allow the use of those offsets, when:

1. The project will disturb less than 5 acres of land; or

2. The post construction phosphorus removal requirement of the project is less than 10 lbs. per year; or
3. The applicant demonstrates that on-site practices have been considered to the maximum extent practicable (MEP) and that full compliance to the water quality requirements cannot be met on-site. If the applicant demonstrates that 75% of the water quality requirement is met on-site, control to the MEP is considered to have been met.

For that portion of a site's compliance with storm water non-point nutrient runoff water quality criteria being obtained through nutrient credits, the applicant shall: comply with a 1:1 ratio of the nutrient credits to the site's remaining post-development non-point nutrient runoff compliance requirement being met by credit use and use credits certified as perpetual credits. Nutrient credits purchased for compliance with post-construction storm water requirements must be perpetual credits meaning the land uses/land management practices remain in place in perpetuity. The Commonwealth of Virginia requires that these credits be certified and that the land be protected through deed restriction or easements that remain in place should corrective action be required.

The Virginia Department of Environmental Quality (DEQ) ensures the responsibility for maintaining perpetual credits purchased remains with the nutrient credit provider (bank).

Within the Program, Virginia provides assurances for the purchaser of nutrient offsets:

- Offset providers (nutrient credit bankers) are licensed to do business in Virginia.

- Offset providers must adhere to the terms of the Nutrient Reduction Implementation Plan (NRIP) describing the offset-generation activities and programmatic details, which is state-approved prior to project implementation.
- Offsets are pre-implemented - prior to the release and transfer of any offsets. They are certified as having been implemented and represent actual on-the-ground nutrient reductions.
- The nature of the nutrient reduction activities generating credits currently certified in the James River watershed banks represent permanent changes to the landscape resulting in perpetual reductions and offsets. In addition, these projects have obtained all necessary federal, state, and local authorizations and permits.
- Legal mechanisms are required to be in place (i.e., deed restriction, easement) to maintain the landscape changes generating credits, i.e. achieving nutrient reductions, in perpetuity. This is very similar to wetland, stream, and upland buffer programs that have been in operation for well over ten years.
- Financial Assurances for the nutrient reduction activities are in place until those reductions are deemed established by the regulatory agencies.
- Reduction activities are monitored by the Offset provider and they provide an annual verification report to DEQ / Virginia Department of Conservation and Recreation (DCR).
- Projects are available for regulatory agency inspection.
- Once transferred, offsets are debited from the offset-generating facility's ledger and documented by the offset provider to DCR and DEQ, insuring permanent removal of that Offset from the supply chain, once offsets are dedicated to a permit.

- Although Virginia’s storm water program uses phosphorus as the keystone component for measurement and trading, offset transfers automatically include the associated nitrogen reductions that resulted from project implementation. The associated nitrogen reductions are retired from the offset ledger along with the phosphorus and are included in the offset price.

### **Case Study Naval Surface Warfare Center Dahlgren Virginia and Marine Corp Base Quantico**

Nutrient trading between DoD institutions is one alternative to allowing DoD to participate in nutrient trading. A trade between DoD facilities for credits does not require changes in federal statutes since federal funds are not being used to subsidize state markets. Phosphorous and Nitrogen point loads for NSC Dahlgren and Marine Corp Base Quantico wastewater treatment plants were analyzed to see if conditions existed that would facilitate nutrient trading. Both these installations are located on the Potomac River in Virginia. Both are included in the same segment of Virginia Watershed Implementation plan and since TMDL limits are set for specific segments this would make trades easier to monitor and enforce. Other Environmental data was also taken from the installations Integrated Resource Management Plan to assess other potential impacts of intra DoD trading.

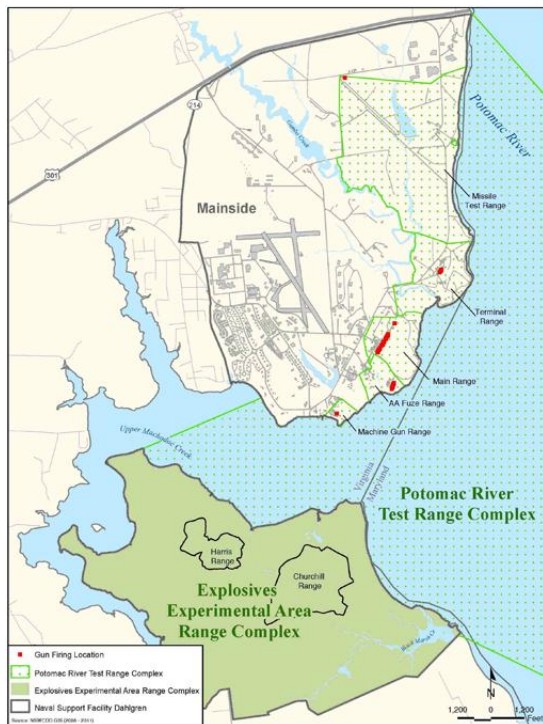
#### *Naval Surface Warfare Center Dahlgren Virginia*

