PROJECT PURPOSE AND OBJECTIVES

Maryland has had a compensatory mitigation program as part of its regulatory nontidal wetland program since the regulatory program began in 1991. Regulations have provisions for the preferred locations of mitigation sites, replacement ratios, required design information, bonding, monitoring, and reporting, and success standards. Success standards primarily consist of the presence of suitable hydrology and coverage by a certain percentage (85%) of desirable wetland vegetation. In addition to regulatory standards, Maryland also uses guidance prepared by an Interagency Mitigation Task Force (IMTF) in 1994. Participating agencies were: U.S. Army Corps of Engineers, U.S. Environmental Protection Agency, U.S. Fish and Wildlife Service, National Marine Fisheries Service, Federal Highway Administration, Maryland Department of the Environment (MDE), Maryland Department of Natural Resources, and the Maryland State Highway Administration.

Maryland's Nontidal Wetlands Act and the Chesapeake Bay Agreement both have requirements to achieve a "no net loss" of wetland acreage and function. Maryland has met the acreage goal through minimization of wetland losses and compensatory mitigation. Most wetlands that are proposed for loss or adverse impacts through a regulated activity are assessed by the permit reviewer using their best professional judgment. Permittees are required to describe how their proposed mitigation will replace both acreage and function. However, no procedures have been implemented to predict functional success of mitigation sites.

The success of the mitigation program was a priority goal of Maryland's State Wetland Conservation Plan, completed in 2003. The Plan was developed by MDE with an advisory group of stakeholders from federal, State, and local governments, consulting, business, agriculture, forestry, mining, other advisory groups and environmental groups. Some work group members have expressed interest in whether or not mitigated wetlands are performing wetland functions. In 2001, the National Research Council (NRC) published the report Compensating for Wetland Losses under the Clean Water Act that described many shortcomings of mitigation at the national scale, particularly in the replacement of wetland functions.

The purpose of this project is to conduct an in depth examination of the State's mitigation program, and develop new guidance for aspects of the program that are deficient. Every stage of a mitigation project will be evaluated: conceptual planning and site selection; project design; construction; monitoring; length of time for projects to be completed; and staff follow up. One aspect of monitoring to be expanded upon in detail is the approach to determine if mitigation wetlands are successfully performing wetland functions. All types of mitigation project types (creation, restoration, or enhancement) will be considered. Wetland functions that will be evaluated include water quality improvement, flood attenuation, groundwater discharge, and wildlife habitat. The approach must also be developed in such a way that implementation of the functional evaluation can be done in a timely and cost effective manner for the regulatory program. Key objectives will focus on overcoming the challenges associated with conducting a functional evaluation or assessment of a mitigated wetland. Since lands with existing high resource value are usually not used for mitigation, it is a given that wetlands created, disturbed, or enhanced for mitigation are in somewhat disturbed areas. For this reason, the practice of comparing these mitigated wetlands to a relatively undisturbed reference wetland is more difficult. In addition, the evaluation of wetland function in a mitigated or voluntarily restored wetland must project over a long period of time what the wetland functions will be. For example, if a 30-year old forested wetland were lost and mitigated, it would take another 30 years before a truly accurate assessment of wetland function could be made of the mitigated wetland.

Another objective will be to develop some guidance on assessing cumulative impacts. The issue of cumulative impacts, and wetland mitigation to try to reduce adverse cumulative impacts, was raised by the work group advising the Department of the Environment during development of the State Wetland Conservation Plan. There is limited guidance available at the state and federal levels for addressing cumulative impacts. This report will be prepared under separate cover.

MDE WETLAND MITIGATION PROGRAM BACKGROUND

Definitions, procedures, and requirements related to mitigation are described in COMAR 26.23.04 Nontidal Wetlands Mitigation and in *Maryland Nontidal Wetland Mitigation Guidance* (MDE, 1998). This document was funded through a State Wetland Program Development Grant from the U.S. Environment Protection Agency. The following text is from MDE, 1998:

> What is mitigation?
>
> When authorizations are issued for activities which will cause unavoidable losses of nontidal wetlands, the losses must be countered with wetland gains to meet the "no net loss" goal. The primary means of accomplishing wetland gains is through wetland mitigation. Nontidal wetland mitigation is the creation, restoration, or enhancement of nontidal wetlands, to compensate for nontidal wetlands that were or will be lost due to regulated activities or non-exempt agricultural activities. The State definition of mitigation corresponds to the Federal definition of compensatory mitigation. Mitigation is not required for temporary impacts to wetlands or impacts to the wetland buffer or expanded buffer.
>
> Nontidal wetland creation projects establish nontidal wetlands on upland sites. These projects usually involve lowering the elevations of uplands by grading the soil for the purpose of increasing the frequency of soil saturation, flooding, and ponding.
>
> Nontidal wetland restoration projects reestablish nontidal wetlands on sites where they were formerly located. For example, the removal of drainage structures from agricultural fields can result in nontidal wetland restoration.
>
> Nontidal wetland enhancement projects provide additional protection to, or improve the functions of, nontidal wetlands. Planting wetlands that are farmed or dominated by lawn grass is the most common type of enhancement project.

Stream restoration projects, such as stabilizing the banks or restoring the natural meander pattern to a channelized stream, are examples of projects that can enhance existing nontidal wetlands. Enhancement projects do not increase the acreage of nontidal wetlands.

When is mitigation not required?

The following activities are exempt from permit and mitigation requirements:

- **Forestry activities**
- Traditional **agricultural activities** such as plowing and cultivating, which do not drain, dredge, fill, or otherwise convert undisturbed nontidal wetlands
- **Development activities** with minimal impacts to nontidal wetlands and which are exempt or qualify for a Letter of Authorization, except Letters of Authorization for activities in the Chesapeake Bay Critical Area.

What activities require mitigation?

Mitigation is required for the regulated and agricultural activities listed below:

- Removal, excavation, or dredging of soil, sand, gravel, minerals, organic matter, or materials of any kind
- Changing existing drainage characteristics, sedimentation patterns, flow patterns, or flood retention characteristics
- Disturbance of the water level or water table by drainage, impoundment, or other means
- Dumping, discharging of material, or filling with material, including the driving of piles and placing of obstructions
- Grading or removal of material that would alter existing topography
- Destruction or removal of plant life that would alter the character of a nontidal wetland
- Agricultural activities in undisturbed wetlands

Since it is important to understand the steps in the mitigation process in order to evaluate the mitigation program, this process is summarized as follows:

1) During the application review process, the applicant proposes mitigation through their Phase I Mitigation Plan. This Phase I plan is basically a concept plan. Some of the things it should include are justification for selecting the mitigation site, site location, acreage, vegetation type, and proposed hydrology source. It may instead be a proposal to pay into the MDE Nontidal Wetland

Compensation Fund or buy credits from an approved Consolidated Wetland Mitigation Site. The Phase I plan must be submitted and approved before the Permit/LOA is issued. The wetland mitigation is required as a condition of the Permit/LOA. If this condition is omitted from the Permit/LOA, MDE cannot require mitigation.

2) The Phase II Mitigation Plan is due within three months of the Permit/LOA decision date, unless another date is specified by the Department. This Phase II plan should include all the details about the mitigation site, including but not limited to the design, how the wetland mitigation will be achieved, grading details, planting plans, site access, soils, hydrology, construction schedule, and monitoring schedule. It should also include documentation that the wetland will be protected in perpetuity through deed restrictions, conservation easements, deeding the wetland to an organization that will protect it, or through restrictive covenants. MDE should make a decision about the acceptability of the Phase II plan within 45 days of receiving it (unless a final permit decision has not been made). MDE may request additional information before the Phase II will be approved. Once this information is received, the 45-day review period begins again. When MDE is satisfied with the Phase II mitigation plan, the agency sends out a Phase II approval letter.

3) Within 60 days of the Phase II plan approval a permittee shall file a surety bond with MDE. This bond is to ensure the mitigation is completed and is released upon successful construction of the mitigation site according to the approved plan. The bond is $20,000 per acre of wetland mitigation required. The permittee shall construct the mitigation site according to the approved plans within the time period required by the Department and specified in the mitigation plan approval. The mitigation site has a five year monitoring period, with each monitoring report being due by December 31 of each year. At the end of this five year period, greater than 85% of the mitigation site shall be vegetated (either by planted or naturally revegetated plants) by native wetland species similar to those found in the nontidal wetland lost or by a species composition acceptable to the Division.

<u>How is the amount of mitigation required determined?</u>

Acreage replacement ratios are used to determine the amount of mitigation required. Before any nontidal wetlands have been impacted by a project, the amount of each type of wetland to be lost (forested, scrub-shrub, and/or emergent) must be determined. Acreage replacement ratios are expressed as a relationship between two numbers. The first number specifies the acreage to be mitigated and the second number specifies the acreage of nontidal wetlands impacted. The acreage replacement ratios are:

WETLAND TYPE	REPLACEMENT RATIO
Emergent	1:1
Emergent, using a bank	1.5:1
Farmed	1:1
Farmed, using a bank	1.5:1
Scrub-shrub to emergent conversion	1:1
Scrub-shrub to emergent conversion, using a bank	1.5:1
Forested to emergent conversion	1:1
Forested to emergent conversion, using a bank	1.5:1
Forested to scrub-shrub conversion	1:1*
Scrub-shrub	2:1
Scrub-shrub, using a bank	3:1
Forested	2:1
Forested, using a bank	3:1
Emergent (of special State concern)	2:1
Emergent (of special state concern), using a bank	3:1
Scrub-shrub (of special State concern)	3:1
Scrub-shrub (of special State concern), bank	4.5:1
Forested (of special State concern)	3:1
Forested, (of special state concern), using a bank	4.5:1

* Some conversions of forested wetlands to scrub-shrub require mitigation

Scrub-shrub and forested wetlands have higher replacement ratios than emergent wetlands, because it is more difficult and takes longer to successfully reproduce the functions of these types of wetlands. For instance, impacting one acre of a forested wetland that takes fifty years to establish will require one hundred years before the lost acre-years of that type of ecosystem have been replaced using a 2:1 replacement ratio. The lost acre-years would be the one hundred since the impact occurred. The gained acre-years for the impacted wetland type would not start until year fifty, but would equal one hundred by year one hundred because of the 2:1 replacement. The first fifty years would provide other functions during earlier successional stages.

Nontidal wetlands of special State concern have exceptional ecological value of statewide significance, such as habitat for endangered species. They have the highest replacement ratios because their values may be irreplaceable. Nontidal wetlands of special State concern are listed in the Nontidal Wetlands regulations and are mapped on Nontidal Wetlands Guidance maps.

Conversions of wetland type sometimes require mitigation. These conversions do not result in a loss of wetland acreage but do result in a loss of functions. These types of impacts are usually the result of projects involving golf course fairways or overhead transmission lines.

Mitigation that is proposed through use of a bank requires that the ratio be increased by 50% over the typical requirement. This requirement is in law and regulation.

<u>What general criteria should be used to select mitigation sites?</u>

In selecting sites, mitigation are goals based on the wetland impact and improvement of problems within the watershed should both be taken into consideration and combined if possible. For instance, successful wetland creation projects in floodplains can reduce flooding problems which exist in a watershed.

When evaluating whether a site would make an acceptable mitigation site, lands preferred for mitigation usually have one or more of the following physical characteristics:

- Former wetlands that have been effectively drained for agricultural purposes (prior converted cropland);
- Former wetlands that may be degraded;
- Wetlands in agricultural production (farmed wetlands);
- Areas connected to existing nontidal wetlands, waterways or within the 100-year floodplain;
- Disturbed areas, such as sand and gravel mines; and
- Areas that are accessible to earthmoving equipment.

Areas that will not generally be conducive for wetland mitigation are:

- Upland forested areas;
- Areas identified as important habitat for rare, threatened, and endangered plant and wildlife species (enlarging these habitats is encouraged);
- Areas with moderate or steep slopes;
- Dredge disposal areas; and
- Areas with incompatible adjacent land uses, such as commercial development and highways that will be a source of pollutants.

The preferred project type is wetland restoration. Sites that were formerly wetlands usually have a source of water that can be returned to the former conditions. The best example is the restoration of effectively drained agricultural fields listed as prior converted cropland by the Natural Resources Conservation Service.

Sites where wetland creation projects can be done should be investigated second. These sites will require grading to reach an elevation where wetland hydrology can be sustained. The likelihood of a successful creation project is less than that for a restoration project.

If adequate restoration and creation sites cannot be found to meet acreage requirements, wetland enhancement projects may be proposed. Enhancement projects replace lost functions but not lost acreage of wetlands.

To increase the probability that enough water will be available to supply wetland hydrology, mitigation sites should be located adjacent to existing nontidal wetlands, streams, or 100-year floodplains whenever possible. For projects where groundwater is the main source of hydrology, groundwater monitoring will be necessary to determine if the water table is close enough to the surface for the site to be feasible.

Mitigation projects may be on multiple sites, but single sites are recommended. Single sites will be larger, resulting in greater potential for protection and management and greater value as wildlife habitat. Single sites are also easier to monitor, and land purchase and site preparation costs will usually be reduced.

What is the process for selecting mitigation options and sites?

A permittee or person conducting an agricultural activity can propose, or the Department can require, any of the options in this section for fulfilling mitigation requirements. The proposed option will be submitted as part of the Phase I mitigation plan, which will be submitted with the permit application.

This section describes the circumstances and provides the justification for when different mitigation options are appropriate. In the following discussion, taking farmed wetlands out of production and returning them to a natural state, which is technically enhancement, will be considered equal to wetland restoration. Each option should be explored in the order shown, and the first feasible option should be chosen.

Option 1: Onsite restoration or creation

If possible, lost nontidal wetland functions should be replaced within the same ecosystem and functional watershed as the destroyed wetland. Therefore, mitigating for nontidal wetland losses on the site of the wetland loss (onsite) should be the first option evaluated. Onsite mitigation should be ruled out if any of the previously listed conditions that result in a site being not conducive for mitigation occur at the site.

Option 2: Onsite restoration or creation plus enhancement

When onsite mitigation is possible, but there is not enough acreage available to meet the required replacement ratios, the applicant may propose to replace lost nontidal wetland functions through enhancement activities plus a minimum 1:1 creation and/or restoration acreage replacement.

Enhancement activities may be accepted to replace the loss of nontidal wetland functions when an enhancement activity provides additional protection to, creates, or improves the functions of nontidal wetlands. Activities may include:

- enhancement of farmed nontidal wetlands (e.g., planting trees in a wet crop field)
- enhancement of degraded nontidal wetlands (e.g., removing Phragmites, an invasive introduced plant also known as common reed)
- best management practices for agricultural activities
- Department-approved wildlife ponds
- purchase or preservation of upland buffers adjacent to nontidal wetlands
- purchase or preservation of existing nontidal wetlands

- activities consistent with plans and agreements to create or improve waterfowl habitats (e.g., creating shallow water areas around an existing pond)
- stream restoration projects (e.g., stabilizing streambanks to reduce erosion problems)

Option 3: Nontidal Wetland Compensation Fund

The Nontidal Wetland Compensation Fund is designed to accept monies from applicants who may find mitigation technically infeasible or who are unable to locate a suitable mitigation site. Monetary compensation may not substitute for the requirement to avoid or minimize losses of nontidal wetlands. Monies in the Compensation Fund are used only for the expressed purpose of wetland creation, restoration, and enhancement in order to achieve Maryland's goal of "no net loss" of nontidal wetlands.

A proposal to pay into the Nontidal Wetland Compensation Fund should be part of the permit application and include a justification for using the Compensation Fund as opposed to undertaking a mitigation project. Monetary compensation may be accepted under one or more of the following circumstances:

- The size of the nontidal wetland loss is less than 1 acre in size and onsite mitigation
- The size of the nontidal wetland loss is less than 1 acre in size and onsite mitigation is not feasible; or
- Mitigation of the impacted wetland is not feasible. For some types of wetlands, the technical expertise has not advanced to the point where it is generally agreed that successful replication of these types of wetlands is possible. Wetlands that would fall into this category would include areas such as bogs, spring seeps and vernal pools; or

- The size of the nontidal wetland loss is greater than 1 acre and mitigation is not possible onsite or offsite in the same county as the nontidal wetland loss (see Option 7).

Monetary compensation proposals may be rejected if the Department determines that the mitigation requirements can be fulfilled on the site of the wetland impact or that the conditions listed above are not fulfilled.

The compensation fund fee structure was derived from a study of anticipated costs to construct mitigation projects. This included costs for locating and acquiring land, designing, constructing, maintaining, and monitoring a mitigation site. The three major factors considered in developing the compensation fund fee structure in 1991 are discussed below.

1. Prevalence of Cropland Characterized by Hydric Soils

The cost estimates also considered the extent of cropland containing hydric soils in each county. It was presumed that cropland with hydric soils would be the most likely and cost-effective place to locate a mitigation site, since the area would be disturbed, was previously capable of supporting a wetland, and would likely be capable of supporting a wetland again if hydrology were restored.

The Natural Resources Conservation Service provided figures showing estimated acreage by county of cropland which contain hydric soils. Based on this information, the state was divided into two categories. Category A counties have greater than 10% of their land area in cropped hydric soils and Category B counties have less than 10% of their land area in cropped hydric soils. The placement of counties into these categories has a major impact in determining the fee which an applicant must pay as a form of mitigation.

Category A counties include Caroline, Dorchester, Kent, Queen Anne’s, Somerset, Talbot, Wicomico, and Worcester.

Category B counties include Allegany, Anne Arundel, Baltimore, Calvert, Carroll, Cecil, Charles, Frederick, Garrett, Harford, Howard, Kent, Montgomery, Prince George’s, St. Mary’s, and Washington.

2. Land Acquisition Costs

The costs for land acquisition are based on information provided by the Department of General Services. Costs per acre have been calculated for each county statewide averaging the typical price paid for agriculturally zoned or low density land with limited or no development potential. Land acquisition costs must be added to the design, construction, and monitoring costs to determine the full compensation fee.

3. Design, Construction, and Monitoring Costs

The costs of designing, constructing (including planting) and monitoring nontidal wetland mitigation projects were developed by surveying wetland consulting firms statewide. Firms were requested to provide design, construction, and monitoring cost estimates for creating, restoring, and enhancing nontidal wetlands on both upland and cropped hydric soils. The survey identified a major difference in the costs of designing and constructing nontidal wetlands based on soil types. Therefore, the following section has been divided into a discussion of the costs for designing, constructing, and monitoring in Category A and Category B counties.

Category A counties contain a high percentage of cropped hydric soils (greater then 10%). Sites with these soil and land use characteristics are excellent candidates for mitigation because in many instances they have the soil type, and with limited construction, the restored hydrology necessary for establishing wetlands. The average cost for creating nontidal wetlands on cropped hydric soils was computed to be approximately $10,000 per acre.

Category B counties do not possess a high percentage of cropped hydric soils (<10%); therefore, mitigation projects in these areas will generally be more expensive because more extensive design and earth movement during construction will be required. In particular, the cost of grading a site (usually excavation) to create suitable hydrological conditions at or near ground surface to support wetland vegetation can be very high. In establishing the fee structure for Category B counties the average cost of creating nontidal wetlands on upland sites was calculated. The figure calculated was $50,000 per acre.

Option 4: Offsite restoration or creation

When onsite mitigation is not feasible and use of the Compensation Fund under Option 3 is not appropriate, offsite restoration and creation opportunities should be pursued. Regulations list the preferred order in which offsite locations should be considered. Option should be investigated in descending order of preference, unless the Department approves otherwise. The site search should begin within the same watershed (six-digit USGS code, but eight-digit watershed segment is preferred) and then expand into increasingly larger subwatersheds. Consideration is also given to sites that are in the same county as the authorized wetland loss. Regional or large scale planning efforts for watershed management or wildlife habitat or water quality improvement may also identify suitable sites. The Department may approve these pre-identified sites as an alternative to other sequences. An applicant should justify how more preferred locations in the sequence were investigated and rejected, when justifying a less preferred location.

The site selection process should follow the same steps as for onsite mitigation.

Option 5: Offsite restoration or creation plus enhancement

Offsite enhancement projects may be proposed when onsite mitigation is not feasible, use of the Compensation Fund under Option 3 is not appropriate, and the best offsite mitigation site is too small to meet acreage replacement requirements. Wetland enhancement projects should be in addition to creation and/or restoration projects that meet the minimum 1:1 replacement requirement. The site selection process should follow the same steps as for onsite mitigation.

Option 6: Offsite enhancement only

Mitigation consisting only of enhancement activities may be approved by the Department when Options 1-5 are not appropriate. The amount of credit to be given for different types of enhancement projects will be decided on a case-by-case basis.

For example, enhancement may be the best mitigation option when there is an impact to a farmed wetland. The enhancement may involve taking additional farmed wetlands out of crop production and allowing them to revert to a natural wetland state.

Another example for this category is a stream restoration project that could be accepted as mitigation for a road crossing of a degraded stream and a forested floodplain wetland. The project could include stabilizing eroding streambanks, removing trash, and creating depressions that may be used as breeding pools by amphibians.

Option 7: Nontidal Wetland Compensation Fund

The Nontidal Wetland Compensation Fund can also be used when the size of the nontidal wetland loss is greater than 1 acre and mitigation is not possible onsite or offsite in the same county as the nontidal wetland loss. In order for monetary compensation to be permissible in this situation, at least seven potential sites (onsite plus six sites from Options 4-6) must be assessed and deemed to be unacceptable for mitigation. These sites should have been eliminated from consideration because there was no opportunity to create or restore the acreages and functions of the lost wetland on those sites.

Option 8: Preservation

Preservation can be used in conjunction with other types of mitigation. Wetland preservation generally receives one tenth as much mitigation credit as restoration or creation, according to the Interagency Mitigation Task Force guidelines. Preservation of wetlands of special State concern can receive more mitigation credit, such as one-fifth as much as restoration or creation. Preservation of habitat for bog turtles, listed as Federally threatened in November 1997, can be given the same one-fifth credit.

WETLAND FUNCTIONAL ASSESSMENT

MDE entered into a contract with University of Maryland Center for Environmental Science (UMCES) for a literature search and report on measuring wetland function in wetland mitigation sites. The report, "Measuring Success of Wetland Mitigation," was completed in September 2005. The references that were examined were applicable to at least a portion of Maryland's physiographic regions, geology, hydrologic regimes, climate, soils, and hydrogeomorphic class of wetlands. A key outcome of the report is a list of recommended indicators that may be used to predict current wetland function, or anticipated future wetland functions at mitigated wetland sites. In other words, indicator results would determine whether or not a wetland is on the appropriate trajectory to replace lost wetland functions or the design goals of the project. Functions include flood attenuation, groundwater discharge, groundwater recharge, food chain support, fish and wildlife habitat, nutrient transformation, and water quality improvement.