The Naval Surface Warfare Center Dahlgren is a Navy Installation located on the Eastern Shore of Virginia. The installation contains several tributaries of the Chesapeake Bay and is located along the Potomac River at the mouth of the Chesapeake Bay. Dahlgren consists of two major areas. The first major area is referred to as “mainside”. Mainside, is located north of Upper Machodoc Creek, and Pumpkin Neck , and is bounded on the west by the community of

Dahlgren and Williams Creek, on the east by the Potomac River, on the south by Upper Machodoc Creek, and on the north by U.S. Route 301. Mainside is approximately 2,678 acres and contains the majority of the installation's support and community facilities. Gambo Creek cuts through Mainside, running from the northwest corner to the southeast edge and discharging to Upper Machodoc Creek.

Pumpkin Neck is a smaller peninsula south of Mainside and is approximately 1,641 acres. Pumpkin Neck is used primarily for ordnance testing and as an explosive experimental area. NSF Dahlgren consists of forested areas surrounding residential, industrial, and military facilities. Due to its coastal location, the site also contains numerous wetlands and low-lying coastal areas (figure 3)(Navy 2010).

**Figure 3: Map of Naval Surface Warfare Center Dahlgren**



### *Environmental Considerations*

Controlling nutrient run off from both point and non-point sources is an important consideration when trying to protect the environmental integrity of the base and surrounding areas. The installation actively manages over 300 plants, 157 birds, 20 mammals, 16 amphibians, 16 reptiles, and 32 fish species. There are two rare species found on NSWC Dahlgren, the funnel-web spider, and the bald eagle. The bald eagle is listed as a threatened species under the Endangered Species Act. To protect these species the installation has established “special interest areas”. These areas are defined by unique ecological characteristics and/or high quality habitat for rare species. Two special interest areas are located on Mainside (total of 811 acres) and three on the Explosives Experimental Area Range Complex (EEA) (total of 222 acres). These areas are given special consideration during land use planning.

### *Wetlands Management*

16 percent of the installations are characterized as wetlands. Wetlands management includes the creation and restoration of marsh land like Kitts Marsh. Kitts Marsh located in the northeast corner of the installation was once a drainage swale and pond and has now been restored to a one-acre freshwater-brackish wetland. Kitts Marsh was created by excavating, grading, installing a culvert to bring in tidal Potomac River water, and planting freshwater and brackish marsh plants (e.g., arrow arum, pickerelweed, salt marsh cord grass, salt marsh hay, and seaside goldenrod). Kitts Marsh provides wildlife habitat and serves as a storm water control feature by filtering runoff from impervious surfaces (such as parking lots and roads),

and is an educational site for local school students. Kitts Marsh demonstrates the link between ecosystem and species protection and nutrient management (Navy 2001).

### ***Nutrient Mitigation***

The installation controls and monitors nutrient flow into the bay and adjacent tributaries for both point and non-point sources.

Point Source Wastewater Treatment. The base maintains a municipal sewage treatment plant that discharges into Upper Machodoc Creek in accordance with a Virginia Pollutant Discharge Elimination System (VPDES) permit. The following processes are used to treat wastewater: mechanical bar screen; dissolved air floatation unit; first and second stage aeration basins set up for biological treatment removal; constructed wetland; ultra-violet light disinfection system; re-aeration; and flow measurement. Other activities on the base such as industrial discharges resulting from gun mount sumps, oil/water separators, and storm water discharges associated with industrial activities are covered under an additional VPDES permit. The installation issued a request for proposal to upgrade the WWTP to increase the plant's capacity to remove phosphorous. Based on a market survey this upgrade is estimated to cost approximately \$2M in FY13 dollars.

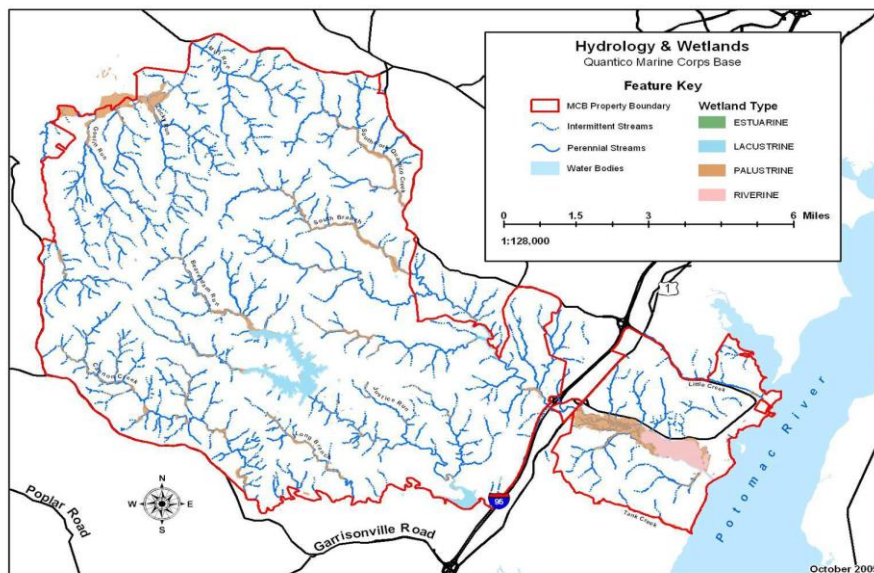
Non-point Source Best Management Practices. The installations employs a number of Best Management Practices to minimize erosion of soil and storm water discharges that otherwise would become sediment flowing into creeks and the Potomac River, adding phosphorous and nitrogen loads to the surrounding tributaries and bays. The installations designs for long-term control of storm water discharges and adheres to state and Navy (LID) regulations on pollution prevention for construction projects.

Shoreline Protection. Dahlgren has more than ten miles of shoreline along the Potomac River and Upper Machodoc Creek. The installation has a number of shoreline restoration projects ongoing. Restoring shorelines, helps mitigate nutrient runoff from non-point sources particularly during periodic northeasters and hurricanes.

### *Marine Corp Base Quantico Virginia*

Marine Corp Base Quantico (MCB) is a Marine Installation located in Northern Virginia approximately 37 miles south of Washington D.C. The installation contains several tributaries of the Chesapeake Bay and is located along the Potomac River approximately 50 mile upstream from NSWC Dahlgren. MCB consist of about 59,000 acres in Northern Virginia, with about 31,360 acres in Stafford County , 24,280 in Prince William County, and 3,360 in Fauquier County. The northern boundaries of MCB are Cedar Run, the eastern boundary is the Potomac River; the western boundary is Dorrells Run; and the southern boundary includes Tank Creek, and Aquia Creek (figure 4)(Navy 2010).

**Figure 4: Marine Corp Base Quantico**



### *Environmental Considerations*

Marine Corp Base Quantico lies within the Eastern Deciduous Forest biome of North America. Upland habitats compose approximately 94% of MCB lands and approximately 6% of the installation is classified as wetlands. The MCB is located within the Piedmont and the Northern Atlantic Coastal Plain physiographic provinces. Approximately 52,000 acres are in the Piedmont and about 7,000 are within the Coastal Plain. Among the more important perennial streams and watersheds near Quantico are Cedar Run, South Fork of Quantico Creek, Chopawamsic Creek, and Aquia Creek . Except for Cedar Run, which flows north/northeast into Occoquan Creek, these creeks flow south and southeast into the Potomac River.

There are a number of rare and protected species that can be found on the installation. A population of the state rare least bittern (*Ixobrychus exilis*) was documented at MCB during field surveys conducted on 2 August 1991. A single specimen of the State Special Concern star-nosed mole (*Condylura cristata*) was collected during the VDCR survey. This species is generally associated with water and occurs primarily in floodplains, riparian zones, fens, and bogs. Three populations of small whorled pogonia (*Isotria medeoloides*), a listed threatened species, were found during the 1992 VDCR study. A population of Carolina fanwort (*Cabomba caroliniana*) was located at the Chopawamsic Creek Marsh site, which is believed to be the only extant site known for Virginia. There is no legal status for this species but it was recommended for special concern at the 1989 Virginia Endangered Species Symposium (Navy 2010).