Components of a wetland that were recommended as indicators include: amount of organic matter, other soil amendments, plant species composition, areal coverage, and condition (drought or wetness stress, predation, disease, etc.), soil characteristics (classification, soil biota), habitat sign and use, hydrology, and size. The type of project (creation, restoration, enhancement) and relationship of project type to functional success should be noted. The following information is from the UMCES report.

Definitions of "Success:"

The authors note that it is often difficult to evaluate the "success" of a program, as success depends on who is evaluating and which parties are involved. Kentula (2000) proposes that wetland management program success be evaluated with respect to three categories:

1) compliance, 2) function, and 3) landscape

However, program managers must set realistic and achievable goals before starting the mitigation program. Furthermore, those goals need to be evaluated with reliable and accurate indicators.

Indicators:

The authors state that there have been many wetland management programs throughout the country. These programs use different indicators to assess the health and success of wetland mitigation sites. Each of these indicators has advantages and disadvantages as described by the reviewers and summarized as follows:

1) *Morphometry:* Morphometry and acreage is useful in determining whether the wetland truly exists and persists. There should be an evaluation of the three required parameters (hydrology, vegetation, soils). GIS-based wetland assessments are also useful, and should provide a suitable set of information for assessment criteria.
2) *Hydrology:* Hydrology is the single most important and universally critical factor to consider in designing and monitoring wetland mitigation projects. Hydrology

comparisons should being made with wetlands of a similar hydrogeomorphic (HGM) subclass.

3) *Sediment:* Accumulation of soil organic matter (SOM) is an important indicator for supporting plants and microbial processes. However, rates of accumulation are often slow and may take many years, typically beyond the five-year monitoring period, to develop and mimic a more natural wetland. Studies have shown that natural wetlands have different sediment composition, even after extended periods of time (25 years) than do restored/created wetland sites. A high SOM content may be viewed as an indicator of success, though lower values do not necessarily indicate that the site is failing.
4) *Macrophyte Community Composition and Density:* Assessments of wetland function should include some combination of macrophyte species richness, diversity, density, survivorship, and percent cover. Multiple visits may be necessary. Other macrophyte indicators that may be useful are seedling development, invasive species, and presence of species with low tolerance of disturbance.
5) *Invertebrate Diversity and Richness*: The authors noted that this may be a more desirable method. Since invertebrates are sensitive to sediment contamination, they prove to be an effective tool for evaluating formerly contaminated or degraded sites.
6) *Target Wildlife*: There are a number of sets of wildlife that could be used as indicators of success. These include: fish, amphibians and birds, among others.
7) *Microbial Processes*: Microbial communities play vital roles in nutrient and carbon cycling, and are sensitive to change. Some studies indicate differences between microbial communities in recently established and undisturbed systems.
8) *Diversity and Community Composition:* Species diversity and richness has also often been used in wetland functional assessments. However, as some species are generalists or may indicate tolerance to disturbance, a weighted approach is recommended to better reflect biological integrity and scarcity.

Following their discussion of the indicators, the authors present a four-tiered approach to evaluating the success of wetland mitigation projects:

1) Hydrologic conditions and physical structure (morphometry, sediment characteristics) are studied and compiled.
2) Second-tier occurs within 1 – 2 years and focuses primarily on characteristics of the macrophyte community.
3) Third-tier occurs within 3 – 5 years and targets faunal indicators.
4) Finally, the final stages (5+ years) focus on biogeochemical function.

The limited time available for monitoring mitigation sites (typically five years) necessitates an approach that will reliably predict long-term success and function. Approaches that evaluate performance trajectories are of great interest, though they may be limited by lack of long-term monitoring data and suitable reference sites to calibrate a rapid assessment.

Integrative Assessment Indices:

One of the best ways to improve assessments is through the use of integrative and comprehensive approaches, such as utilizing the Hydrogeomorphic approach (HGM), Indices of Biotic Integrity (IBI), and Wetland Evaluation Technique (WET).
A summary of each approach follows:

HGM: Identifies the physical and structural aspects of wetlands, which are essential measures for identifying that the characteristics of a wetland exist and persist. HGM should be paired with biological assessments such as IBIs to evaluate ecological function. To aid in the collection of data and information on habitats and region-specific wetlands, the authors note that the Hydrogeomorphic classification serves as a useful surrogate for actual knowledge of site-specific hydrology, especially in the Mid-Atlantic area.

IBI: Provides a comprehensive and integrative assessment of ecological function and ecosystem health. IBIs should focus on species richness, diversity, and presence of specific indicator species. Target populations may include benthic macroinvertebrates, fish, macrophytes, and birds.

WET: This method includes aspects of HGM and IBI approaches by incorporating both hydrology and biology into analyses of ecosystem function. This method provides a non-additive assessment of a wide range of wetland components and is designed to provide a rapid assessment of wetland function that is easily transferable among different wetland types.

Considerations for Restoring/Creating Wetlands:

Although there is no single solution to restoring wetlands, there are a number of areas that researchers and planners have focused on in the past. These areas of focus include:

1) macrophyte community, 2) seed banks, 3) sediment and soil, 4) hydrology, and 5) disturbance.

The reviewers note that the wetland program should address each of these in order to be a success. The following summarizes each area reviewed.

1) *Macrophyte community:* The structure and function of most wetland systems relies heavily on the presence and composition of the macrophyte community. For this reason, any wetland management program should have a focus on the introduction and colonization of the macrophyte community into the site.
2) *Seed banks:* Researchers have found that adequate seed bank abundance and diversity is necessary for the macrophyte community to be successful. Furthermore, the researchers conclude that the timing of restoration efforts with respect to the growing season and considerations of both seed bank and propagule populations are important considerations in establishing the desired macrophyte community.
3) *Sediment and soil:* Sediment and soil composition is important when considering the success of a restoration project. An example would be phosphorous levels being very high because the site is transitioning to a hydric state. Alternatively, sediment organic matter (SOM) development can be expected to be slower in restoration sites than in natural sites.
4) *Hydrology:* Every effort should be made to maintain the natural hydrological cycle. Soils should be allowed to go dry in the summer as a result of the decline in the local

water table, providing for a more mixed plant community. Often projects fail to accomplish such goals as this.

5) *Disturbance:* Natural disturbances (fires, storms, etc.) have an impact on natural wetland systems, and so too should these disturbances be factored into the long-term planning of a wetland management program.

Regional Reference Conditions:

The researchers emphasize the need for a set of regional reference conditions to assist in assessments of wetland restoration sites.

MDE Findings

MDE considered the information and recommendations in the report in developing a new rapid scoring system and improved program implementation actions. The approach is a compilation of some of UMCES recommendations. Monitoring for hydrology, macrophytes, plant community composition, and visual observations of wildlife were included in the scoring system. A HGM classification approach has not been included, as any applicable models have not been fully reviewed. However, principles used in HGM, such as landscape position and hydrology source and flows, are included as indicators from the Landscape Level Functional Assessment Method (1995) developed for MDE by FUGRO East, Inc and adapted into the scoring system. Soil organic matter and microtopography is also assessed. This method includes estimations of wetland capacity and opportunity for performing functions. Microbial processes were tested through use of IRIS tubes, described in a later section. A GIS-based assessment is tested to further examine relationship of the wetland to other features in its watershed.

Other recommendations are partially or not utilized. The recommendation to compare mitigation wetlands to natural wetlands was rejected due to perception problems over invalid comparisons between an immature and mature system. It is neither realistic nor appropriate to compare, and ultimately penalize an early successional community for failing to resemble a mature forest. However, the most successful of mitigation sites will be considered as possible reference sites for other comparable mitigation sites. MDE will be considering performance trajectories, to determine if a mitigation wetland is likely to reach its planned state, which is usually a forested wetland. Long term monitoring will generally not be pursued, due to lack of staff, access and authority over permittee mitigation requirements after a five-year period. Some longer-term follow up is expected for MDE programmatic mitigation sites, State Highway Administration sites, and bank or consolidated sites. Variable mitigation ratios will also not be pursued, due to the need to have predictable mitigation requirements. Use of appropriate IBIs will be considered as these are identified and evaluated.

MITIGATION SITE SCORING METHOD

MDE established a scoring method that was utilized to evaluate the largest number of mitigation sites as possible and reduce the bias of scoring sites. This scoring will be ongoing. This will be done in addition to the standard permittee monitoring and the more detailed sampling completed for a subset of programmatic sites. This scoring method was created using several existing methods. These were established success criteria from the Interagency

Mitigation Task Force (IMTF) and the FUGRO East *A Method for the Assessment of Wetland Function* prepared for MDE under State Wetland Program Development Grant 003617-01-2, which applies basic principles of hydrogeomorphic assessment and includes both field and office procedures. Extensive knowledge of the mitigation program/goals was used in the new method. The final scoring method allows a high number of sites to be evaluated, making them easy to compare, and gives an overall assessment of the success of the mitigation project/the overall mitigation program. The resulting score quickly shows where the site is deficient (vegetation, soils, hydrology, or functions). As part of this method, MDE staff walk the mitigation site and visually observe the plant species present. MDE staff note the dominant plant species, species of concern, success of planted species, and any additional species of interest. MDE staff assess the percentage vegetative cover by native wetland plants, diversity, and vegetative growth. MDE staff predict the projected vegetative type (e.g. forest, scrub-shrub, emergent) and compare this to the wetland mitigation goals. MDE staff also make observations about the hydrology, soils, and functions of the site. Using this scoring system, each site is given a final score based on these combined observations. A detailed instruction sheet accompanies this method describing how the score is determined based on the observations.

It took a relatively long period of trial and error to develop this scoring method. During the winter through spring of 2006/2007 MDE staff were testing variables that would quickly summarize the success/condition of a mitigation site. After developing a working draft, staff scored several sites during the early 2007 growing season. After scoring a site, staff often found revisions that needed to be incorporated into the scoring sheet based on real-life situations. Some questions that were answered are as follows:

1) How should MDE address areas where the planned wetland vegetation types have been shifted to adjacent (but also protected) areas? MDE made several changes to the calculations of plant diversity. The scoring for hydrology was also changed, including how open water and SAV is scored differently than upland areas.

2) How should one score affects/be limited by another score (ex: the functions score is limited by the hydrology score, so if only 50% of the site has wetland hydrology, the functions score can not exceed 50% of the maximum value)?

3) How should the bonus rare species score be determined, based on recent observations versus historic records? The most recent version of the Mitigation Site Scoring Method can be found in Appendix A.1. The Instructions for Completing the Mitigation Site Scoring Method can be found in Appendix A.2.

As the time needed to develop this scoring system was longer than envisioned, MDE staff were not able to score as many sites in 2007 season as was anticipated. This was also due to the fact that MDE wanted to wait to score the sites until the growing season, so the vegetation could be better evaluated. However, this scoring method will be used in future years and the results will now be comparable.

Staff from the central office in Baltimore spent a day scoring mitigation sites with the Western Region mitigation staff member, in hopes of calibrating how all would score sites. However, when staff later compared scores from this region, it is clear that more calibration is necessary. The most obvious discrepancy between the regions is that the Western Region gave a much higher score for function than the Central Region did. As function allows for the most bias within the scoring method, this is not a surprise.   It may result in a difference of about 6 points, leading to higher scores for the Western Region. MDE will need to address the bias in the functions section of the scoring sheet.

Use of the 100-point scale Mitigation Site Scoring Method began at the start of the 2007 growing season through September 5, 2007. Scores were also assigned letter grades, with 90-100 points = A, 80-90 points = B, 70-80 ponts = C, 60-70 points = D, 50-60 points = E, and below 50 points = F. Scores below 60 were considered failing. A total of 92 sites were scored. The 92 sites had a combined acreage of approximately 333 acres. MDE only scored sites having had at least a full growing season to become established. Scored projects ranged in size from 600 square feet (0.01 acres) to 4,007,520 square feet (92 acres). The average score for all sites was 74, with scores ranging from 20 to 108. Figure 1 shows the results from the Mitigation Site Scoring Method, sorted into Permittee, Consolidated, and Programmatic mitigation sites. The number of Consolidated sites (4 sites) and Programmatic sites (12 sites) scored is less than that scored for Permittee sites (76 sites). Permittee sites had the lowest average (73), followed by Consolidated (78), with Programmatic sites having the highest average (86). Two Programmatic sites scored above 100, due to presence of rare, threatened, or endangered (RTE) species. The average area score for vegetation was 20/30, the score for soils was 19/20, hydrology was 22/30, and functional score was 12/20.

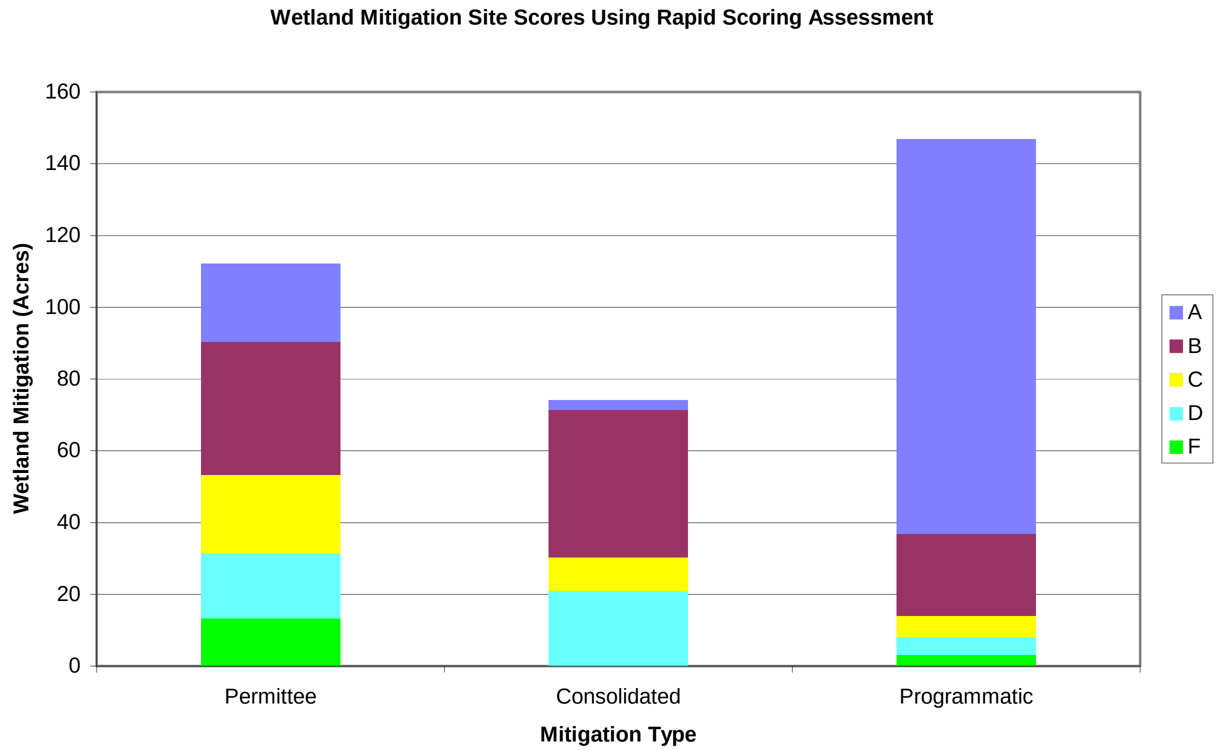

Figure 1. Wetland mitigation site scores by acreage.

MONITORING A SUBSET OF WETLAND MITIGATION SITES

We selected twenty wetland mitigation sites (four State Highway Administration (SHA) sites, four consolidated sites, and twelve programmatic sites) to do more extensive monitoring (Table 1). These sites were located throughout Maryland (Figure 2) and were chosen largely for accessibility, rather than for known success or failure. The largest number of sites chosen were programmatic sites since these sites are not being monitored by outside consultants, as was supposed to be the case with permittee sites. At these twenty sites, MDE evaluated hydrology, soils, soil reduction, and vegetation.

Table 1. Background on twelve subset wetland mitigation sites chosen for more intensive monitoring by Maryland Department of the Environment.

Site	Type of site: C=consolidated, P=Programmatic, S= SHA	Size (acres)/ Vegetation Type (FO=forest; SS=scrub/shrub; EM=emergent)	Mitigation type	Date mitigation completed	Past land use
Miller Dobson	C	20.9 FO	creation	March 2005	surface mine
Port Tobacco Phase I	C	41 FO	restoration	May1995	agriculture
Clifton	S	12.5 (11.7 FO/SS; 0.8 EM)	creation	October 1995	agriculture
Merkle	P	9 FO	creation	Spring 1994	Wildlife Mgmt Area/ agriculture
Lakeside	C	9.46 (6.25 FO/SS; 3.21 EM)	creation	June 1999	sand & gravel mine
Federalsburg Phase 1	P	6 (1 FO, 2 SS, 3 EM) tidal/ nontidal	creation	Fall 1998	floodplain/ surface mine reclamation
Jackson Lane	P	92 (70 FO, 22 EM)	restoration	Fall 2003	agriculture
Wye Island	P	6 FO	restoration	Fall 1994	agriculture
Bishop	S	~6 FO			agriculture
Herring Creek	P	5 (4 FO, 1 EM)	creation	Spring 1996	fallow field
Rum Pointe	P	3 (1 FO, 1 SS, 1 EM)	restoration	Spring 2000	Landscape Mgmt Area
Horse Farm	S	3.69 FO	creation	October 1997	old horse farm
Hawkins	S	15.7 (14.3 FO, 1.4 EM)	creation	September 1994	floodplain/ meadow/ brush
McGuigan	P	7.36 FO/SS	creation	May 2005	agriculture
Patuxent Preserve	C	2.75 FO	creation	December 1997	surface mine
North Point	P	8.5 (5.1 FO, 3 SS, .4 EM)	creation	Spring 1995	agriculture
Amish Road	P	1 FO	creation	October 2005	none
Boonsboro	P	1 (EM w/ SS fringe)	creation	Spring 2000	dry SWM Pond
Union Bridge	P	6 (2 FO, 2 SS, 2 EM)	creation	Spring 2000	floodplain/ pasture
Hedderick	P	0.5 EM	creation	Spring 2004	Disturbed/ topsoil harvested historically

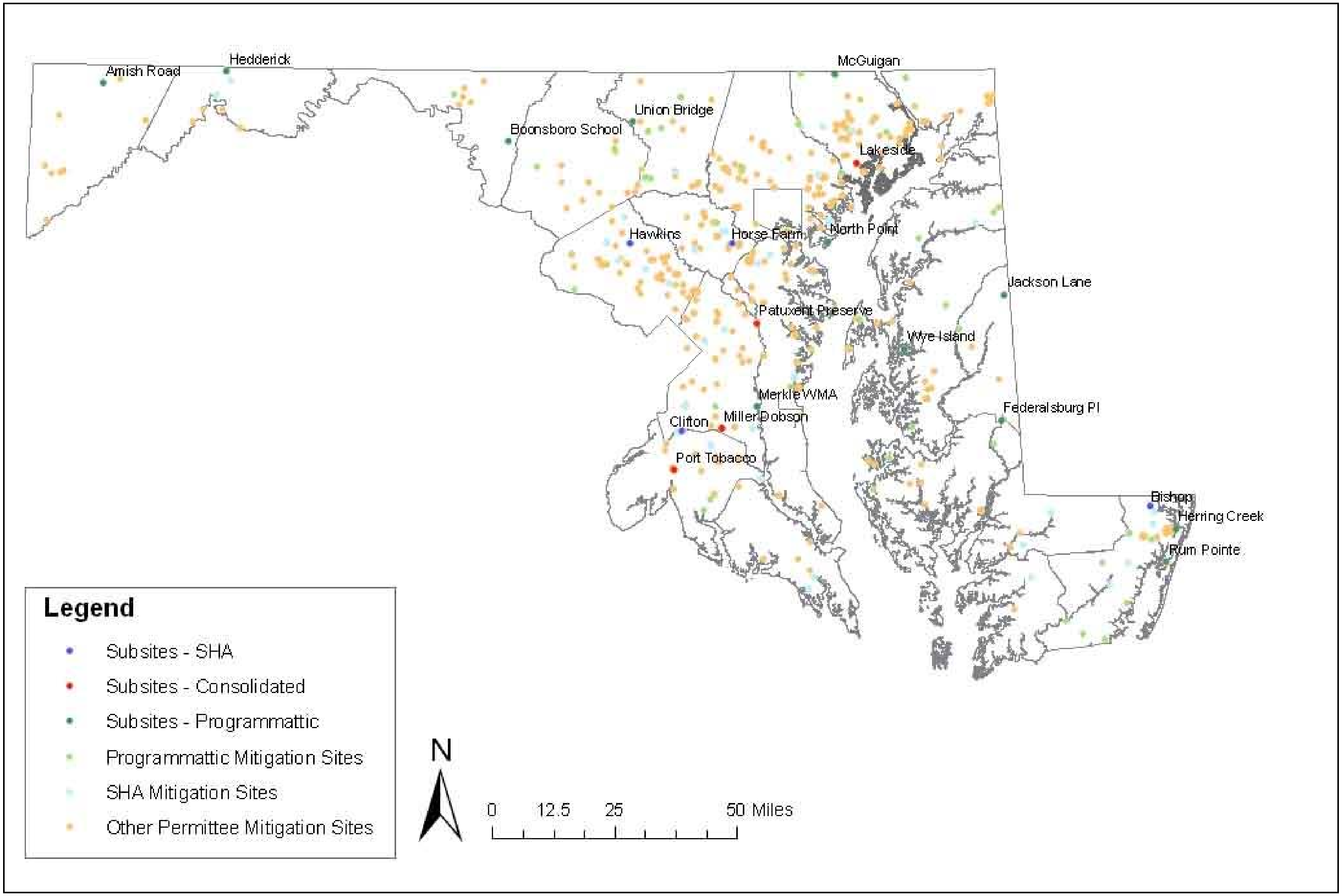

Figure 2. A subset of wetland mitigation sites were selected to conduct more extensive monitoring. These were located throughout Maryland.