## **Nutrient Mitigation**

### *Point Source Waste Water treatment*

Marine Corps Base Quantico has spent about \$2 million to maintain compliance with permit limits at the wastewater plant, which has a capacity of 2 million gallons a day. The plant operates below authorized discharge limits, making it one of the cleanest facilities in the Bay region. The installation plans to increase the plant's capacity by 300,000 gallons per day, which will allow for anticipated growth. The upgrade will include the installation of Biological Nutrient Removal technology designed to reduce the discharge of nitrogen from sewage treatment plants. In addition, the upgraded plant will disinfect wastes using an ultraviolet process, eliminating the use of chlorine.

### *Non-point Source Best Management Practices*

MCB Quantico employs a number of traditional BMPs that convey and manage storm water in large, end-of-pipe facilities located at the bottom of the drainage areas; i.e. storm water pond, as well as low impact development (LID) Features/Best Management Practices (BMPs) that manage storm water through infiltration, filtration, storage, evaporation, and detainage of runoff close to its source; i.e. vegetated buffers, bio retention, swales and permeable pavers.

Actual load calculations for NSWC Dahlgren and MCB Quantico are included in table 3.

## **Trading Scenarios**

The following data was collected to compare the waste loads generated by NSWC Dahlgren and Marine Corp Base Quantico to illustrate if a trading opportunity exists between two DoD facilities. This would be the easiest implementation strategy because both

installations are located within the same watershed implementation plan and both discharge treated point source loads into the Chesapeake via the Potomac River and her tributaries. Point loads were as reported by both installations IAW NPDES Permit requirements.

**Table 3: Waste Load Comparisons NSWC Dahlgren vs. Marine Corp Base Quantico**

Facility	Total N Waste load Allocation Lbs./yr.	Total P Waste load Allocation Lbs./yr.	N/P Delivery Factor	Delivered N Waste load Allocation Lbs./yr.	Delivered P Waste load Allocation Lbs./yr.	Delta
NSWC Dahlgren	6,578	658	1	6,578	708	(50)
Marine Corp Base Quantico	20,101	1,206	1	20,101	817	389

**Table 4: Potential Trading Scenarios**

**No Trading Scenario**

	NSWC Dahlgren	Marine Corp Base Quantico	Total		
Cost of Technology Upgrade (Aquadisc)	~\$2.0M	0	~\$2.0M		
P Credits bought	–	0			
P Credits Sold	–				
Net (Cost)/Revenue	~2.0M				
Reduced Load	50		~\$2.0M		

## Trading Scenario

	<b>NSWC Dahlgren</b>	<b>Marine Corp Base Quantico</b>	<b>Total</b>		
<b>Cost of Technology</b>		<b>0</b>	<b>0</b>		
<b>Credits bought</b>	<b>\$1,050,000</b>	<b>0</b>			
<b>Credits Sold</b>	<b>0</b>	<b>\$1,050,000</b>			
<b>Net (Cost)/Revenue</b>	<b>\$1,050,000</b>		<b>\$1,050,000</b>		
<b>Reduced Load</b>	<b>50</b>		<b>\$1,050,000</b>	<b>\$950,000 savings</b>	

The potential costs savings from nutrient trading are illustrated in table 4. Under the TMDL, the NSWC Dahlgren is required to reduce phosphorous loads to the Bay by an extra 50 lbs. per year, but installing additional treatment technology to meet this requirement costs \$2M per year. Marine Corp Base Quantico is not required to further reduce its phosphorous loads, and already exceeds phosphorous requirements by 389 lbs./yr. If NSWC Dahlgren purchases the reductions (i.e., credits) from Quantico in lieu of investing in a \$2M upgrade to the NSWC Dahlgren wastewater treatment plant facility, the overall savings to the Navy would be ~\$950,000 M with the same reduction in phosphorous loads to the bay. How the two parties share in these benefits depends on the price of the credits.

In a DoD market trades are driven are not driven by price signals driven by the market. Installations are merely trading to meet cap levels and trades will not necessarily capture the full efficiency of the state markets that have more potential traders and greater potential for

efficiencies. Public funding, through the DoD budget process, has already accomplished the reduction by funding BMP through appropriated funds for installation military construction accounts. DoD facilities conceivably could undercut private entities participating in the nutrient market by selling credits at a lower cost. This gives DoD a competitive advantage over those entities who do not receive public funds. Public funds distort the market and could potentially disadvantage other markets participants, ultimately reducing the number of participants willing to participate in the market.

### **Findings and Recommendations**

Federal statutory authority is required before Navy, DoD, and possibly other Federal Agencies and Departments, can participate in Virginia's Water Quality Nutrient Trading Program. While purchasing nutrients credits/offsets may be a lower cost option to installing and maintaining a Best Management Practice (BMP), it may not fully comply with Navy LID policy nor meet EISA Section 438 requirements. Additionally, as demonstrated by NSWC Dahlgren and Marine Corp Base Quantico, many installations have ecologically sensitive areas and protected species that could be adversely affected if trading occurs. Although the use of environmental markets/nutrient trading is discussed in the EO 13508 Strategy for Protecting and Restoring the Chesapeake Bay Watershed, some advocacy groups perceive buying credits as a lowering of standards and are opposed to the practice. To mitigate these concerns the Navy should address the following issues in any future trading framework:

- A trading program should consider legislative changes that are consistent and workable for all Federal entities.

- Consistent with U.S Environmental Protection Agency's trading guidelines and the trading program policies/regulations in Virginia, A trading program must not create or worsen local pollution or create hotspots within the watershed. Additionally monitoring and enforcement mechanism must be clearly defined and are key to ensuring that this criteria is met. This is particularly important for DoD installations that are responsible for managing sensitive ecosystems and protecting species within government property.
- Participation of DoD in state markets may weaken the public trust. Best management practices funded by tax DoD funds could generate pollution credits and be traded or sold to private entities to offset loads from other sources resulting in little or no reduction in the overall load. Public funding, through the DoD budget process, has already accomplished the reduction by funding BMP through appropriated funds for installation military construction accounts. Trading could be viewed as an additional payment to the private sector for the same reductions. This would deflate the price of a pollution credit and distort the market. DoD facilities conceivably could undercut others who did not receive such funds by selling credits at a lower cost. This places those who cannot or could not receive public money at a competitive disadvantage. This will likely limit participation in the market to a relatively small number of entities. Trading frameworks developed by DoD should develop market controls that restrict DoD's ability to undercut the market yet still reap the benefits of market efficiency.

- Nonpoint source BMPs may provide other benefits (i.e. Habitat, flood control, recreational) not captured in a nutrient market. At a minimum, installations must achieve a pre-established level of reductions before participating in trading activities. Additionally; non-point source should not sell pollution credits until it has established and implemented a predetermined number of best management practices. The process should encourage the implementation of conservation practices.
- Credits must be verifiable and enforceable. DoD must be completely transparent in the mechanism they use to generate credits and monitor compliance to caps. DoD trading regulations should include procedures to account for, verify and monitor trades between point sources and nonpoint sources.
- Maintain the public trust through transparency. The public should have access to information and be provided the opportunity to provide input on proposed trades. All trades should be publicized periodically, least once per quarter. DoD should adopt a web-based nutrient-tracking database to provide transparency, promote efficiency and accountability. The Environmental Protection Agency's use similar tracking methods for "Clean Air Markets".

## **Conclusion**

The Navy has a unique relationship with the Chesapeake Bay. The Bay has been part of the Navy's history for over 200 years. The Navy has gone to great lengths to be a good steward of the bay and an active partner in Chesapeake Bay conservation and protection efforts. The Navy

should carefully weigh the advantages and disadvantages of nutrient markets. Basing decisions on purely economic outcomes may not be the right answer for the bay or the public trust.

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## Appendix 1: Non-Point Source BMP Mitigation Cost Estimates

BMP	TP lbs/yr per 1 Impervious Acre	BMP TP Removal Efficiency	Cost of BMP per 1 Impervious Acre	BMP Treatment Cost for 2.17 TP lbs/yr	Treatment Costs for 1 lb TP/yr
Vegetated Open Channel	2.17	0.28	\$ 26,000	\$ 92,857	\$ 42,791
Bioswale	2.17	0.72	\$ 44,000	\$ 61,111	\$ 28,162
Bioretention	2.17	0.4	\$ 50,000	\$ 125,000	\$ 57,604
Infiltration Practice	2.17	0.78	\$ 66,000	\$ 84,615	\$ 38,993
Permeable Pavers	2.17	0.7	\$ 335,000	\$ 478,571	\$ 220,540
Green Roof	2.17	0.52	\$ 800,000	\$ 1,538,462	\$ 708,968

TP is Total Phosphorus

According to VA's runoff reduction spreadsheet, 2.17 lbs TP is generated from 1 impervious acre (IA)

BMP Phosphorus removal efficiencies based on VA's runoff reduction method technical memo

Cost of BMP per 1 IA based on UMCES report

The 2.17 lbs TP/yr assumes that at 100% efficiency the BMP will remove 2.17 LBS of TP