At the subset sites, MDE evaluated hydrology at least twice during the growing season between March and June by noting presence/depth of inundation or saturation in the top 12 inches of soil. We did not make these evaluations on days following heavy rain storms. Staff described the soils, looking for presence of hydric soils or other redoximorphic features.

MDE investigated a new technology to determine if the soils were reducing. Some of the soils did not show any redoximorphic features, possibly due to the young age of the wetland mitigation site. Other sites that did have redoximorphic features were thought to actually be historic hydric soils, formed long before the mitigation was completed. It is extremely difficult to determine if the soil redoximorphic features are new or old. The presence of hydric soils alone does not mean the soils are functioning as wetland soils. Therefore, MDE decided to evaluate if the soils were actively reducing by installing IRIS (Indicator of Reduction in Soils) tubes.

IRIS TUBES

IRIS tubes are 24 inch pvc tubing that are coated with a specially formulated Fe oxide paint. When installed in the ground, the paint on the tubes is designed to dissolve under reducing soil conditions (Rabenhorst, 2006). Results will indicate whether or not there is sufficient hydrology and organic matter to support microbial processes for reduction. This will be a good indication of whether the soils are functioning as hydric soils. In addition, the evidence of functioning microbial processes for reduction also indicate that the microbial processes will support wetland functions such as nutrient transformation. IRIS tubes are a much less time consuming way to determine soils reduction in the soil than Eh electrodes. IRIS tubes are a fairly new technology and are not yet utilized in Maryland Department of the Environment's wetland mitigation program. Therefore, MDE was interested in evaluating the ease of utilizing IRIS tubes in our program.

IRIS tubes were inserted 20 inches into the ground in mid through late March. These tubes were in groups of five replicates with an average of three sample points per mitigation site. Larger sites and sites with more variability had more sample points, while smaller uniform sites had fewer sampling points. Staff took notes on the location of the IRIS tubes, including vegetation, hydrology, and soils (Table 2). These tubes were left in for approximately four weeks, then removed and replaced with another set for an additional four weeks. This second time period set was left in four weeks and then removed. The second time period was eliminated if the earlier set of IRIS tubes showed clearly reducing soils. IRIS tubes were taken back to the office for interpretation using visual assessment by trained MDE employees. These tubes will be saved for a period of time, and any questionable interpretations can be sent to the University of Maryland for verification using computer software interpretation.

Table 2. Characteristics of IRIS tube site locations.

Site	Area	Date	Dominant spp	Hydology	Soil
Miller Dobson	1	3/26/07	*Juncus effusus,Juncus tenuis*, *Coronilla varia, Lespedeza sp.*	moist	Hydric: 10YR 5/2 w conc
		4/30/07		Very moist	
		5/30/07		dry	
	2	3/26/07	*Juncus effusus, Phalaris, Juncus* sp.	moist	Not hydric: 0-18" 10YR 5/4 w/ faint conc
		4/30/07		very moist	
		5/30/07		Very dry	
	3	3/26/07	*Juncus effusus, Phalaris, Juncus* sp.	Sat. to surface	Hydric: Gleyed to near surface
		4/30/07		Sat. to surface	
		5/30/07		Soil dry	
	4	3/26/07	*Juncus effusus, Phalaris, Juncus* spp.	Sat. to surface	Hydric: 10YR 3/2 w/ conc
		4/30/07		Sat. to surface	
		5/30/07		dry	
	5	3/26/07	Sparse unk upl grass (redtop?), some *Juncus effusus*	moist	Not hydric: Some gravel 10YR 5/3
		4/30/07		moist	
		5/30/07		Very dry	
	6	3/26/07	Upl weeds (grass), *Lespedeza* sp., some *Juncus effusus*	moist	Not hydric: 10YR 5/6
		4/30/07		moist	
		5/30/07		Very dry	
	7	3/26/07	*Juncus effuses, Juncus tenuis*	moist	Not hydric: 10YR 5/6
		4/30/07		moist	
		5/30/07		Very dry	
Port Tobacco Phase I	1	3/26/07	*Phalaris*	Inundated 1-2"	Hard to ID soils, since falls out of probe
		4/25/07		Sat. to surface	
	2	3/26/07	*Alnus serrulata*, *Apocynum* sp.	Sat. near surface	Hydric: Reduced w/ conc.
		4/25/07		Saturated	
	3	3/26/07	*Juniperus virginiana*, *Solidago* sp.	Sat. to inun. <1"	Hydric: Reduced w/ conc.
		4/25/07		Saturated	
	4	3/26/07	Trees, some cut by beaver	Moist	Hydric: Reduced w/ conc.
		4/25/07		Moist	
		5/25/07		Moist	
	5	3/26/07	Ferns, grass	Sat. to surface, crayfish burrow	Hydric: 0-6" gleyed w/ many conc
		4/25/07		Sat. to surface	
Clifton	1	3/28/07	*Sphagnum*, unk grasses	Sat. to surface	Hydric: >1" gleyed
		4/25/07		Sat. to surface	
	2	3/28/07	*Liquidambar straciflua. Acer rubrum*, *Juncus effusus*	moist	Hydric
		4/25/07		Top sat. then drier below	
Merkle	1	3/28/07	Emergent, sparse shrubs; not noted	Sat. to surface	Not hydric: 10YR 4/3
		4/30/07		Sat. to surface	

	2	3/28/07	*Platanus occidentalis*	Sat. to inun. <1”	Hydric: 0-5” 10YR 4/1; >5“ 2.5YR 5/2
		4/30/07		Sat. to surface	
Lakeside	1	3/29/07	*Juncus effusus*	moist	10YR 4/2 w/ common conc 10YR 4/6
		4/26/07		moist	
	2	3/29/07	*Solidago* sp.	Moist (looks like upland)	Not hydric: chroma 4 w/ faint conc
		4/26/07		dry	
	3	3/29/07	Woolgrass, *Phragmites, Typha latifolia*	Sat. at top, only moist lower in profile	Hydric: 0-12” 10YR 4/2 w/ distinct conc
		4/26/07		Sat. at top, only moist lower in profile	
Federalsburg Phase 1	1	4/5/07	*Salix nigra, Alnus serrulata, impatiens capensis*, *Juncus effusus*	Sat. to surface	Not hydric: 10YR 5/6
		5/7/07		Sat. to surface	
		5/31/07		Sat. to surface	
	2	4/5/07	Emergents; not noted	Sat. to surface	Not hydric: 10YR 4/4
		5/7/07		Sat. to surface	
		5/31/07		Sat. to surface	
Jackson Lane	1	4/5/07	*Liquidambar styraciflua Cyperacae* sp., etc	Sat. to surface	Hydric: 0-10” 7.5YR 2.5/1
		5/7/07		Sat. ~10”deep	
	2	4/5/07	*Liquidambar styraciflua* , *Juncus effusus*, *Scirpus cyperinus*	Sat. to surface	Hydric: 0-10” 7.5YR 2.5/1
		5/7/07		Saturated	
	3	4/5/07	*Platanus occidantalis*, unk grass	Sat. to surface	Hydric: 0-10” 7.5YR 2.5/1
		5/7/07		Saturated	
Wye Island	1	4/5/07	*Liquidambar styraciflua* , *Rosa multiflora*, unk grass	moist	Hydric: 0-6” plow layer; >6” gleyed w/ conc
		5/31/07		Very dry	
	2	4/5/07	*Liquidambar styraciflua* ,Dense	moist	Hydric: 10YR 5/2 w conc
		5/31/07		Very dry	
Bishop	1	4/10/07	Pinus sp., unk grass	moist	Hydric: 0-4” very dark plow?; >4” gleyed
		5/9/07		moist	
		6/5/07		moist	
	2	4/10/07	Unk grass, *Juncus effusus*, mix dec trees	moist	Hydric: 0-6” dark, then white sand
		5/9/07		moist	
		6/5/07		moist	
Herring Creek	1	4/10/07	*Phragmites*	Sat. to inun. <1”	Hydric: 10YR 4/2 w conc
		5/9/07		Sat. to surface	
	2	4/10/07	*Phragmites*	Sat. to surface	Hydric: 0-5” 10YR 4/2 w conc
		5/9/07		Sat. to surface	
Rum Pointe	1	4/10/07	*Pinus* sp., *Liquidambar styraciflua* , *Lonicera japonica, Rubus* sp.	Only slightly moist (site seems too dry)	Hydric: 0-6” 10YR 4/2; >6” 10 YR 4/1
		5/8/07		Only slightly moist	
		6/5/07		Dry	
	2	4/10/07	*Pinus* sp.	Dry	Hydric: 0-3” plow;

		5/8/07		Dry	
		6/5/07		Dry	
Horse Farm	1	4/11/07	*Juncus effusus*	Sat. at 5”	Not hydric: 10YR 4/3 w/ conc
		5/8/07		Not noted	
	2	4/11/07	*Juncus effusus, Cyperacae* spp.	Sat. to surface	Not hydric: 10YR 4/3 w/ conc
		5/8/07		Not noted	
Hawkins	1	4/12/04	Arthraxon w/ some *Juncus effusus*	Sat. to surface	Hydric: 10YR 4/1 w/ conc
		5/8/07		Not noted	
	2	4/12/04	*Phalaris*	Sat. to surface	Hydric: 10YR 4/1 w/ conc
		5/8/07		Not noted	
	3	4/12/04	*Phalaris*	Sat. to surface	Hydric: 10YR 4/1 w/ conc
		5/8/07		Not noted	
	4	4/12/04	*Typha latifolia*	Sat. to surface	Hydric: 10YR 4/1 w/ conc
		5/8/07		Not noted	
McGuigan	1	4/16/07	*Juncus effucus*	Sat. to surface	Soil falls out of probe
		5/15/07		Sat. to surface	
	2	4/16/07	Sparse	Sat. to surface	Not hydric: no conc; gleyed below 12”
		5/15/07		moist	
	3	4/16/07	Clover, upl weeds	Sat. at top 1” then only moist below	Not hydric; gleyed below 12”
		5/15/07		dry	
	4	4/16/07	Sparse, a few *Typha* nearby	Sat. at top 1” then , then moist below sat. below that	Not hydric
		5/15/07		Shallow inundation	
Patuxent Preserve	1	4/17/07	Unk ornamental grass	Sat. to surface	Not hydric: >1” 10YR 5/4 wo conc
		5/21/07		moist	
	2	4/17/07	*Betual nigra, Andropogon virginicus*,, *Juncus effusus*, *Sphagnum* moss, unk grass	Sat. to surface	Not hydric: >1” 10YR 4/6
		5/21/07		Sat. to surface	
North Point	1	4/18/07	*Andropogon virginicus*	Sat. to 1” deep then slightly moist below	Not hydric: 0-12” 10YR 4/3 w/ many conc.
		5/16/07		dry	
	2	4/18/07	*Liquidambar styraciflua* , unk grass, some Andropogon virginicus	Sat. to 1” deep then slightly moist below	Not hydric: >1” 10YR 5/4 w/ many conc.
		5/16/07		dry	
	3	4/18/07	*Phragmites*, *Salix*	Sat. to surface	Not hydric: 10YR 4/4 w/ many conc. and gleyed spots
		5/16/07		V moist to almost saturated	
	4	4/18/07	*Salix nigra*, *Liquidambar styraciflua* , *Cyperus, Juncus* spp.	Sat. to 1” deep then slightly moist below	Not hydric: 10YR 4/3 w/ many conc.
		5/16/07		dry	
Amish Road	1	4/12/07	*Typha latifolia, Carex* sp., *Eleocharis* sp.	Sat. to inundated 1”	Hydric: 0-15” 10YR 3/1 Ox rhyz
		5/10/07		Sat. to inundated 1”	
	2	4/12/07	Sparse *Juncus* sp.	Sat. to inundated 1”	Not hydric: 0-15” Chroma 2.5
		5/10/07		Sat. to inun. <1”	

Boonsboro	1	4/11/07	Unk grass, *Carex* sp.	Inundated 1-2”	Not hydric: 0-12” 10YR 5/6
		5/9/07		Inundated 1”	
	2	4/11/07	*Typha latifolia*	Inundated 1-2”	Not hydric: Mix of 10YR 5/6 and 10YR 4/3
		5/9/07		Sat. to surface	
Union Bridge	1	4/11/07	*Carix stricta*	Sat. to surface	Hydric: 0-7” 10YR 4/1 w/ ox rhyz.; 7-12” 10YR 5/2 w 5YR 4/6 fine dist w/ oxy rhyz
		5/9/07		Sat. to surface	
	2	4/11/07	*Eleocharis* sp.	Sat. to inun. <1”	Hydric: 0-12” 10YR 3/1
		5/9/07		Sat. to surface	
	3	4/11/07	*Salix nigra, Juncus effusus*	Sat. to surface	Not hydric: 0-15” chroma 3.5
		5/9/07		Sat. to surface	
	4	4/11/07	*Acorus calamus*	Depression not currently inundated	0-2” 10YR 4/3; 2-12” 10YR 3/2 w/few faint 7.5 YR 4/6 w/ox ryhz
		5/9/07		Depression not currently inundated	
Hedderick	1	4/12/07	*Eleocharis* sp., *Carex stricta*, *Carex* sp.	Inundated 1”	0-12” 10YR 4/2 w/ 7.5YR 4/6 conc
		5/10/07		Sat. to inun. <1”	

Figure 3. IRIS tubes were installed in sets of five at the subset wetland mitigation sites. A soil probe was utilized to create a pilot hole for the IRIS tubes.

MDE concluded that the lack of soil reduction in certain sites was due to either a lack of sufficient hydrology or the soil microbes responsible for reduction were being limited by lack of organic matter or abnormal pH.

While the IRIS tubes were a much less time consuming endeavor than the standard platinum electrodes, they did require a good deal of time. Installing them in wetland mitigation sites is apparently much more difficult than installing them in existing wetlands due to the huge difference between the soils of wetland mitigation sites and existing wetland sites. This is likely due to wetland mitigation sites having much higher bulk density and lower organic matter than existing wetland sites. Many of the mitigation sites had soil that was very sandy or gravelly. MDE had to utilize a rubber mallet to pound the soil probe 20 inches into the ground for the majority of mitigation sites to create a pilot hole for the IRIS tubes. The tip broke off a soil probe due to gravel and many other times the gravel jammed the soil probes, requiring a good deal of time spent in removing the gravel. A mallet also broke. It was even more difficult to insert the tubes once the soil dried later in the spring.

Figure 4. IRIS Tubes on left have not yet been installed, paint is still intact. IRIS tubes on right were in the soil of the wetland mitigation site for four weeks and now show significant paint removed, suggesting soil reduction.

Some sites that were expected to reduce, based on appearing to have adequate hydrology, did not. Staff could not find three sets of IRIS tubes due to heavy vegetative growth (in the case of one set) or removal by vandals. While most others were relatively easy to find, using a GPS to track the initial installation locations would help in cases where the vegetation is dense.

Staff re-installed new tubes at nine of the twenty mitigation sites due to lack of reduction in at least one of the sample locations (Table 3). When removing the first set of tubes in the field, staff made a quick estimate of the paint removal. This estimate was conservative, and later lab interpretations revealed some tubes that staff initially estimated were below 20 percent reduction were actually above 20 percent reduction, and thus soils at the sites were considered to be reducing. As a result, staff ultimately replaced more tubes than necessary. The following results are from the final IRIS tube interpretations. Since interpretations of IRIS tube percent reduction are more accurate when more people interpret the same tube separately, and then average the results, three staff members interpreted each tube. First each one determined the four-inch range along the tube that had the highest amount of paint removed. They noted this area. They each estimated the amount of paint removed for that area. Staff then noted the total area that appeared to have ≥20 % paint removed to determine where the overall reduction is taking place (e.g.: in only a 4 inch area near the surface of throughout the entire length of the IRIS tube.) These results are found in Appendix 1. Two of the four consolidated sites had areas that were not reducing (Miller Dobson and Lakeside). One of the four SHA sites had portions that were not reducing (Bishop). Three of the twelve programmatic mitigation sites had areas that were not reducing (McGuigan, North Point, and Rum Pointe). Complete results can be found in Appendix B.

Table 3. Number of IRIS tubes installed, number replaced, and number with sufficient reduction, scores from Mitigation Site Scoring Method, use of transects/other observational methods, number of soils samples analyzed.

Site	IRIS tubes installed	IRIS tubes replaced	IRIS tubes w/ <20% reduction (lab interpretation)	Score	Transects	Soils
Miller Dobson	7	7	3	61	NA	3
Port Tobacco	5	1	0	83	NA	2
Clifton	2	0	0	93	NA	1
Merkle	2	0	0	92	Crabs	1
Lakeside	3	3	2	75	NA	3
Federalsburg P1	2	2	0	100	Y	2
Jackson Lane	3	0	0	108	Crabs	0
Wye Island	2	0	0	89	Y	1
Bishop	2	2	1	61	NA	2
Herring Creek	2	0	0	65	Crabs	0
Rum Pointe	2	2	2	54	Y	2
Horse Farm	2	0	0	87	NA	0
Hawkins	4 (lost #3)	0	0	70	NA	0
McGuigan	4	2 (lost one)	1	83	Ecotone	3

Patuxent Preserve	2	0	0	91	NA	0
North Point	4	2	1	83	Y	3
Amish Road	2	0	0	87	Y	0
Boonsboro	2	0	0	97	Y	0
Union Bridge	4	1(but lost)	0	~76	Y	0
Hedderick	1	0	0	~93	Y	0

SOIL SAMPLING

Staff collected soil samples from most sites that did not have reducing IRIS tubes to determine if lack of organic matter or abnormal pH may be the cause of poor reduction at some sites (Table 3). Additional soil samples were also collected from sites that did have IRIS tube soil reduction, in order for comparisons. Staff used the soil probe to collect several samples from the top four inches of soil for each distinct sampling location near the IRIS tubes. The samples were consolidated and mixed thoroughly to get one sample. The Maryland Environmental Service then tested these samples for organic matter content (Volative Solids, Method SM 2540E) and pH (Method SW846 9045) under another project.

The soils results did not show any obvious patterns. Sites that were not reducing based on the IRIS tubes had a wide range of organic matter and pH (Figures 5 and 6). It was obvious from MDE's field visits that some sites did not have hydrology, and this was the likely culprit for the majority of sites showing poor reduction. The exception is Miller Dobson. Unfortunately, MDE was unable to remove soil samples from the Miller Dobson sites that were not reducing, since the soil was too hard and dense to retrieve a sample with available equipment. However, there seemed to be little variation in the soils at that site. The vegetation was relatively sparse throughout the site. Some areas at Miller Dobson where MDE installed the IRIS tubes were inundated with water. It is possible that this water was perched very near the surface due to soil compaction that occurred during construction. This may have resulted in extreme fluctuations in soil hydrology.

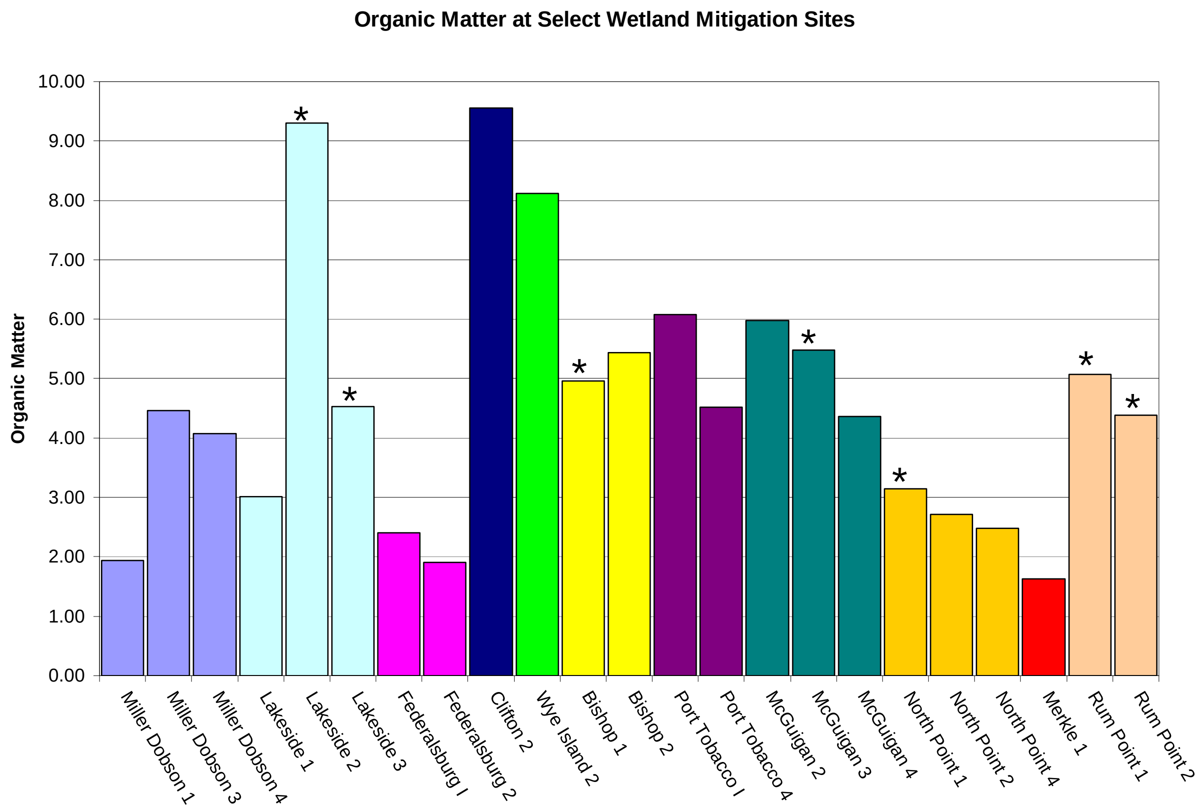

Figure 5. Soil organic matter at select wetland mitigation sites. "*" denotes sites where the IRIS tubes found less than 20% paint removal, and therefore insufficient soil reduction.

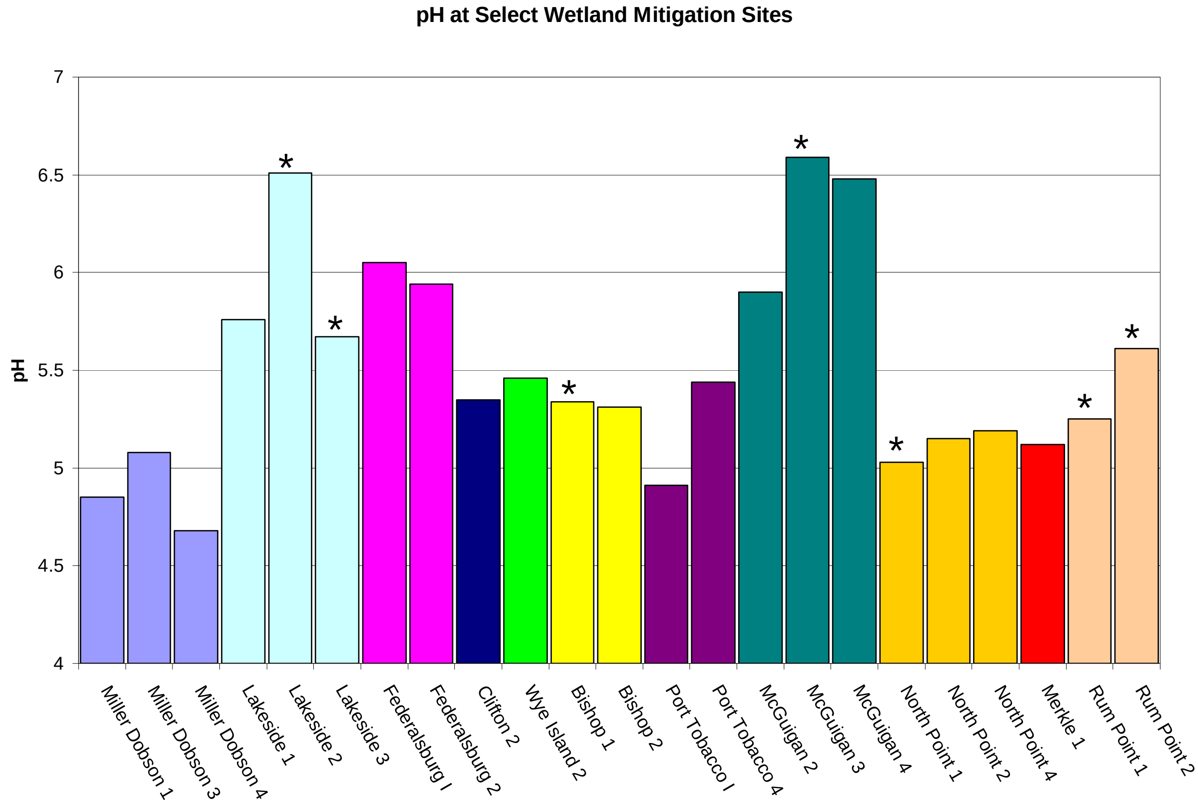

Figure 6. Soil pH at select wetland mitigation sites. "*" denotes sites where the IRIS tubes found less than 20% paint removal, and therefore insufficient soil reduction.

DETAILED SITE ASSESSMENT

MDE sampled a subset of programmatic mitigation sites, following the 1987 Corps of Engineers Wetland Delineation Manual, as summarized below. The protocol for sites larger than five acres in size is as follows:

1) Establish the baseline length of the project site.
2) Determine the required number and position of transects.
3) Sample observation points along the transects by choosing representative locations within each distinct plant community type. For these observation points, use a 5-ft radius plot for herbs and saplings/shrubs and a 30-ft radius plot for trees and woody vines. Within these plots, estimate the percent cover of the dominant species for each stratum.
4) Determine the wetland indicator status of the top 50% of the plant species.
5) Note presence of hydric soil indicators and observe hydrology indicators for each observation point.

The protocol for sites equal to or less than five acres in size is as follows:

1) Identify the plant community types at the site and sketch these on a base map.
2) Select representative observation points in each plant community type.

3) Determine the cover of the dominant plant species in each vegetative stratum.
4) Determine the wetland indicator status of the top 50% of the plant species.
5) Note presence of hydric soil indicators and observe hydrology indicators for each observation point.

These sites were also scored using the newly developed MDE Rapid Scoring Assessment Method, to compare results.

MDE's subset of sites consisted of three sites larger than five acres in size and five sites smaller than five acres in size. The results can be found in Appendix C. Table 4 summarizes the results. While staff did note the presence/absence of hydric soils, this factor was not taken into account when determining if the site is a wetland, since the hydric soils are remnant, and were not created from the wetland mitigation itself. Due to the drought starting in early 2007, some sites with no observed wetland hydrology may have hydrology during normal years/wetter times of the year.

Table 4. Summary of transect/observation points.

Site	Number of Transects/Observation Points	Conclusion (wetland or not wetland)
Amish Road	2 observation points	2 wetland
Boonsboro	2 observation points	2 wetland
Federalsburg	6 transect observations	4 wetland; 2 possibly not wetland
Hedderick	5 observation points	5 wetland
North Point	6 transect observations	4 wetland; 1 possibly not wetland; 1 not wetland
Rum Pointe	2 observation points	2 not wetland
Union Bridge	2 observation points	2 wetland
Wye Island	5 transect observations	4 wetland; 1 not wetland

As mentioned previously, the remaining four programmatic mitigation sites are being monitored by the University of Maryland (sites: Herring Creek, Jackson Lane, and Merkle) and Ecotone (McGuigan site). University personnel estimated from the McGuigan site monitoring (conducted in July 2006) that 40% of the area was inundated 1-3 inches and 55% was saturated within eight inches of the surface. Wetland vegetation covered more than 90% and installed woody plants had a 95% survival rate. All of the cells were found to be developing wetlands. It is interesting to note that based on MDE 2007 site monitoring, MDE found hydrology to be lower than the University reported (more areas without obvious wetland hydrology) and cover by upland species to be much higher for a few cells than what the University reported.

MONITORING BY PERMITTEES

Permittees follow standard sampling protocols that are included in the Interagency Mitigation Task Force (IMTF) Guidance. Sampling methodologies are required to determine that the hydrology, hydrophytic vegetation, and hydric soils are present and a wetland is being established. The information from the sampling methodologies (e.g., raw data sheets, mapping) will be reviewed in context of a yearly monitoring report, which is submitted to MDE, to evaluate the success of the site based upon established performance standards. Monitoring reports are typically required for five years after the completion of a mitigation site. However, if a site is doing particularly well it may not require a full five years of monitoring and, vice versa, if a site has problems and is not meeting its established performance standards, additional monitoring beyond 5 years may be required. The Maryland Compensatory Mitigation Guidance sorts the recommended sampling methodologies into two categories: Those for projects less than or equal to 0.5 acres and those for projects greater than 0.5 acres.

The monitoring of projects that are less than or equal to 0.5 acres is fairly simple. MDE requires the typical 5-year period of monitoring for these projects that includes a yearly monitoring report due by December 31 of each monitoring year. The monitoring reports should include a general description of the site and whether or not it has met its mitigation goals and standards. Other things that should be included in the yearly monitoring reports are a list of plants species from most dominant to least dominant, photographs of the site, and potential invasive species problems along with an eradication plan. Water level data attained from groundwater monitoring wells may also be included. It is also important to note that the as-built site plans/drawings must be submitted to MDE within 120 days of completion of construction.

As one might expect the monitoring for projects greater than 0.5 acres are similar to, but considerably more involved and detailed than for the smaller projects. A five-year monitoring period along with yearly monitoring reports is still necessary, however more data is required to be collected and more information is needed in the report. Detailed vegetation density measurements need to be done during the second, third, and fifth growing seasons subsequent to the completion of the site. The guidelines for vegetation density sampling methods for emergent, scrub/shrub, and forested wetlands, both tidal and non-tidal, can be found in the IMTF Maryland Compensatory Mitigation Guidance document, which can be accessed through the USACOE Baltimore District’s website. Both groundwater well data and surface water depth measurements are needed. Additional information on the instillation of groundwater monitoring wells as well as guidelines for the groundwater well readings and water depth measurements can also be found in the IMTF document. Other required hydrology information includes maps showing the locations of ground water monitoring wells and water depth measurements, a summary of the information regarding groundwater and surface water elevations, and monthly rainfall data for the area to address its influence on hydrology. Random soil samples to determine the depth of topsoil, muck, and organic compost shall be taken within two weeks of the completion of grading at the site. Guidelines for the soil sampling can also be found in the IMTF document. Results of the sampling, including a map depicting sampling locations, must be included in the first year monitoring report submitted to MDE.

MITIGATION PROJECT SITE LOCATION

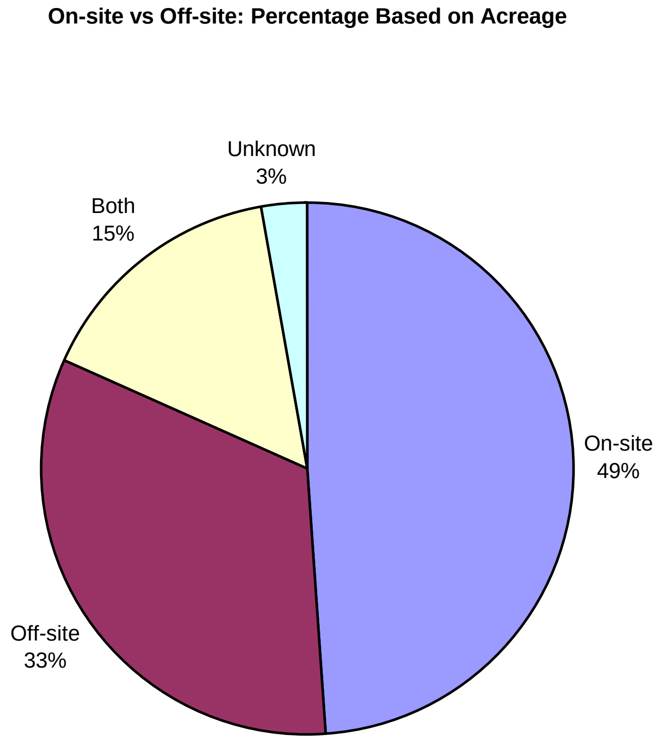

Figure 7. Percentage, based on area, of mitigation projects permitted prior to January 1, 2007 that were completed on-site, off-site, both on and off-site, and those that are not currently known. There are 444.6 acres of projects on-site, 297.4 acres of projects off-site, 139.5 acres of projects that are both, and 26.3 acres of projects that are unknown.

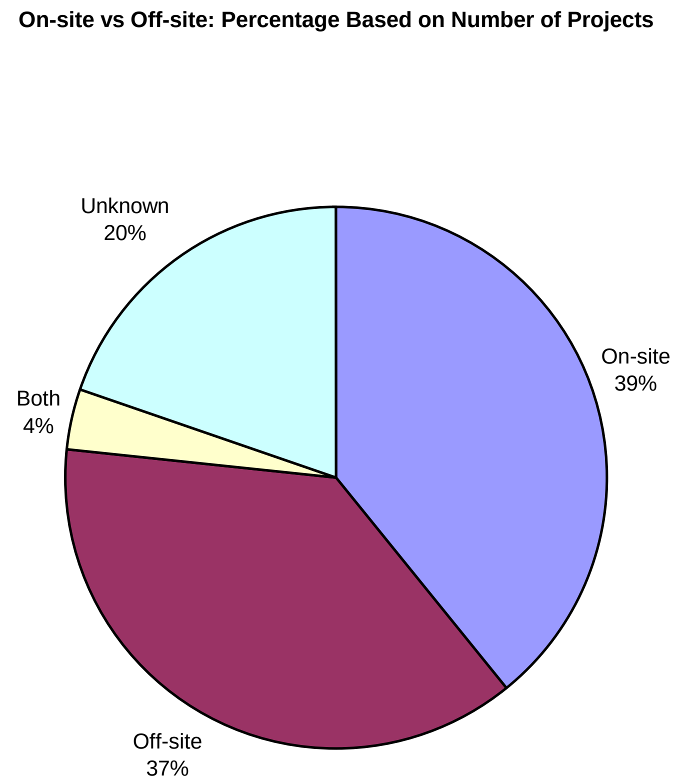

Figure 8: Percentage of mitigation projects permitted prior to January 1, 2007 that were completed on-site, off-site, both on and off-site, and those that are not currently known. There are 251 on-site projects, 240 off-site projects, 24 projects that are both, and 126 projects that are unknown.

MITIGATION PROJECT STATUS

During this project, staff spent considerable time trying to determine the status and success of projects. Half of the projects were "successful" (Figure 9), (43% of the acreage required mitigation; Figure 10). Even though these projects were "successful," many still had some portions with poor wetland hydrology, invasive plant species, mowing/human disturbance, poor soils, poor tree establishment, or extensive animal damage. If the project were scored using the Mitigation Site Scoring Method and received a score of 60 or greater (a "D" or better), it was placed in this category. If the project was not scored, but a site visit suggested it would receive a score of "D" or better, it also was in this category.

When considering just the three mitigation types most encouraged by MDE (creation, enhancement, and restoration; Figure 11) the success rates were fairly high (>80% by area). These three mitigation types consisted of 398 mitigated projects located on 392.5 acres of land. It is important to note that only projects that could be determined as successful to some degree or not were included in Figure 11.

An initial evaluation of the mitigation program revealed a surprising number of sites for which the mitigation status was unknown, meaning MDE was uncertain whether or not the mitigation had been completed, even though it should have been done by this time. In many of these cases, staff were able to determine the status through contacting the applicant or consultant, or conducting a site visit. However, MDE has "lost track" of other projects, and now have no way of figuring out what happened to them: if they were ever done, if they were successful, why they failed, etc. This is often the case when the file has become lost or was purged and the project manager either has left MDE or simply does not remember the project. Some of these projects may have been completed, but are so complicated due to multiple permit modifications and splitting up the mitigation into multiple sites or paying partially into the Compensation Fund, that figuring out what impacts actually occurred and what/if any mitigation actually occurred has not yet been done. The category "unclear" includes these projects. It also includes projects in which the mitigation was completed but MDE is not sure of the success of the project. This is usually because there have been no site visits conducted after construction. In some cases, a site visit was made, but due to poor plans or unusual climate conditions (e.g. drought periods) MDE is are still unsure if the site is a success. Fifteen percent of the projects fit into this category.

There were many projects that are considered as failures. Out of the 641 total projects considered, 84 projects were unsuccessful (13% of projects, 7% of the acreage mitigation required). This is often either because they were never constructed or because they were constructed but the mitigation failed (Figure 12). There were 36 projects that failed because they were never constructed. The total required mitigation for these 36 projects encompassed approximately 15.17 acres (660872 square feet). There were a variety of causes for the failure of the remaining 48 projects that were constructed and unsuccessful. Two projects requiring approximately 0.54 acres (23511 square feet) of mitigation failed because the mitigation was incorrectly done at a replacement ratio of 1:1 instead of 2:1. Three projects requiring approximately 0.48 acres (21118 square feet) of mitigation failed because they were ponded and too wet. Fourteen projects requiring approximately 6.51 acres (283597 square feet) of mitigation failed due to a combination of reasons including a lack of hydrophytic trees/vegetation (in some cases the site had been mowed or deer had eaten the vegetation) and a lack of hydrology (i.e. site was too dry). One project requiring approximately 0.35 acres (15338 square feet) of mitigation failed because it was built too small (only 3200 square feet of mitigation done). Seven projects requiring approximately 5.08 acres (221102 square feet) of mitigation failed because some part of their required mitigation was not completed and/or the majority of their site was not wetland. One project requiring approximately 0.29 acres (12519 square feet) of mitigation failed because the mitigation plan had never been approved due to a lack of a protection mechanism. The descriptions that we have on the other 20 projects (17.27 acres; 752125 square feet) that were constructed and failed are much more vague or, in the case of one project, nonexistent. These vague descriptions simply state that the mitigation failed, that there is no monitoring, and/or that the site looked poor. In most of these cases, MDE did not follow-up on tardy monitoring reports and missed opportunities to identify problems and have the applicant fix them. As a side note, there is sometimes a big difference between what the monitoring report says and what MDE mitigation staff report out in the field. The applicant or their hired consultant has an interest in making the site appear better than it actually is. When staff discovered that the site was doing poorly or was not built correctly, MDE sometimes decided it was too late to pursue any remedies. During this project, MDE was able to get some of the projects that had not yet been completed, but were long overdue, to either pay into the MDE Wetland Mitigation Compensation Fund or pursue/complete their original mitigation projects.

Some projects (6% of permits, 3% of acreage required mitigation) were "somewhat successful." These were sites that were not scored, but had site visits showing some major problems. However, they were not necessarily complete failures. Scoring them would allow them to be clearly placed in either the success or failure category, since they are currently somewhere in the middle.

It was too early to determine the success of the site for some projects (5% of permits, 16% of acreage required mitigation). These mitigation sites have been constructed, but are generally very young in age (often less than one year old). They will be evaluated in future years.

Ten percent of the permits (16% of the acreage required mitigation) issued prior to 2007 have not yet been completed, but will likely be completed at some point. Since mitigation is often done concurrently with the impacts or at the completion of the impacts (e.g.: when a temporary sediment basin used during construction is then converted to the wetland mitigation site), there is a delay between the impacts being done and the mitigation being completed. This is a temporary loss of function. Some of the other projects that are not yet completed are from permits issued a few to several years ago. In these cases, MDE is working with the applicant and feel relatively confident that the mitigation will be done in the future.

It should be noted that these evaluations were based on looking through the mitigation files and discussions with the mitigation managers. If the information, especially about follow-ups, is not in the mitigation folder and is not mentioned by the mitigation manager, there are no other information sources. There may have been phone calls and other informal contacts that were not recorded.

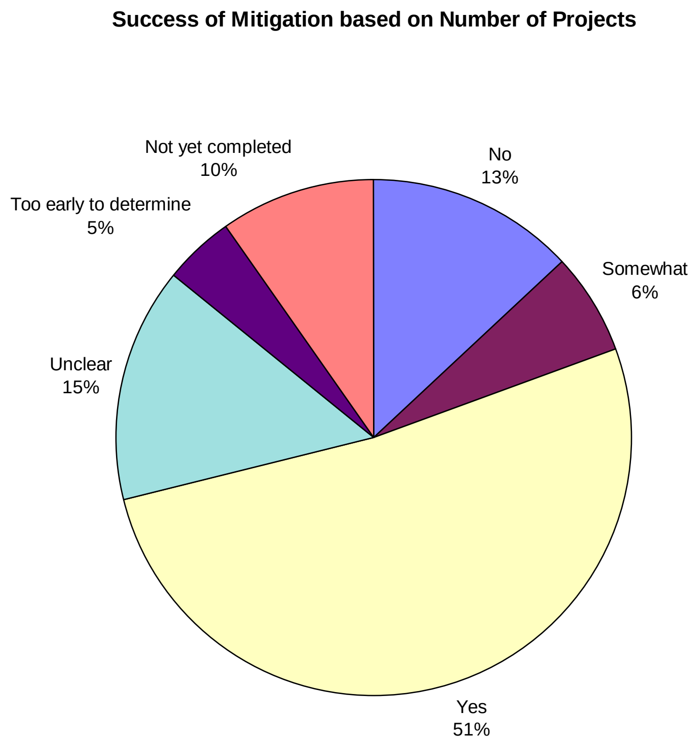

Figure 9: Success of Permittee Mitigation Projects, based on number of projects, for permits issued prior to January 1, 2007.

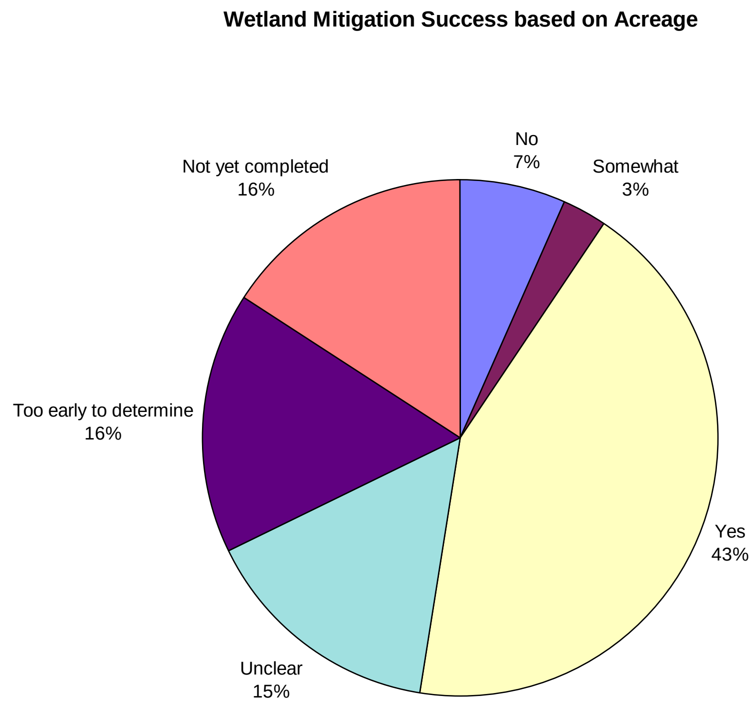

Figure 10: Success of Permittee Mitigation Projects, based on area, for permits issued prior to January 1, 2007.

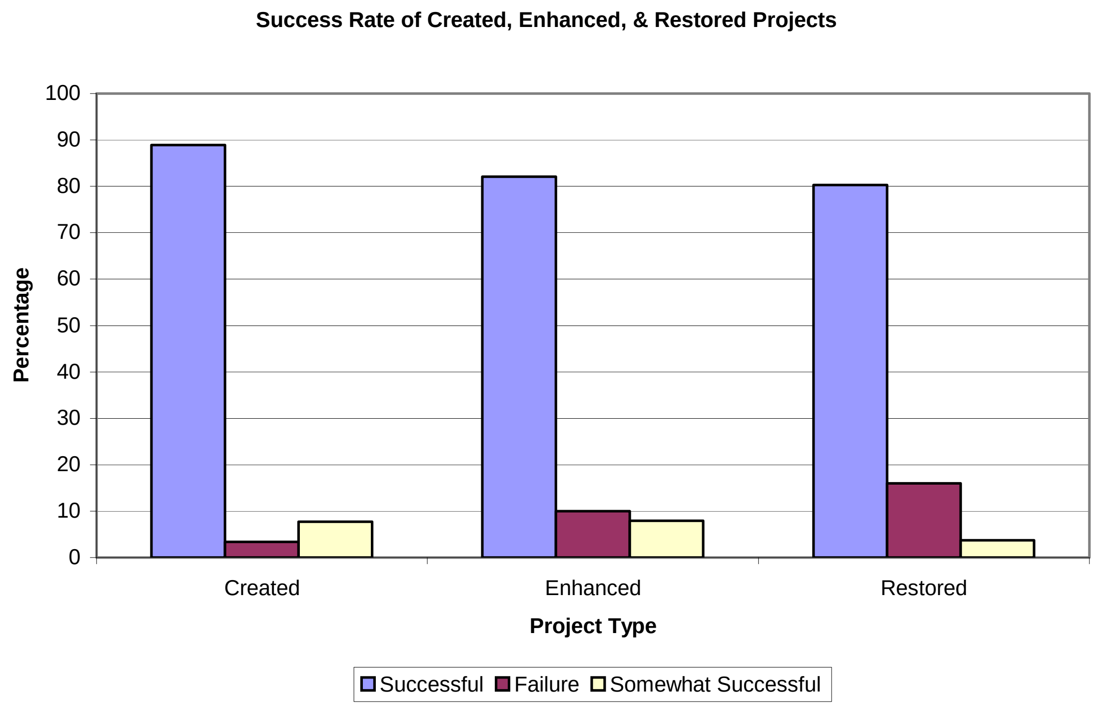

Figure 11: Success rates, based on acreage, of the three major types of wetland mitigation used by Permittee Mitigation Projects permitted prior to January 1, 2007.

Figure 12. Example of a wetland mitigation site currently rated as a failure due to lack of hydrology (as evidenced by the near monoculture of tall fescue in the foreground) and extensive mowing (and dog-training facility).

It appears that the required vegetation type for mitigation does not affect the success of the project too drastically (Figure 13).

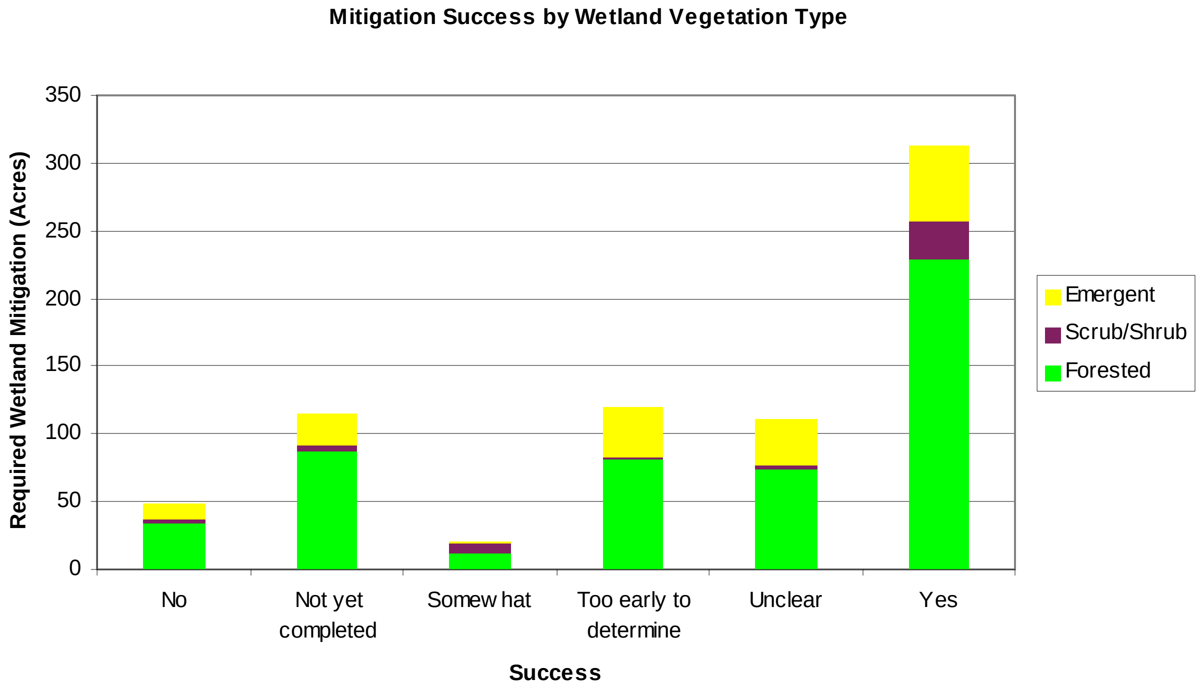

Figure 13. Success of Permittee Mitigation Projects, based on area and vegetation types, for permits issued prior to January 1, 2007.

Some Sub-Basins had higher levels of wetland mitigation success than others (Figure 14). Choptank River and Middle Potomac River had the highest ratio of failure:success projects, although the actual acreage of failures was not too high.

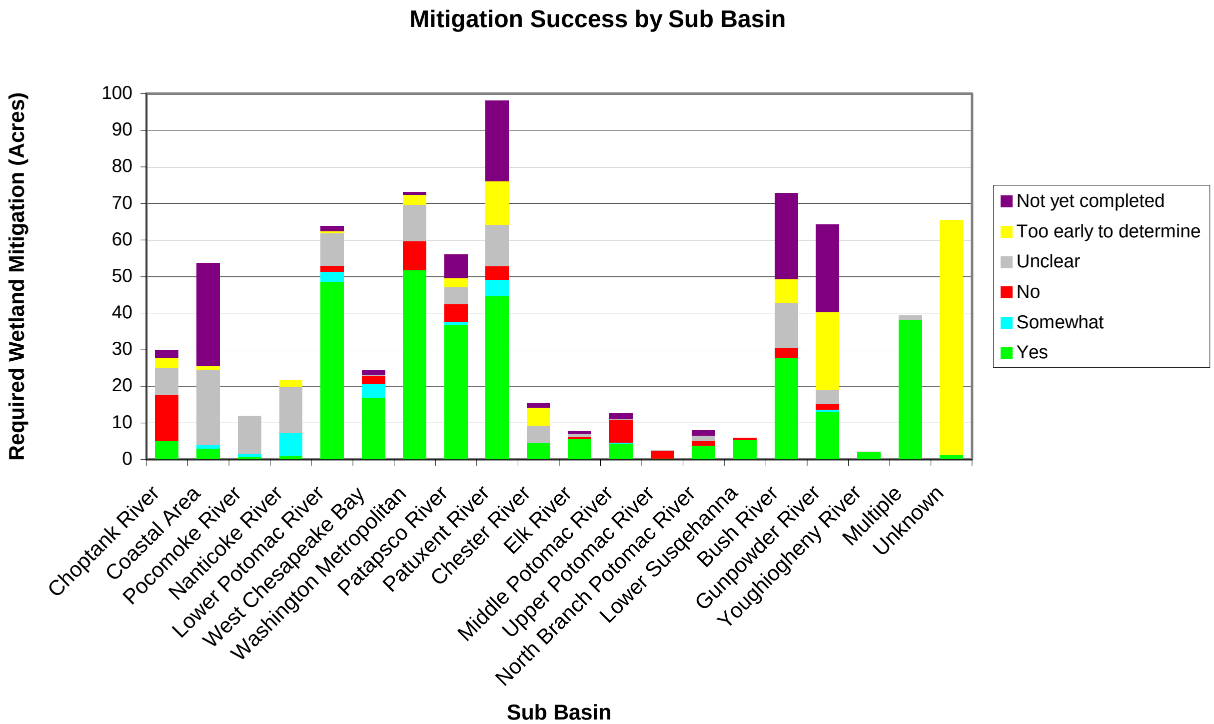

Figure 14. Success of Permittee Mitigation Projects, based on area, for each Sub-Basin, for permits issued prior to January 1, 2007.

ADMINISTRATIVE EVALUATION

During this project, MDE evaluated different aspects of the mitigation process. All individual permittee mitigation sites and consolidated sites are included. MDE does not include projects paying completely into a Wetland Mitigation Compensation Fund or Programmatic Mitigation projects. These are discussed in a later section. All data is for permits issued before January 1, 2007.

For the majority of permits issued prior to January 1, 2007, a Phase II Mitigation Plan was submitted (551 projects; Figure 15). Sometimes this plan consisted of payment into a consolidated mitigation site. In some cases, this Phase II plan was submitted as part of the original permit application. For other projects, this Phase II plan was submitted after the mitigation construction was completed. This is obviously not desirable because MDE does not have a great opportunity to make comments and suggest revisions to a plan that is after-the-fact. In many cases, when the plan was not received, there is documentation that MDE staff followed-up with the applicant. However, at other times, there was no apparent follow-up by MDE.

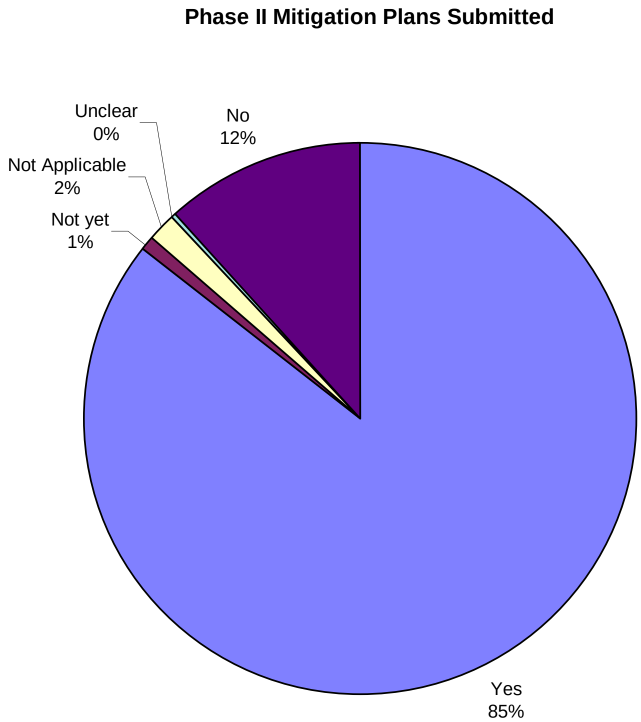

Figure 15: Number of Phase II Mitigation Plans Submitted

Many of the submitted Phase II wetland mitigation plans that were submitted were received late (Figure 16). Forty percent of submitted Phase II plans were for consolidated mitigation sites. Due to the nature of consolidated sites, with some sites being completed prior to the issuance of the individual permit, these Phase II dates are sometimes treated differently. Some mitigation managers use the date of the original Phase II for the entire consolidated site, while others use the date that the individual applicant actually paid into the consolidated site. As above, when the Phase II was submitted late, in some cases there is documentation that MDE mitigation staff did follow-up with the applicant, but in other cases MDE did not follow up.

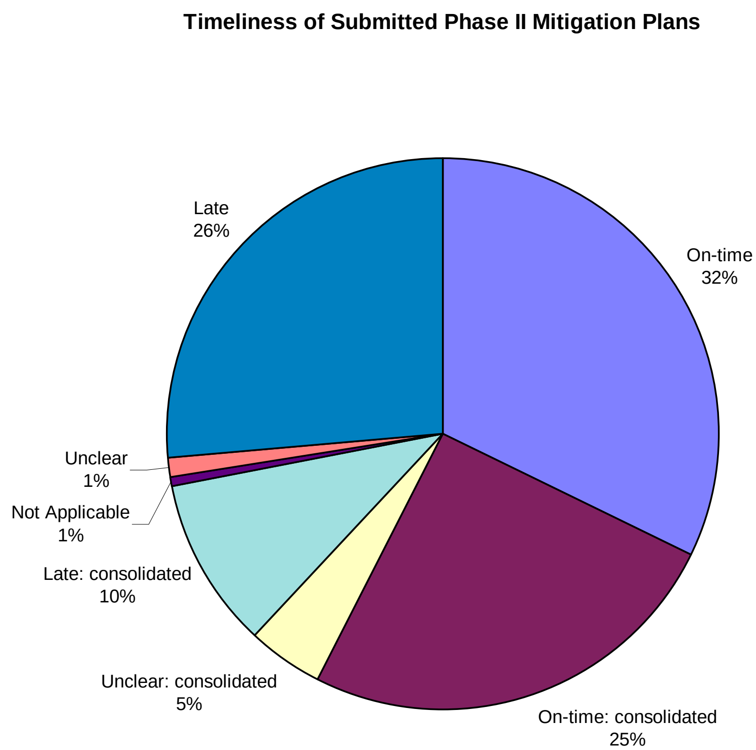

Figure 16: Timeliness of Submitted Phase II Mitigation Plans

Among the Phase II Mitigation Plans that were eventually submitted, Phase II due date extensions were only granted in fifteen percent of the cases, with most of these being for extensions of less than a year (Figure 17).

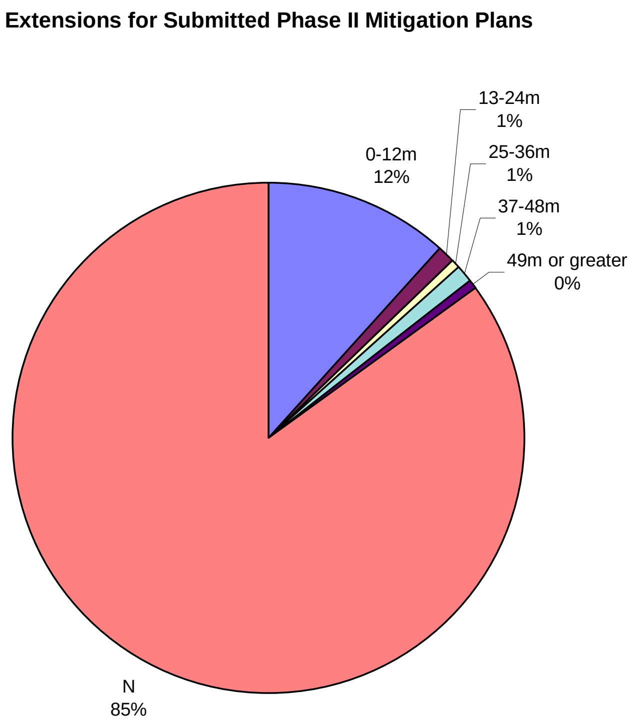

Figure 17: Extensions for submitted Phase II mitigation plans

Nearly half of the approved Phase II mitigation plans were approved within the first year after the permit was issued (Figure 18). Some Phase II plans were not approved until several years after the permit was issued. This may be the case for complicated projects, when the project changes, or when the project gets delayed. For some projects (14%), the Phase II plan was approved prior to the permit issuance. This may be the case when the project mitigates at a consolidated site (that was already built) or when the Phase II plan is submitted as part of the permit application. Of the 551 submitted Phase II plans, 59 were never approved by MDE.

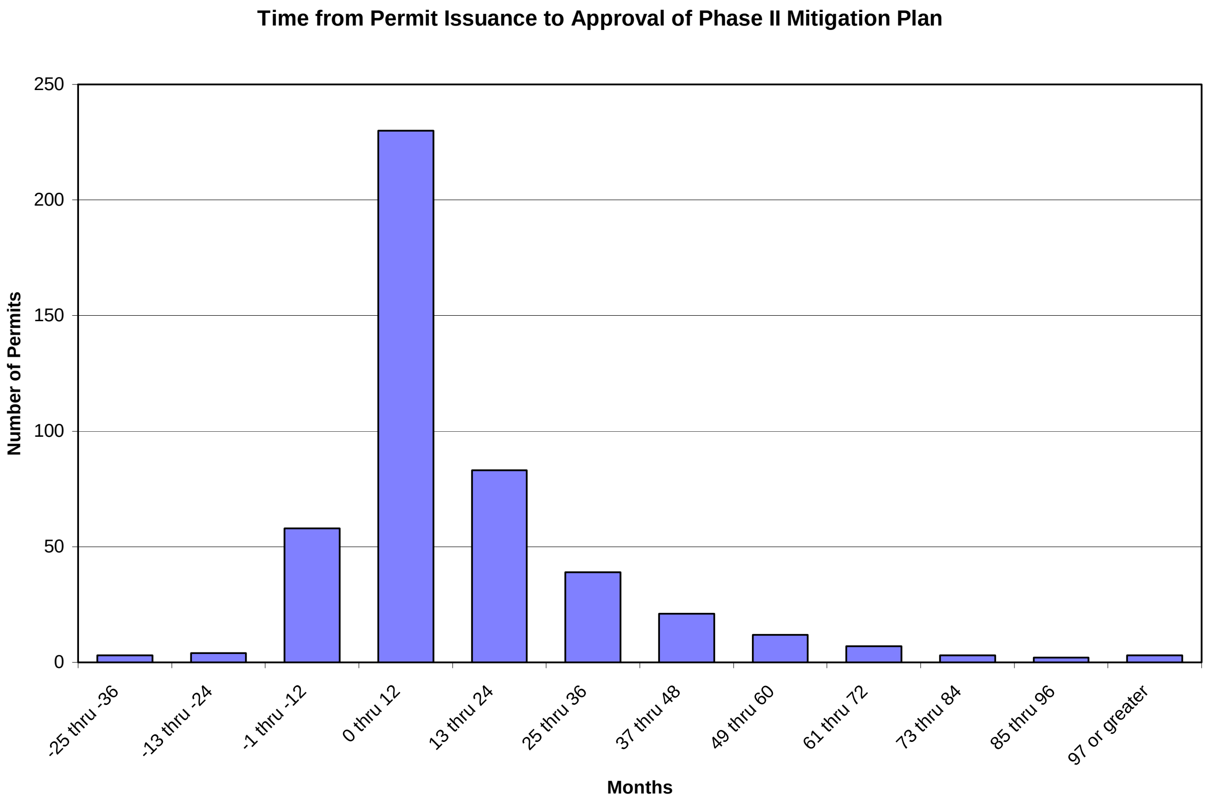

Figure 18: Time from Permit Issuance to Approval of Phase II Mitigation Plan

Among mitigation projects that were completed, the majority (53%) were completed within three years after the permit was issued (Figure 19). In theory, unless stated otherwise in the Phase II Mitigation Plan approval letter, it is assumed that the wetland mitigation project construction will be completed within the three years that the permit is active. There were 107 projects (23%) that were completed after three years from the permit issue date. Since many of the project files were purged or were not well maintained, it is difficult to tell how well MDE followed-up in many of these cases. In some projects, the files have documentation of MDE's reminder letters or phone-calls. In other files, there is no documentation of these follow-ups and MDE assumes there was poor follow-up in at least some projects. In some cases, MDE's follow-up was years after permit was issued. Other projects (24%) were completed prior to the permit issue date. These were mostly projects paying into an already-constructed consolidated mitigation site.

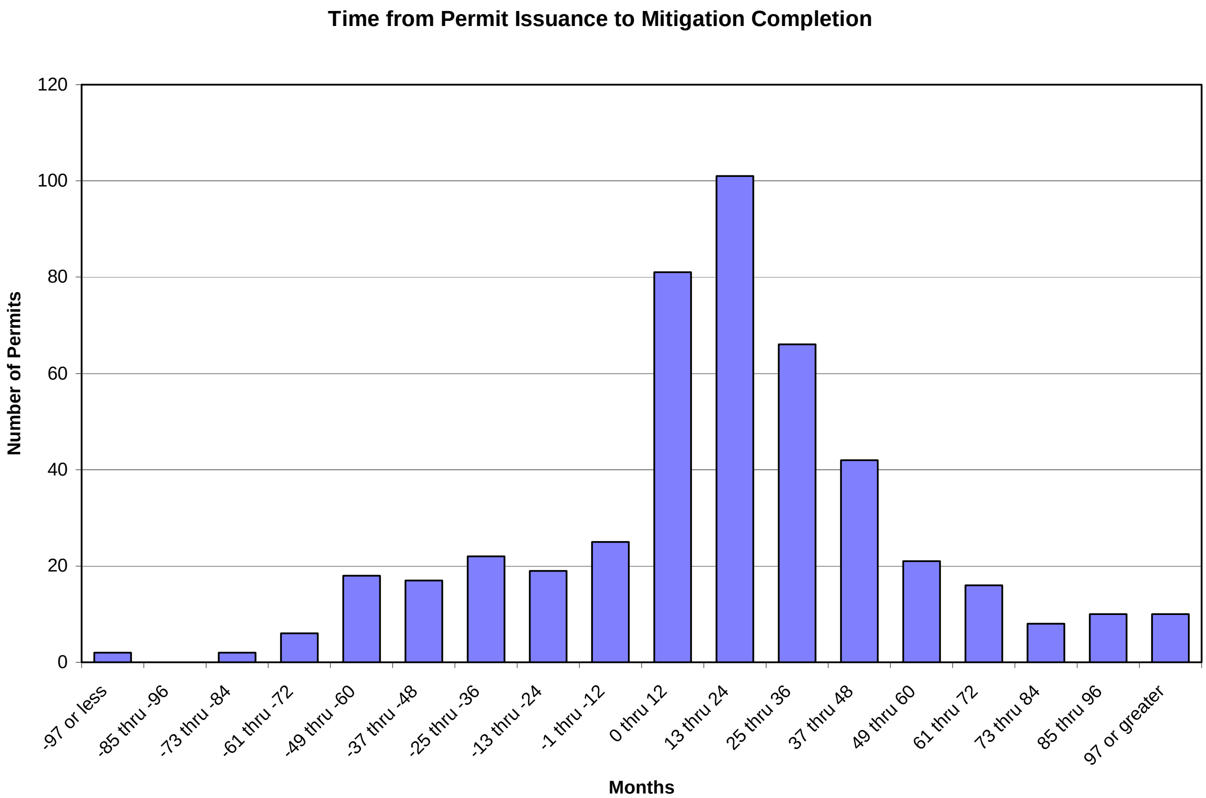

Figure 19: Time from Permit Issuance to Mitigation Completion

Over one-half of the mitigation projects that were completed were completed within three years of the Phase II Mitigation Plan approval (Figure 20). Nearly one-third were completed prior to the Phase II approval. These were mostly projects paying into an already-constructed consolidated mitigation site, especially the ones that were completed years in advance of the Phase II approval.

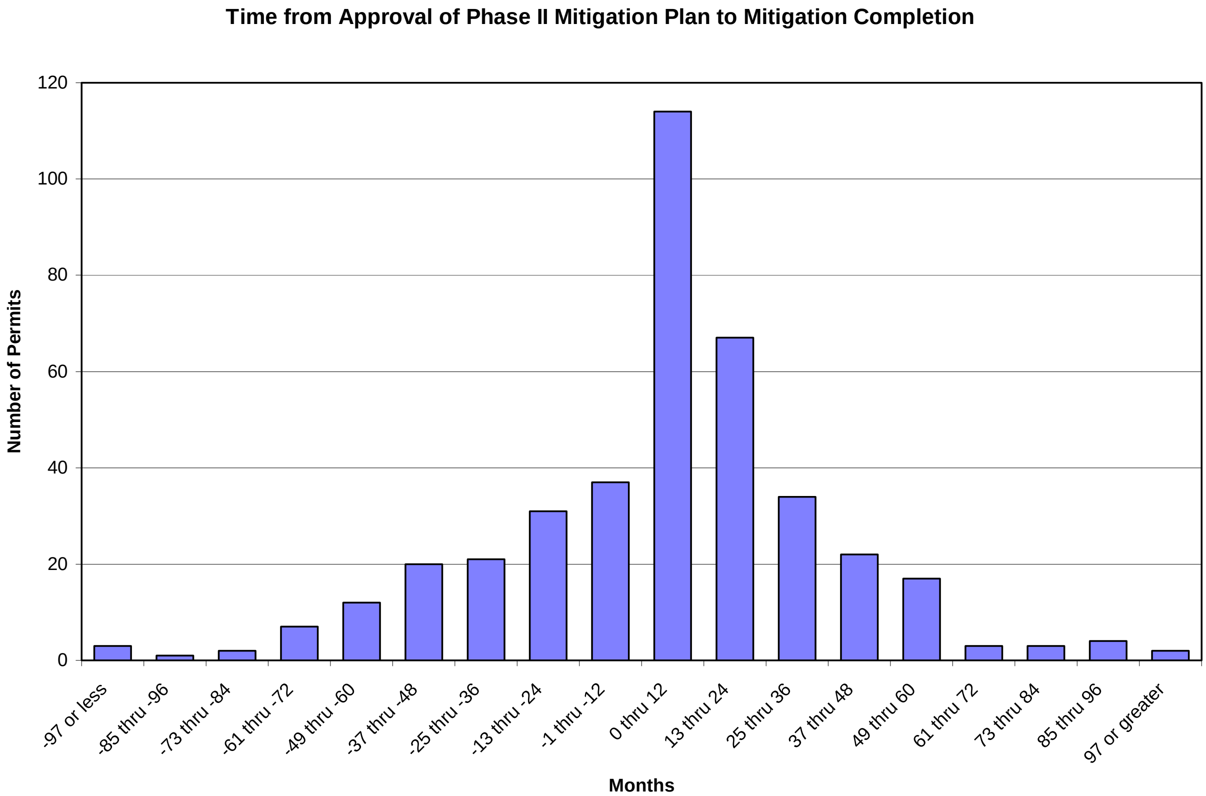

Figure 20: Time from Approval of Phase II Mitigation Plan to Mitigation Completion

Monitoring reports of any kind or for any year were only submitted for 67% of the cases for projects with required mitigation, (Figure 21). Monitoring reports for all five required years after mitigation completion were submitted in very few cases. In some cases where monitoring would normally be required, monitoring was waived (e.g.: some cases where the mitigation was tree planting only). Approximately 28% of the projects requiring monitoring actually submitted monitoring reports for all years required. However, when monitoring reports were received and problems were discussed in the report, MDE did not necessarily follow-up to make sure these problems were remedied. In cases where monitoring was terminated early or the project was constructed recently, and all the required monitoring reports were submitted, MDE still considers these as being in compliance. However, of projects that submitted all required monitoring reports, most of the projects submitted some, if not all, of the monitoring reports late (as discussed in the next figure). For nearly one-third of the projects, not even one monitoring report was submitted. In some cases, there is documentation of MDE follow-up about tardy monitoring reports. However, in many cases, there was no follow-up or a letter was sent years after the monitoring reports were required.

MDE only received a bond for 3% of permits issued prior to January 1, 2007. Only about one-half of these bonds were submitted on-time.

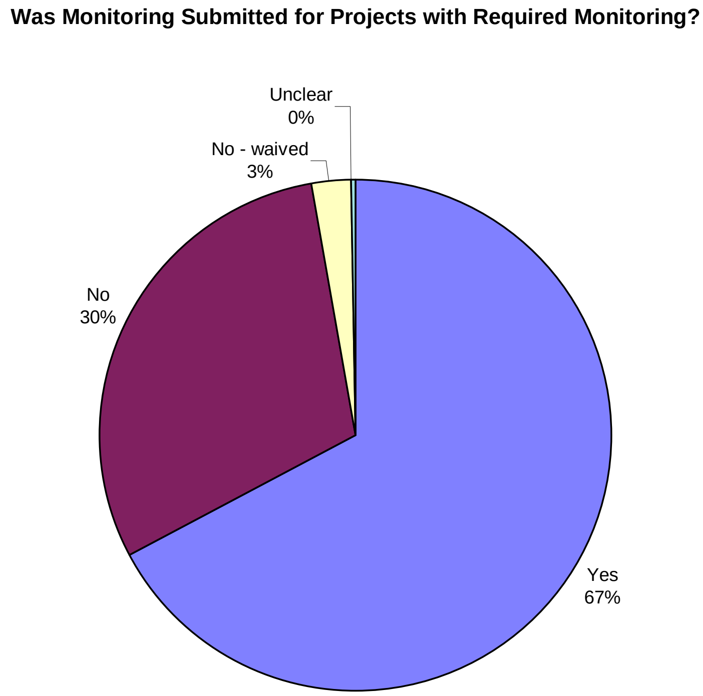

Figure 21: Was Monitoring Submitted for Projects with Required Mitigation?

The percentage that were not submitted was slightly higher over the course of the monitoring (from 25% in year one to 38% in year five; Figure 22). This already takes into account the projects where monitoring was terminated early or the project is in an earlier year of monitoring. This decrease in submittal of monitoring reports over time is not as bad as expected. One would expect the applicant to submit the monitoring reports early in the monitoring period and then ignore the remaining reports as the project nears the end of its required monitoring. While this is sometimes the case, many applicants do not turn in their monitoring in the earlier years and are reminded about the monitoring requirement in later years.

Figure 22: Monitoring Reports Submitted by Year for Projects Doing Any Monitoring

Approximately one-half of the monitoring reports that were submitted were late (Figure 23). This trend generally continued over the five-year monitoring period. Reports were considered late if they were received after December 31 of each year. In addition, some field visits were made outside of the growing season. While this may allow for easier observations of the hydrology (especially when conducted in the winter and early spring), it does not allow for accurate observation of the vegetation (especially in sites dominated by emergent species), and is discouraged. In questionable sites, ideal monitoring would include a site visit when the hydrology is more evident (early spring) and then one during the growing season, to evaluate the vegetation.

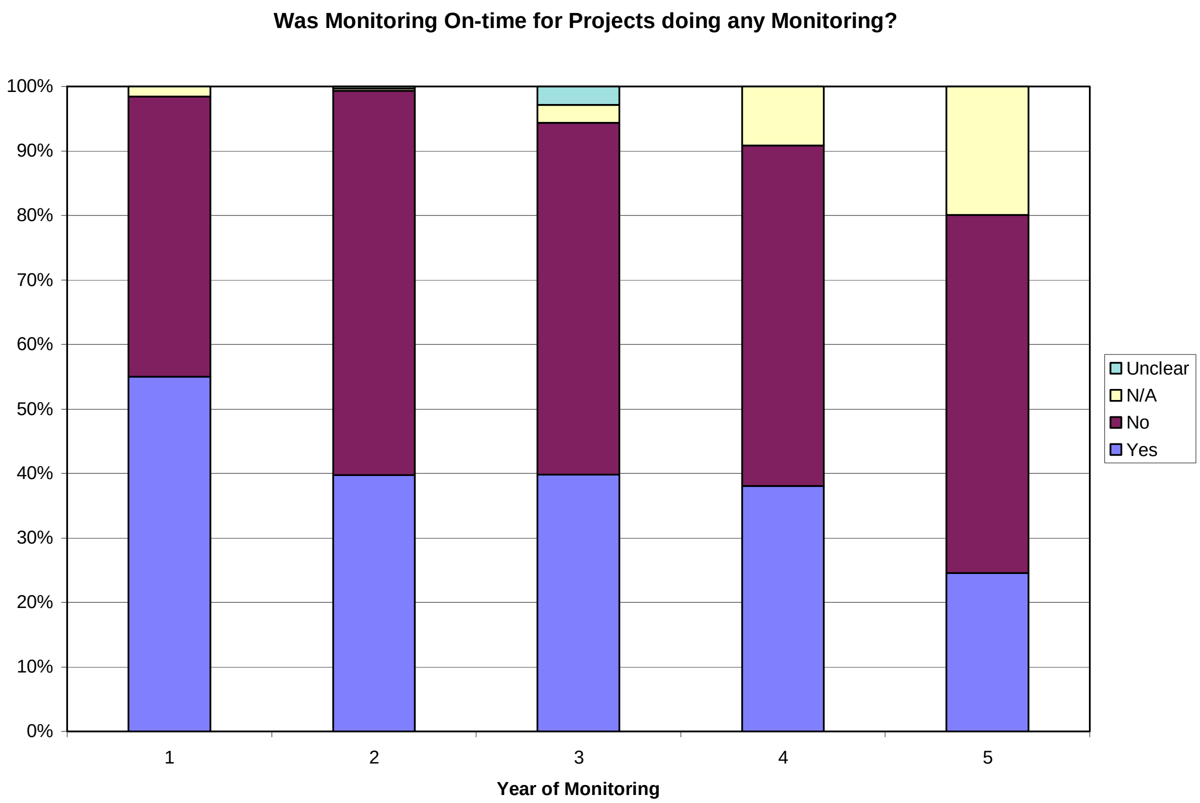

Figure 23: Was Monitoring On-time for Projects Doing Any Monitoring?

The amount of approved wetland impacts for projects not paying into the MDE Wetland Mitigation Compensation Fund wwas highest in Baltimore County, Howard County, and Prince Georges Counties (Figure 24). When taking into account wetland conversion as well, Worcester also has a very high amount of approved wetland impacts. Approved impacts are highest for forested wetland (55%), followed by emergent (35%), scrub/shrub (5%), farmed (4%), and Landscape Management Area (<1%) of the total 418 acres of approved impacts. Conversion losses were highest for forest to scrub/shrub (35 acres), while forest to emergent (18 acres) and scrub/shrub to emergent (14 acres) are lower.

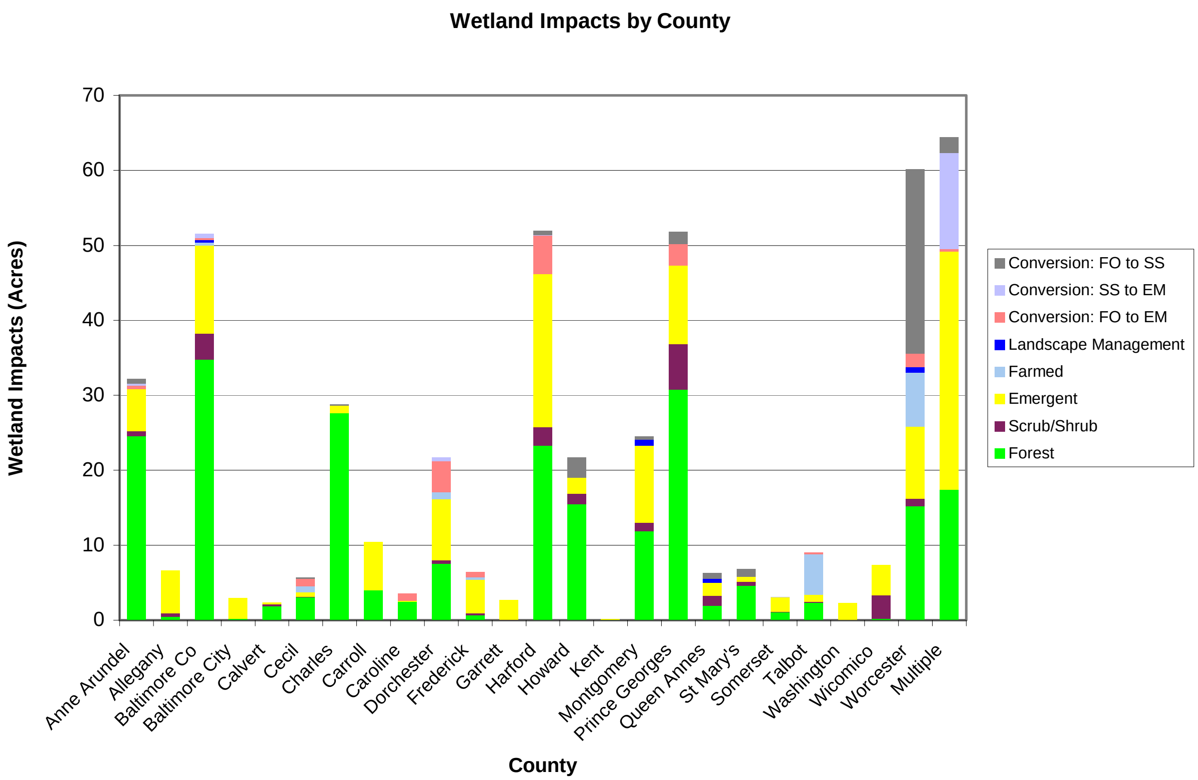

Figure 24: Approved Permanent Impacts by County for Permittees Not Paying into the MDE Compensation Fund.

The approved wetland impacts for projects not paying into the MDE Wetland Mitigation Compensation Fund were highest in sub-basins Patuxent River, Bush River, and Washington Metropolitan (Figure 25). When taking into account wetland conversion as well, the Coastal Area sub-basin also has a high amount of approved wetland impacts.

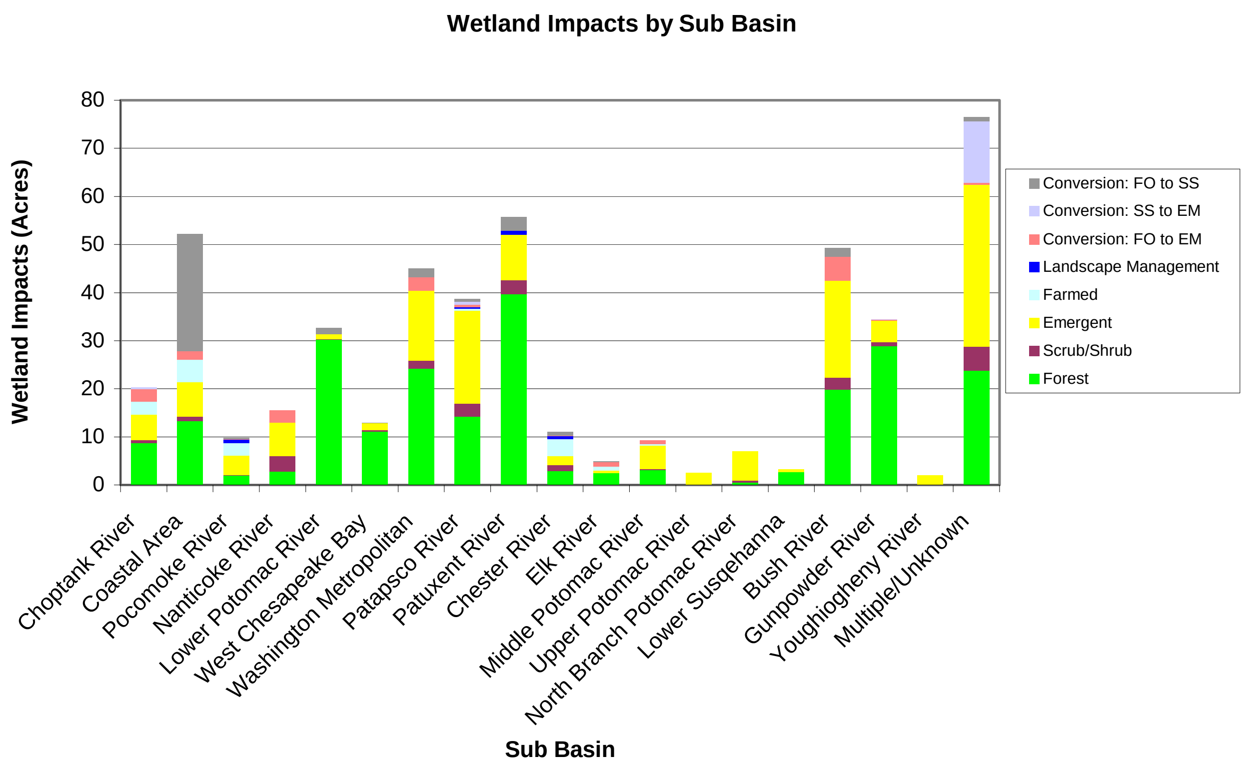

Figure 25: Approved Permanent Impacts by Sub Basins for Permittees Not Paying Into the MDE Compensation Fund

The highest amount of completed permittee wetland mitigation (including creation, restoration, and enhancement only is for forest (402 acres; 70%), followed by emergent (138 acres; 24%), and scrub/shrub (36 acres; 6%), totalling 576 acres (Figure 26). The majority (406 acres; 70%) is created, with the remainder being restoration (95 acres; 17%) and enhancement (75 acres; 13%). Preservation also accounts for a large amount of wetland mitigation, with credit often being given at a 10:1 ratio. This preservation is roughly split between forest and emergent. Even with all of the problems in mitigation, the amount of completed wetland mitigation (576 acres), excluding preservation, is higher than the amount of approved impacts (418 acres). In addition, it is very important to remember that there is a time lag between when the impacts are approved (the date in which the permit is issued), and when the wetland mitigation is completed. Therefore, since we are including all projects issued prior to January 1, 2007, many projects will not yet have completed their mitigation, since not enough time has passed. There are also many out-of-kind mitigation projects that have occurred, including stream restoration, stream buffer enhancements, upland buffers, tidal wetland restoration, education, etc. In most cases, the applicant must provide wetland mitigation at the ratio of 1:1 before any of these out-of-kind mitigation options can be considered. These are also not included in the acreage of completed permittee wetland mitigation.

As mentioned previously, there are many mitigation projects, that while completed, have not turned into successful wetlands. Many of these are still included in the above calculations, due to the difficulty of delineating the actual wetland area in a new wetland mitigation site, and the risk in doing this after only visiting the site during drought years. However, many of the impact sites were also low-quality in nature, with many being highly disturbed and/or dominated by *Phragmites* or other invasive plant species.

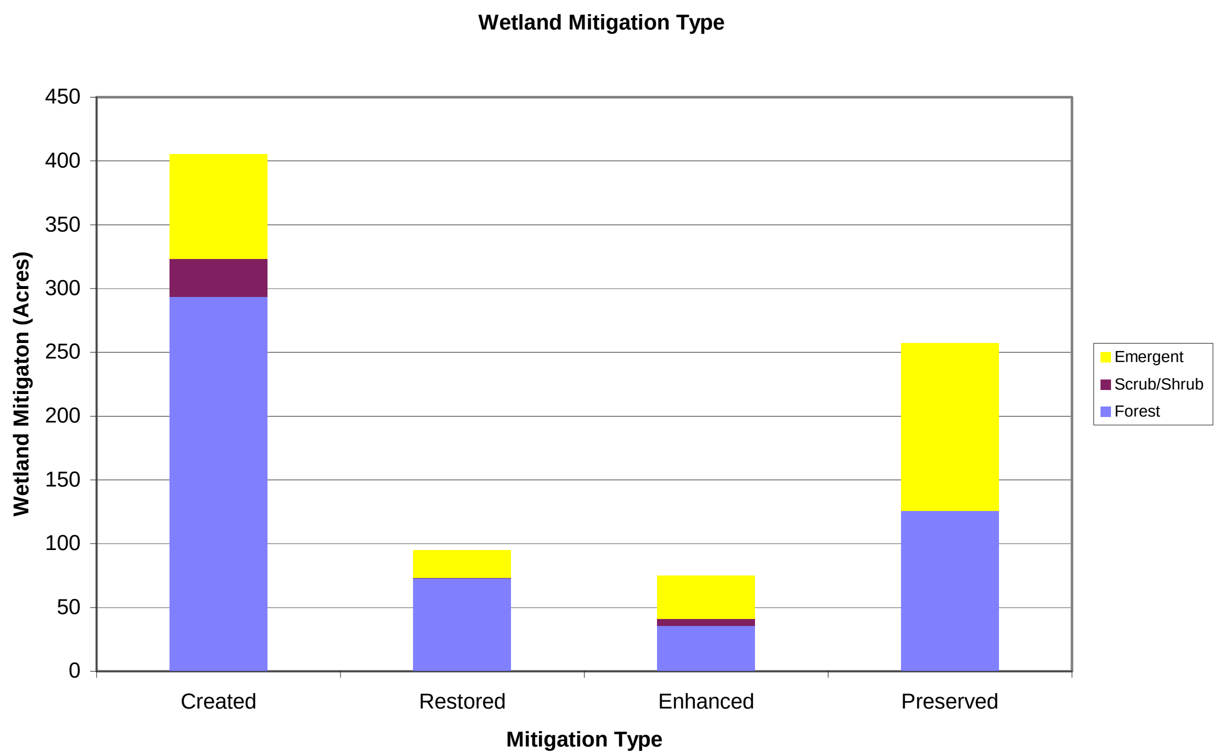

Figure 26: Mitigation by construction type (created, restored, enhanced) and vegetation type.

Wetland mitigation (excluding preservation) is highest in Baltimore County, Charles, Anne Arundel, Prince Georges, Harford, and Worcester (Figure 27). Preservation is highest in Carroll, followed by Baltimore County and Charles.

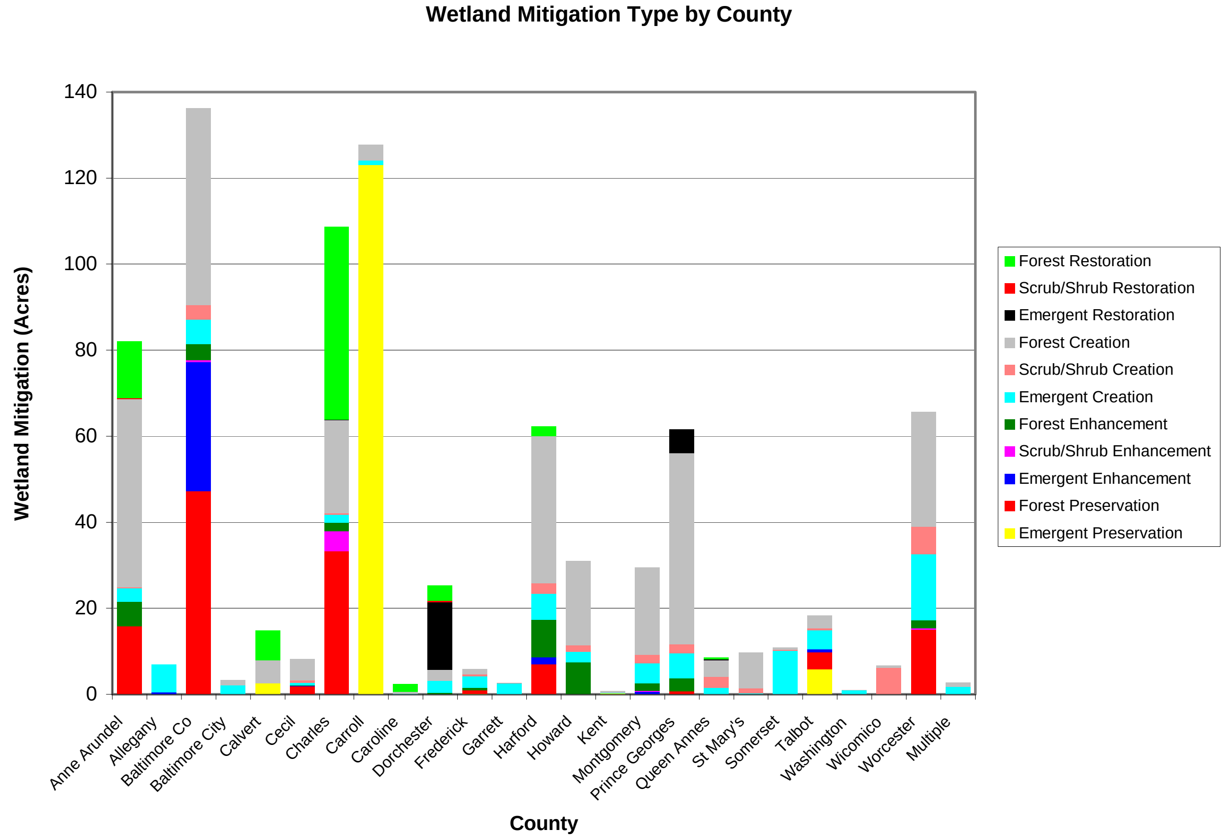

Figure 27: Mitigation type (construction and vegetation type) by County

Wetland mitigation (excluding preservation) is highest in sub-basins Patapsco River, Lower Potomac River, and Patuxent River (Figure 28). Preservation acreage is overwhelming highest in the Patapsco River sub-basin, primarily due to conservation of bog turtle habitat.

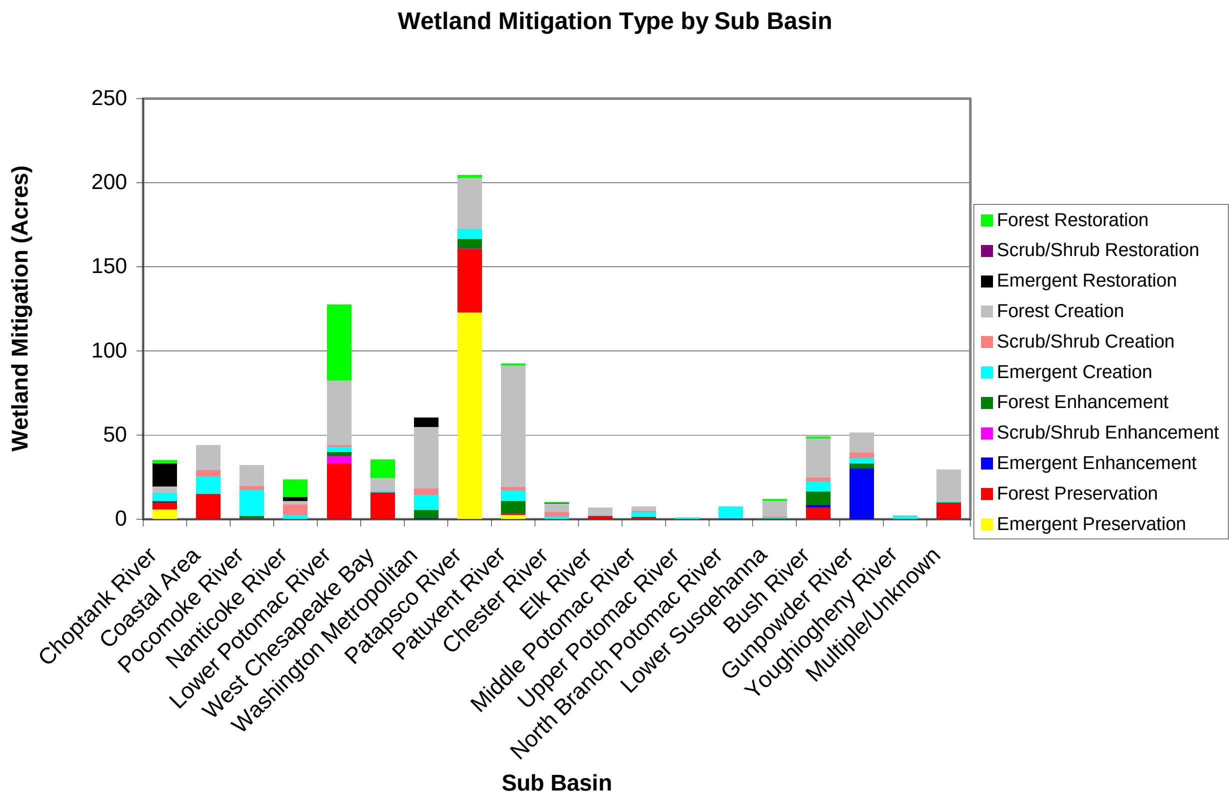

Figure 28: Mitigation type (construction and vegetation type) by Sub-Basins

Wetland gains through mitigation were higher than that of wetland losses through authorized permanent impacts in all Sub-Basins except the following: Coastal Area, Elk River Area, West Chesapeake Bay Area, and Upper Potomac River Area (Figure 29). The differences between gains and losses in these basins are very minimal and the overall gains throughout all of the sub-basins still greatly outnumber the total losses.

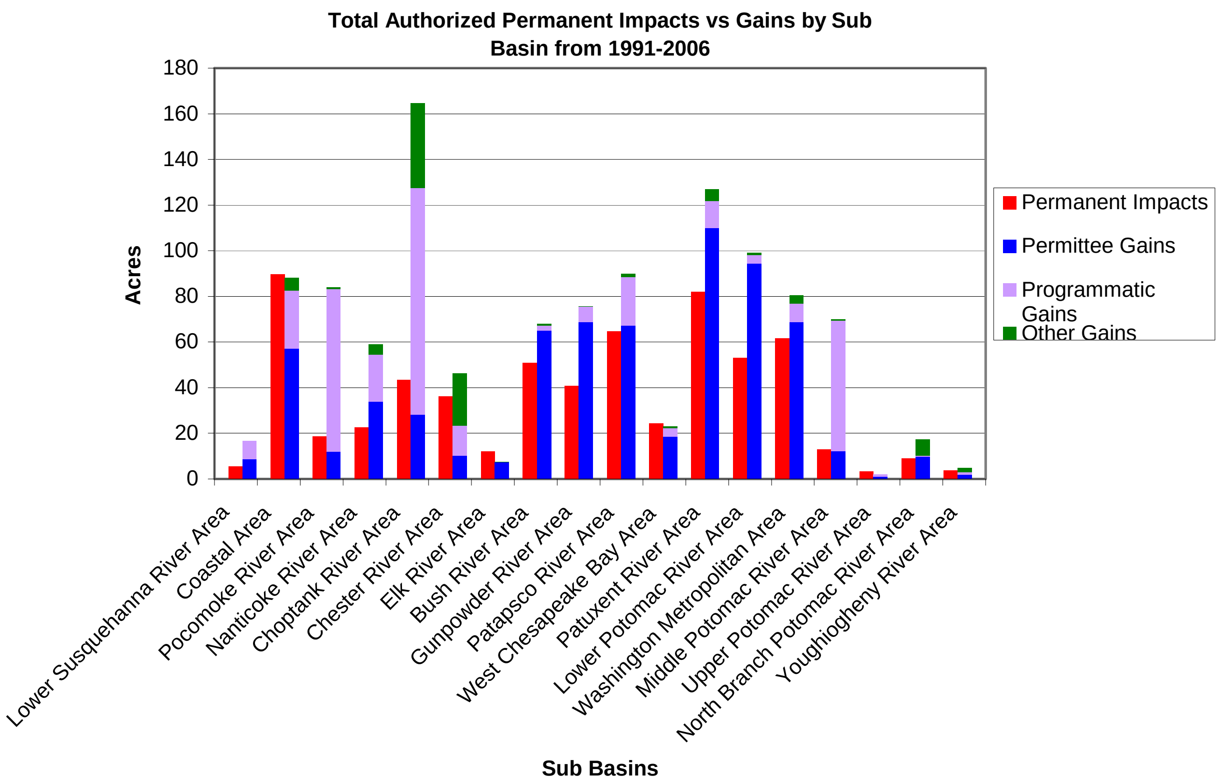

Figure 29: Total Authorized Permanent Impacts vs. Gains by Sub Basin from 1991-2006.

CONSOLIDATED SITES

Consolidated sites are wetland mitigation sites that have multiple users. Consolidated sites differ from banks in that there is no requirement for the site to be successful prior to use, and permittees remain responsible for meeting their mitigation requirements. There are two main types of consolidated mitigation sites. In one type, the permittee may have a wetland mitigation requirement, and may design the site to be much larger than needed to meet the mitigation obligation. The remaining area may be approved to meet the permittee's future mitigation requirements, or the permittee may sell credits to use the balance of the mitigation area. The other type of consolidated site is designed by an outside consultant but is not initially part of a wetland mitigation obligation. These sites are constructed in anticipation of others having wetland mitigation requirements. Both types of sites must be reviewed and approved by the MDE mitigation section. The permittee or consultant then builds, monitors, and maintains the large wetland mitigation site. Other permittees with a wetland mitigation requirement can propose to buy wetland credits from the site to satisfy their wetland mitigation requirements, provided MDE approves the proposal. Advantages to the use of consolidated sites are that there are fewer sites for the MDE mitigation department to review and monitor. MDE generally recommends that permittees with small amounts of wetland mitigation required and no onsite mitigation opportunities pay into these sites, rather than building small fragmented wetlands elsewhere or pay into the Nontidal Wetland Compensation Fund. MDE considers these larger wetlands to have a higher chance of success because they can be monitored more thoroughly. Some consolidated wetland sites are constructed before the impacts occur. A benefit of allowing payment into an already constructed consolidated wetland mitigation site or bank is that these sites often are a few years old, reducing the lag time between when the wetland impacts occur (and the wetland functions are lost) and when the mitigation occurs (and the wetland functions are restored). Additionally, if these consolidated sites do not appear to be successful, MDE will not allow the use of any more mitigation credits until problems are fixed. This does not mean that all of the consolidated sites are successful. As seen by the four sites scores (Figure 2), and the site summaries found below, some have failed.

Below is a list and brief description of consolidated sites with multiple users. The numerous smaller consolidated sites that have two or three users are not included.

Bryantown

This site has a total of 15.28 acres of restored forested wetland in the Zekiah Swamp watershed in Charles County. This site was previously used for agriculture. Project construction was started and completed in May 2000 and vegetation was established through natural colonization. Rapid regeneration of wetland vegetation did in fact occur. An additional 3.1 acres of wetland mitigation was established in 2005 in an area of hydric soils adjacent to Zekiah Swamp and a stream drainage area. P.A. Schaumberg is the consultant managing the site.

MDE received three monitoring reports, the third, fourth, and fifth years. However, according to the fifth year monitoring report, P.A. Schaumberg, the consultant managing the site, states that there have been five monitoring reports submitted - in 2000, 2001, 2002, 2003, and 2004.

The site is now a very diverse wetland. A monitoring report submitted by P.A. Schaumberg in 2004 states that there are a wide range of hydrologic conditions, from saturated to seasonally flowing water. Hydrology normally includes surface run-off and overbank flooding, with beaver activity also contributing. Most of the soils in the fields are Bibb silt loam. (P.A. Schaumberg, 2004)

The original mitigation credit for Bryantown was 15.28 acres. As of the end of 2007, the balance was 2.83 acres.

Double Bridges

This site has 2.1 acres of predominantly emergent wetlands, with some forested wetlands, established through creation. This wetland mitigation is located on former agricultural land in the Fishing Bay watershed of Dorchester County. Project construction was started in January 2007 and completed in March 2007. The landowner has taken a personal interest in the project's success. Monitoring is beginning in 2007.

The original mitigation credit for Double Bridges was 2.1 acres. As of the end of 2007, the balance was 0.02 acres.

Farber I

This site has a total of 10 acres of created emergent and scrub-shrub wetlands in the Jones Falls watershed in Baltimore County. Project construction was started in April 2003 and was completed in November 2003. The consultant involved in the project is Ecotone, Inc.

This site was originally artificially drained flat land used for agriculture, which had mapped hydric soils. The plan for this site was to increase water retention to generate greater saturation of the soil year-round. The site was designed to derive hydrology from the seasonally high water table, overland flow from upland areas, and from overbank flooding of the adjacent tributary. It is worth noting that the Jones Falls watershed is a Use III watershed with a naturally reproducing trout population. Implementation of this site should help reduce existing thermal impacts to the North Branch of the Jones Falls.

As of November, 2006, Ecotone, Inc. has submitted three monitoring reports. The 2006 report noted that excessive deer browse and scraping were proving to be detrimental to many of the trees, with much of the tree growth now being re-sprouts from the ground. This report also stated that significant portions of the cells had very high soil saturation or up to several inches of inundation. (Bartell, 11/14/06)

MDE will conduct additional review to determine if remediation is required.

The original mitigation credit for Farber I was 10 acres. As of the end of 2007, there was a balance of 2.12 acres.

Farber Stage II

This site has a total of 3.38 acres of created forested wetlands in the Jones Falls watershed in Baltimore County. Project construction was started in January 2006 and was completed in May 2006. As with Farber's sibling consolidated site, Farber I, the consultant involved in the project is Ecotone, Inc.

This site is located within two distinct areas of non-wetland fallow agricultural fields, both located in low-lying areas adjacent to tributaries of the North Branch of the Jones Falls. According to the Phase I Plan for Farber Stage II, hydrology will be obtained through excavation of several wetland cells to intercept locally shallow groundwater and retain local run-off from precipitation.

MDE has not yet received any monitoring reports.

The original mitigation acreage credit for Farber II was 3.38 acres. As of the end of 2007, there was a balance of 1.37 acres.

Hillmeade

This site was originally designed to be a 5.8-acre restored forested wetland mitigation site. However, as successive monitoring reports have concluded, much of the western portion of the site has failed to produce wetland characteristics. Therefore, as of July 2007, the Hillmeade consolidated site is counted as only having 2.6 acres of mitigation credit. This site is located in the Gilbert Swamp watershed, in Charles County. Homecroft Development Corporation has agreed to provide, maintain, monitor, and protect the Hillmeade site. Construction was started and completed in December 2000.

During the 1980's, this site was used as farmland, growing a mixture of soybeans, grass, pasture, tobacco, corn and hay. More recent crops are evidenced by corn and hay residue. The soil at the site is predominantly Bibb silt loam. Hydrology for the site is present due to a high water table and runoff from higher elevations surrounding the area. A 2001 monitoring report states that hydrology for the site may be gained from more creative methods in the future.

Monitoring reports submitted by Lorenzi, Dodds & Gunnill, Inc. (LDG) have provided detailed updates on the progress of the Hillmeade site. In the 5th year of monitoring, the report states: "The presence of significant natural regeneration was reported in the second report…Sometime during the summer of 2003, the site was bush hogged. The majority of the woody and herbaceous vegetation was cut to a height of three to six inches." The report goes into greater detail on the damage done: "An area at the northeastern corner of the site of approximately 50' by 75' has been bush hogged and converted to a wildlife food plot by unknown persons."

Later in the same report, it is stated that while the eastern portion of the site is proving to be a success, the western portion has performed poorly due to a number of problems: "…the western portion of the site appears to contain a high percentage of gravel in the upper foot of the soil…The gravel could be attributed to the deposition of the material excavated from Gilbert Swamp Run during the channelization. The combination of the deposition of this soil from the channelization and the channelization itself will likely prevent the western half of the site from maintaining adequate hydrology to establish nontidal wetlands." (LDG, 2005)

MDE will conduct additional review to determine if additional remediation can be required.

The original mitigation acreage credit for Hillmeade was 2.59 acres. At the end of 2007, there was a balance of 0.49 acres.

James Rum Pointe

This site is 6.4 acres of enhanced forested wetland in the Zekiah Swamp watershed of Charles County. Since it was originally wet pasture, enhancement of the site is given one-half of the mitigation credit that creation or restoration would be assigned. MDE potentially recognizes credit for 3.2 acres of wetland mitigation. The enhancement included no grading, but natural regeneration occurred when horses and cows were removed in 2006. If it does not regenerate into wetland forest naturally, it will be planted with trees. If the site appears to be successful, then it will be receive the above-mentioned wetland mitigation credit. The consultant involved is Scott Burrows.

The hydrology sources include ground water, stormwater runoff, and an flooding from an adjacent stream. The site already has good microtopography due to the past horse footprints.

Monitoring has not yet been conducted.

The bank approval process is still underway.

Lakeside

This site is 7.4 acres of created emergent, scrub-shrub and forested wetland in the Lower Winters Run watershed of Harford County. This site was previously a sand and gravel mine. Construction for this site was started in July 1998 and finished in June 1999. The consultant for this project is Eco-Science Professionals, Inc.

There are two different “Planting Areas” for this project. Hydrology for Planting Area 1 is derived from a combination of seasonally high groundwater and surface water discharge from an adjacent groundwater-fed pond and newly constructed centralized stormwater retention facility. Hydrology for Planting Area 2 is derived from the permanent pool of a stormwater management facility.

The only monitoring reports MDE received were for the first and fifth year status after completion of construction. As of 2005, the hydrology of the site has been seriously impacted by beaver activity. In particular, the planned permanent pool in one zone had been expanded due to beaver activity, an event which subsequently inundated other zones to an unexpected degree. Despite this development, most of the zones in Planting Area 1 meet the hydrologic design criteria as established in the mitigation plans. However, one zone did not appear to meet the hydrologic criteria. This failure was due to the final elevations in this zone being roughly twelve inches higher than designed.

The fifth-year report also mentions that *Phragmites* was present in Planting Area 1, but the patch was small enough to be dealt with through the use of Rodeo™ or a similar herbicide. However, an MDE site visit in 2007 still found *Phragmites* on the site.

For Planting Area 2, two zones have insufficient wetland hydrology due to improper grading. The zones are now at an elevation that is too high to be subjected to seasonal saturation or regular inundation. Furthermore, during construction the grading contractor apparently did not install a system of ditches that were intended to increase surface water dispersion throughout the shrub terraces.

It is important to note that the monitoring report discussed above does not specifically address the mitigation “bank” area of the Lakeside site. While the information contained within the monitoring report can still be used as a gauge of the site’s health overall, it is important to note that hydrology and functions associated with Planting Areas 1 and 2 are not necessarily equal to those in the mitigation “bank” area. (Eco-Science Professionals, 2005)

MDE conducted a "Mitigation Site Assessment Scoring Chart" for the Lakeside mitigation site on June 1, 2007. Scoring was broken into six different areas for the site overall:

1) Area 1 forested/scrub-shrub (77 out of 100 total points),
2) Area 1 emergent (67 out of 100),
3) Area 2 scrub-shrub (66 out of 100),
4) Area 2 emergent (69 out of 100),
5) Bank Forested/scrub-shrub (78 out of 100),
6) Bank emergent (84 out of 100)

The combined score for all of the areas was 75. It is interesting to note that functional scores for the two "Bank" sites were only 12 out of a possible 20 points.

MDE also conducted IRIS Tube sampling in the spring of 2007 at this site to determine if the soils were reducing, a vital function in the development of hydric soils. Of the three sites sampled within Planting Area 1, two samples did not show sufficient reduction. This indicates that sufficient wetland hydrology was not present in these two sample areas to allow for the development of wetland soils.

MDE will conduct additional review to determine if remediation should be required.

The original mitigation acreage credit was 7.4 acres. At the end of 2007, the balance was 1.18 acres.

Madison Bay

This site has a total of 12.72 acres of forested wetland in the Little Choptank River watershed in Dorchester County. The previous land use was cropland. The Madison Bay construction was started and completed in May 2003. The contractor involved is Mike Hollins.

This site was poorly graded and is currently dominated by *Phragmites* and cattail. Since one of the permittees paying into this consolidated wetland mitigation site has a bond on their mitigation, MDE anticipates that the contractor will fix the grading issues.

The original mitigation acreage credit was 12.72 acres. All credits have been used.

Maple Dam

This site is a total of 16.67 acres of restored forested, emergent and scrub/shrub wetland in the Little Blackwater River watershed in Dorchester County. This site was previously in cropland for soybeans, corn and wheat. Construction was started in August 2006 and completed/planted by April 2007. Unfortunately, the drought that occurred during and after planting may negatively impact plant survival.

This consolidated mitigation site is designed to establish 42 acres of forested, scrub/shrub and emergent wetlands in three separate phases (Phase I, the current one; Phase II, 15.26 acres; and Phase III, 10.09 acres). Construction for the site includes plugging ditches to restore hydrology, creating microtopography, and planting seedlings, shrubs and grasses to create a natural wetland environment. Soils on the site are Elkton series.

Monitoring should begin in 2007.

The original mitigation credit was 16.64 acres. At the end of 2007, there was a balance of 14.93 acres.

Marte Lynn

This site is 6.01 acres of created forested wetland in West Chesapeake Bay Area watershed of Anne Arundel County. The previous land use was agriculture. The project was started and completed in February 1999. The consultant involved in the project was Environmental Resource Services, Inc. (ERS).

The first- and second-year monitoring reports have been submitted. In the second year monitoring report, ERS indicated that the site was functioning properly and vegetation, both planted and volunteer, was healthy and diverse. The report does mention a number of invasive species present on the site, including poison ivy, Japanese honeysuckle, and multiflora rose. Poison ivy is so heavy in places there is concern it will choke some of the establishing trees. MDE also noted the presence of *Phragmites* that should be controlled. The monitoring report recommends herbicide control for some of the undesirable species. (ERS, 2002)

The property was sold and the new homeowner was unaware of the mitigation site and associated restrictions on the property. As a result, part of the mitigation site was disturbed to install a geothermal system and not yet replanted and another part has an old spoil pile that needs to be re-graded.

MDE will pursue remediation of this site.

The original mitigation credit for Marte Lynn was 4.11 acres. All credits have been used.

Miller Dobson

This site comprses a total of 20.86 acres of created palustrine forested wetland in the Mattawoman Creek watershed of Prince George's County. This site was previously a surface mine. Construction for this site was started in May 2004 and completed in March 2005. According to the consultants involved in the project, Environmental Systems Analysis, Inc., (ESA) the objectives of the created wetland are to serve as a biofilter for the removal of pollutants from run-off associated with the nearby upland development, provide groundwater recharge, reduce thermal loading to Mattawoman Creek by providing additional buffer area, and improve wildlife habitat. Hydrology for the site is derived from direct precipitation and seasonally high groundwater levels.

According to the first monitoring report submitted in March, 2007, ESA states that, "The percent cover of wetland plants is high in all created wetland cells. The vegetation looks healthy, indicating that hydrology is strong and wet soils are present for a significant portion of the growing season. Standing water was a frequent occurrence in the monitoring plots, enabling predominantly hydrophytic plants to grow in these areas." The monitoring report does mention an isolated pocket of *Phragmites,* but plans were in place for spraying to help eradicate the invasive species. (ESA, 2007)

Repeated site visits in 2007 by MDE staff have not found such optimistic results. Since the soil at the site is from the deep subsoil, it may not be adequate for optimal wetland creation. Additionally, hydrology is not apparent for all cells within the site. While there are areas of shallow inundation, there are other areas that appear to have insufficient wetland hydrology and are dominated by upland weeds. Wetland vegetative cover is low for some areas. MDE conducted IRIS Tube sampling in the spring of 2007 to determine the amount of soil reduction that was occurring. Staff installed one set of samples per each of seven cells. Of these seven, three cells were found to have insufficient soils reduction necessary to develop hydric soils. Additionally, MDE scored the seven cells within this site using a Rapid Scoring Assessment Method. Based on a total possible score of 100, the cell scores were as follows: 68, 74, 62, 65, 56, 50, and 66. MDE does not believe that this site is currently thriving as a wetland.

Monitoring of the site will continue and some remediation may be necessary.

The original mitigation credit for Miller Dobson was 23.78 acres. At the end of 2007, there was a balance of 1.25 acres.

Patuxent Greenway

This site has 3.68 acres of created forested wetlands in the Patuxent River Middle Area watershed of Anne Arundel County. The Patuxent Greenway site was previously a sand and gravel mine operated by Brandywine Sand and Gravel, Inc. The western edge of the property served as a sediment basin. Prior to construction, the site was naturally regenerating and had impeded drainage from the surrounding upland areas. Construction was started and completed in June 2001. The site did not require grading as it was noted that certain areas within the infiltration basin, if left unmodified, would naturally develop into wetlands. The site consultant is Patuxent Greenway Reforestation, LLC. Overall, the site appears acceptable, but some areas may be too wet. MDE has not received any monitoring reports.

The original mitigation credit for Patuxent Greenway was 3.68 acres. All credits have been used.

Patuxent Preserve Lot 28

This site is 2.75 acres of created forested wetland in the Patuxent River Upper Area watershed of Anne Arundel County. This site was previously a sand and gravel mine, and additional grading was used to create wetland characteristics. Construction started in November 1997 and finished in December 1997. Volunteer vegetation established from upstream plantings. The consultant for the project was McCarthy & Associates.

MDE conducted IRIS Tube sampling at this site to determine if there were sufficient soil reduction necessary to develop hydric soils. Both samplings showed sufficient reduction. MDE also scored this site using the Rapid Scoring Assessment Method. The site scored 91 out of a possible 100 points. The site has developed into a beautiful wetland, with a thick layer of sphagnum moss covering the floor. It has a healthy population of sundew that apparently volunteered from a nearby upstream planting and the site seems to be providing abundant wildlife habitat.

This site was meant to contain experimental plots that would be monitored. Due to miscommunication, these experimental plots were not established as desired and MDE did not require monitoring of this site.

The original mitigation credit for Patuxent Preserve Lot 28 was 3 acres. At the end of 2007, there was a balance of 0.5 acres.

Port Tobacco

This site is 40.97 acres of restored forest wetlands in the Port Tobacco River watershed of Charles County. This site was past agricultural land. Construction was completed in early May 1995. The consultant noted the difficulty of creating such a large site and the need to conduct grading in phases. All wetland areas were then seeded with a wet seed mix. The consultant for the project is BRI-EN-CO.

MDE conducted IRIS Tube sampling at this site to verify that the soil was reducing sufficiently to begin functioning as a hydric soil. Of the five IRIS Tube sets installed, all showed sufficient reduction. MDE also scored this site using the Rapid Scoring Assessment Method. The site scored 83 out of a possible 100 points, suggesting the site appeared to be above average in condition. Overall, most areas are developing into a decent forested wetland. There are some areas that are not reforesting as well, including some pockets of *Phalaris* monocultures, but the site overall has good diversity and growth.

MDE received three monitoring reports before terminating monitoring in early 1997 since the site was establishing well.

The original mitigation credit was 40.97 acres. At the end of 2007, there was a balance of 5.27 acres.

Port Tobacco II

This site is 90.4 acres, of which 49.9 acres are of wetland credit value for the combination of wetland creation/restoration, upland buffer reforestation, and preservation of existing forest. The site is located in the Port Tobacco River watershed of Charles County. This site was also past agricultural land. Construction was initiated and completed in December 2001. The consultant involved in the project is McCarthy & Associates, Inc.

The site has achieved the desired objectives in terms of wetland hydrology and establishment of hydrophytic vegetation. MDE has received four monitoring reports, for years one through four. The fifth year report is due at the end of 2007. MDE has terminated monitoring for certain sections of the site since it appears to be doing well.

The original mitigation credit was 49.9 acres. At the end of 2007, there was a balance of 20.95 acres.

South County Stage I

This site is 3.38 acres, consisting of 0.23 acres of forest preservation, 0.58 acres of wetland enhancement, and 2.57 acres of wetland creation credits. While it does include some emergent wetlands, forested wetlands compose a significant portion of the total. It is located in the West Chesapeake Bay Area watershed of Anne Arundel County. The site was originally a completely wooded parcel of land. Then in the spring of 1981, it was converted to a golf course. Construction for the wetland mitigation was started and completed in November 2002. Modifications to existing grades and the removal/eradication of turf grass was necessary prior to completion of the project. The consultant for this project is Ben Dyer Associates.

The entire site is mapped as Elkton silt loam, a poorly drained hydric soil. They have a high available moisture content and a high water table. Therefore, due to the qualities of this soil, the consultant did not add any soil amendments to the site during construction. Hydrology for the site will be achieved from the seasonal high water table and direct precipitation. This is possible due to the low-lying nature and flat topography of the site, along with the presence of the Elkton silt loam soil and its slow drainage characteristics.

The site is doing well. Although this site does have many different projects using it to satisfy mitigation requirements, many of them are very small in size. Of the fifteen different mitigation projects with purchased mitigation credit on this site, only two of them are above 10,000 square feet (.23 acres). MDE has received four monitoring reports for this site, for years one through four. The fifth year report is due at the end of 2007.

The original mitigation credit was 3.38 acres. All credits have been used.

South County Stage II

This site is 5.38 acres of wetland, with 4.59 acres created, 2.07 acres enhanced and 0.27 acres preserved. It is located in the West Chesapeake Bay Area watershed of Anne Arundel County. As was true of Stage I, this site was originally a completely wooded parcel of land until 1981, when it was converted to a golf course. Construction for this project was started and completed in November, 2002. The consultant for this project is Ben Dyer Associates.

Much of the more detailed information discussed in South County Stage I above applies to South County Stage II, including the history of the land prior to construction of the wetland, nature of the soil, hydrology, and construction plans, etc. This site is also doing well.

The original mitigation credit was 5.67 acres. At the end of 2007, the balance was 2.46 acres.

Stricker

This consolidated site created 3.01 acres of forested wetland in the West River watershed in Anne Arundel County. The site was created at an existing upland agricultural field adjacent to Popham Creek. Construction for the project was initiated in June 2001 and completed in June 2002. Planting for this site was implemented in the fall of 2001. The consultants involved in the project were Ecosystem Management, Inc., as well as Ecotone, Inc.

The primary goal of the mitigation project was to replace the biological and water quality functions of the wetlands that were impacted. These functions included providing wildlife habitat, filtering sediments and discharging and recharging groundwater.

According to a monitoring report submitted in January of 2004, hydrology for this site is primarily created through direct precipitation into the different “cells” of the site (there are three different cells, A, B, and C), as well as overflow discharge from cells upland in the site (site A is the lowest, with C being the highest). Cell C, being the highest up-gradient in the site, is supported by overland run-off from the surrounding field and overall drainage area, as well as direct precipitation. (Morris, 12/29/03)

MDE has received two monitoring reports, for years one and two. The site is functioning well. The second year monitoring report (2004) states that the site has strong wetland hydrology and greater than 95% vegetative cover dominated by native hydrophytic species.

The original mitigation credit was 3.01 acres. All credits have been used.

Umbarger

This consolidated site consists of 2 acres of created forested wetland at an existing upland agricultural field adjacent to Coolbranch Run near Churchville, in Harford County. Deer Creek is the watershed for this consolidated site. Construction started in June 2006 and was completed in April 2007. The consultant involved in the project is Ecotone Inc.

The Harford County Soil Conservation District has deemed the entire project area prior converted cropland. Surface hydrology is evident and based on historical accounts and field observations, the project area is underlain by an extensive drain tile system. According to a Phase II mitigation plan, the project design called for the creation of eight wetland cells deriving hydrology from intercepting shallow subsurface flow through drain tile removal, toe of slope seeps and local run-off from precipitation. (Bartell, 4/18/06)

The site is doing well so far. There are currently two projects on this site, with a remaining mitigation credit being 0.84 acres. Due to the fairly recent completion of the project, no monitoring reports have been submitted yet.

The original mitigation credit was 2 acres. At the end of 2007, there was a balance of 0.03 acres.

Wilkerson

This site was designed to be 18.92 acres of wetland credit, with the majority being forest and scrub shrub wetland and a smaller amount enhancement of emergent wetland. This site is managed by Ecotone, Inc, and is located in the Lower Gunpowder Falls watershed in Baltimore County. Plans for the project were approved in February 2007. Construction and planting of the site is planned to begin in the fall of 2007.

The site area was used for hay production until around 2002, and it appeared that a channel on the southern end of the site was created in the past to drain the surrounding fields for agricultural use. The 2006 Phase II Mitigation Plan states that the surrounding wetlands have been damaged by the alterations to hydrology: "The cumulative effect of the ditching, channel alterations and years of agricultural use has altered and severely degraded the majority of the existing wetlands." Hydrology for the site will be from the shallow depth to groundwater, measured from monitoring wells on the site, combined with grading that will help restore "robust wetland hydrology" throughout the mitigation area. (Bartell, 6/27/06)

Plans for construction of the site include grading, plugging an existing man-made channel down slope of a spring/seep area, as well as excavation of upland areas to more evenly distribute hydrology in the form of surface and shallow subsurface seepage.

This consolidated site was built primarily for a project called the Crossroads at 95. However, as there is a high amount of surplus at the site (8+ acres), the remainder is considered a consolidated site.

The original mitigation credit was 18.92 acres. At the end of 2007, the balance was 6.99 acres.

COMPENSATION FUND SUMMARY

The MDE mitigation program allows some permittees, especially those with smaller mitigation obligations, to satisfy their mitigation requirement by paying fully or partially into the MDE Wetland Mitigation Compensation Fund based on an established fee structure for each County. MDE then uses this Fund to create/restore/enhance wetlands throughout the State, with special emphasis on those watersheds with the most regulated wetland impacts.

Of the projects that paid into the Compensation Fund (totaling 75 acres), over half of the approved permanent impacts are to forested wetland (40 acres; 54%), over a third are to emergent wetlands (27 acres; 36%), and lesser amounts are to scrub/shrub wetlands (4 acres; 6%) and farmed wetlands (2 acres; 3%), with very little being to Landscape Management Area wetlands (<1 acre) (Figure 30). Approved impacts from conversion of forest to emergent and forest to scrub/shrub are very low, being less than an acre each.

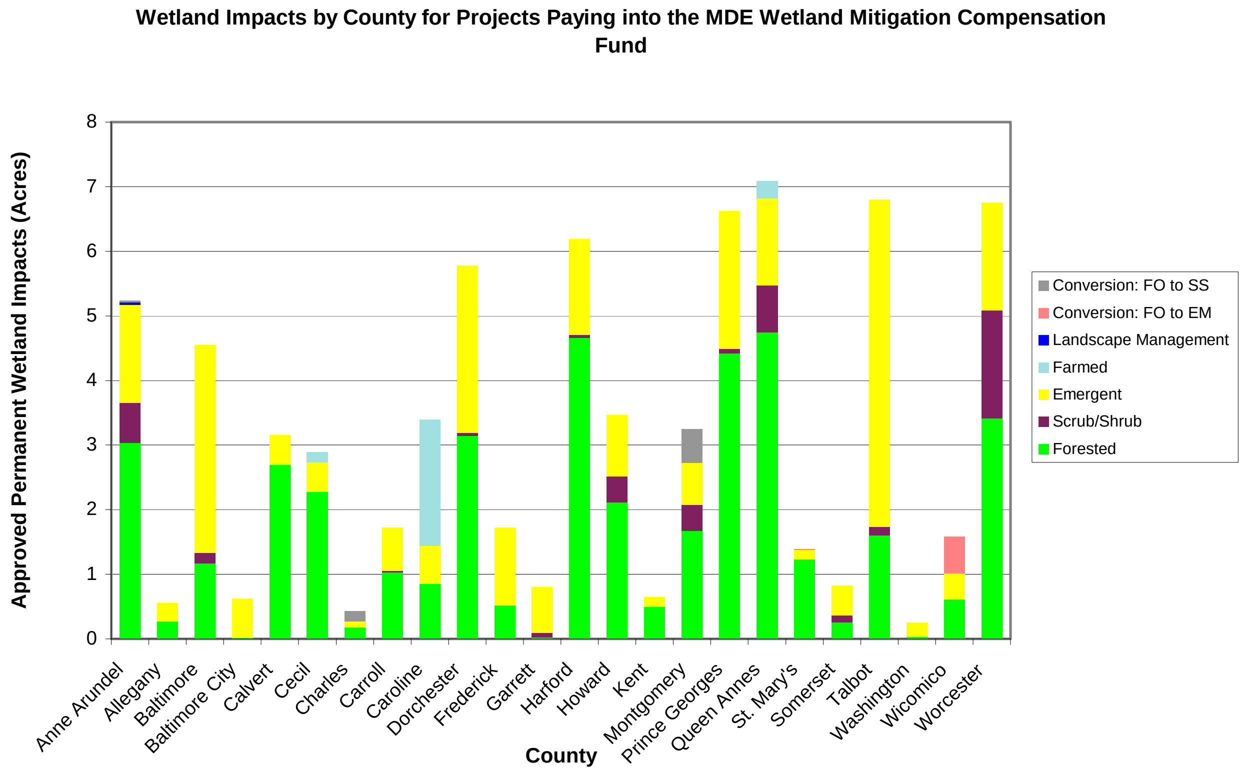

Figure 30: Approved Permanent Impacts by County and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund

Of the projects that paid into the Compensation Fund, approved permanent impacts are the highest for sub-basins Choptank River, Chester River, and Patuxent River (Figure 31).

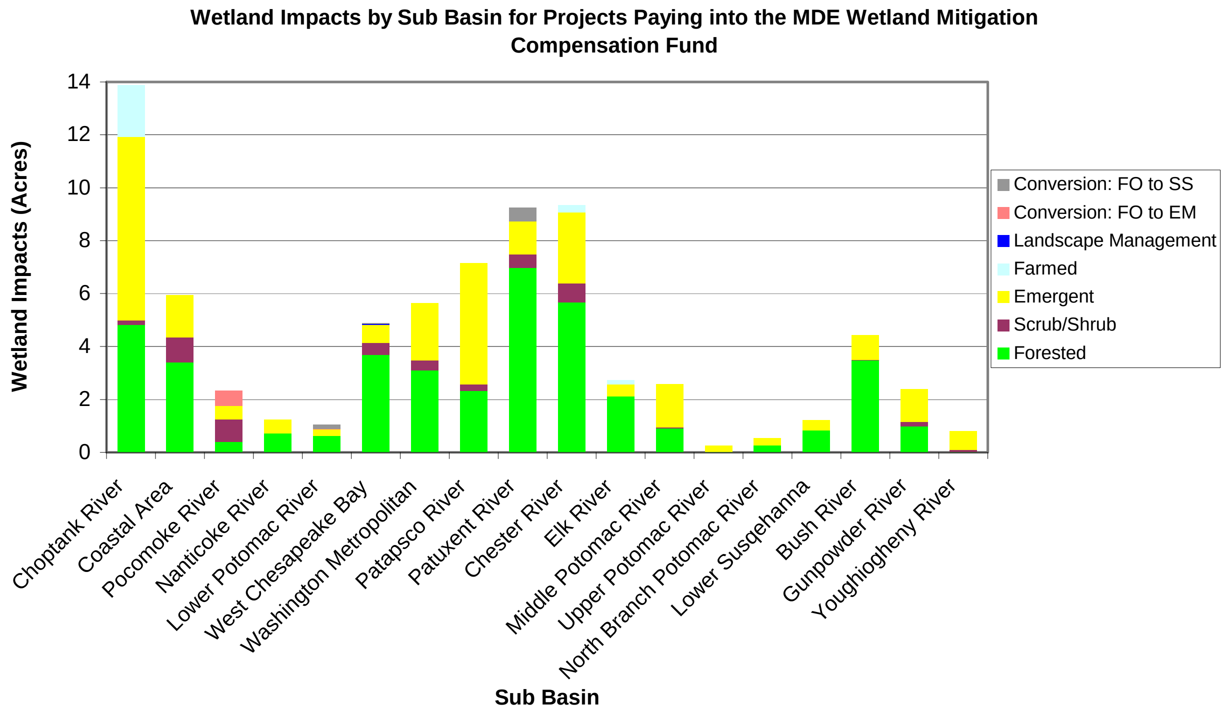

Figure 31: Approved Permanent Impacts by Sub-Basin and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund

Of the 120 acres of required mitigation for projects that paid into the Compensation Fund, two thirds of the required mitigation is forested (81 acres; 68%), a quarter is emergent (29 acres; 25%), and the remainder is scrub/shrub (9 acres; 7%) (Figure 32).

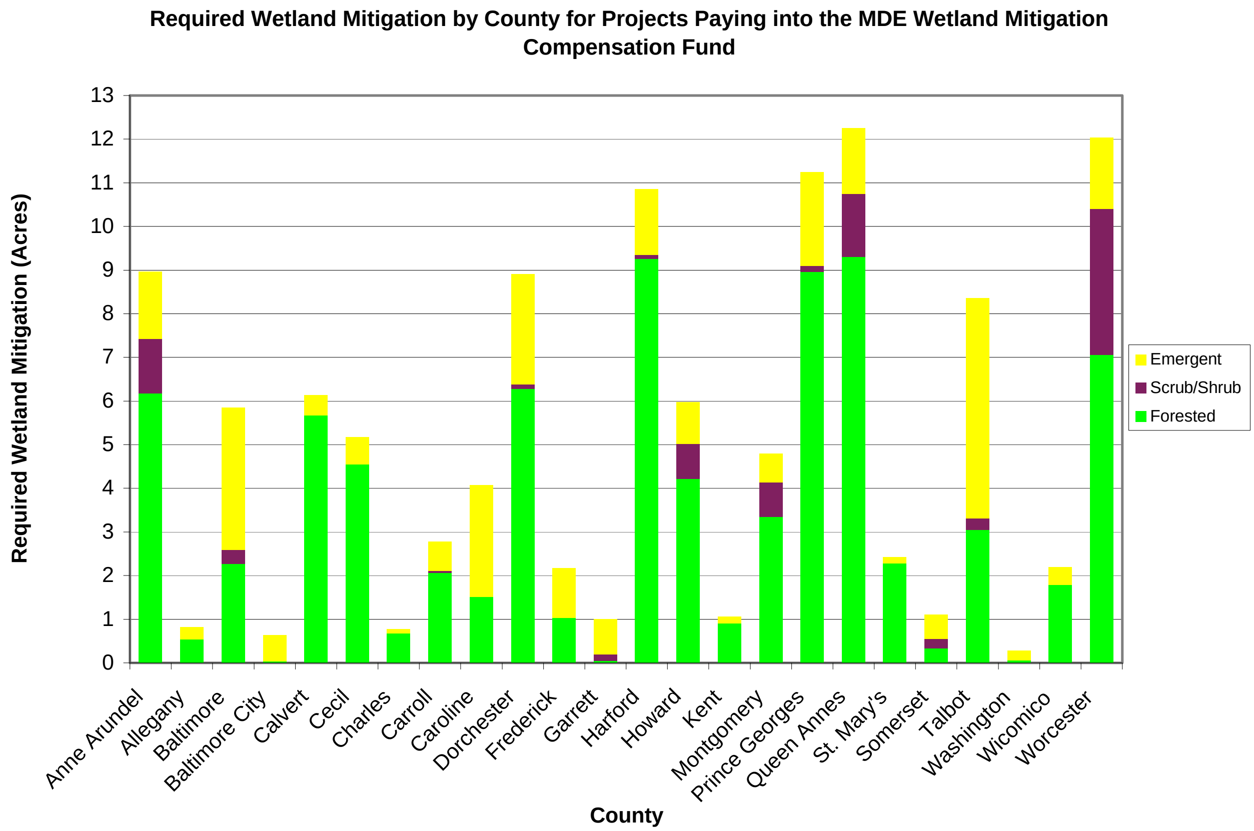

Figure 32: Required Mitigation by County and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund

Of the projects that paid into the Compensation Fund, required mitigation is highest in the sub-basins Chester, Choptank, and Patuxent (Figure 33).

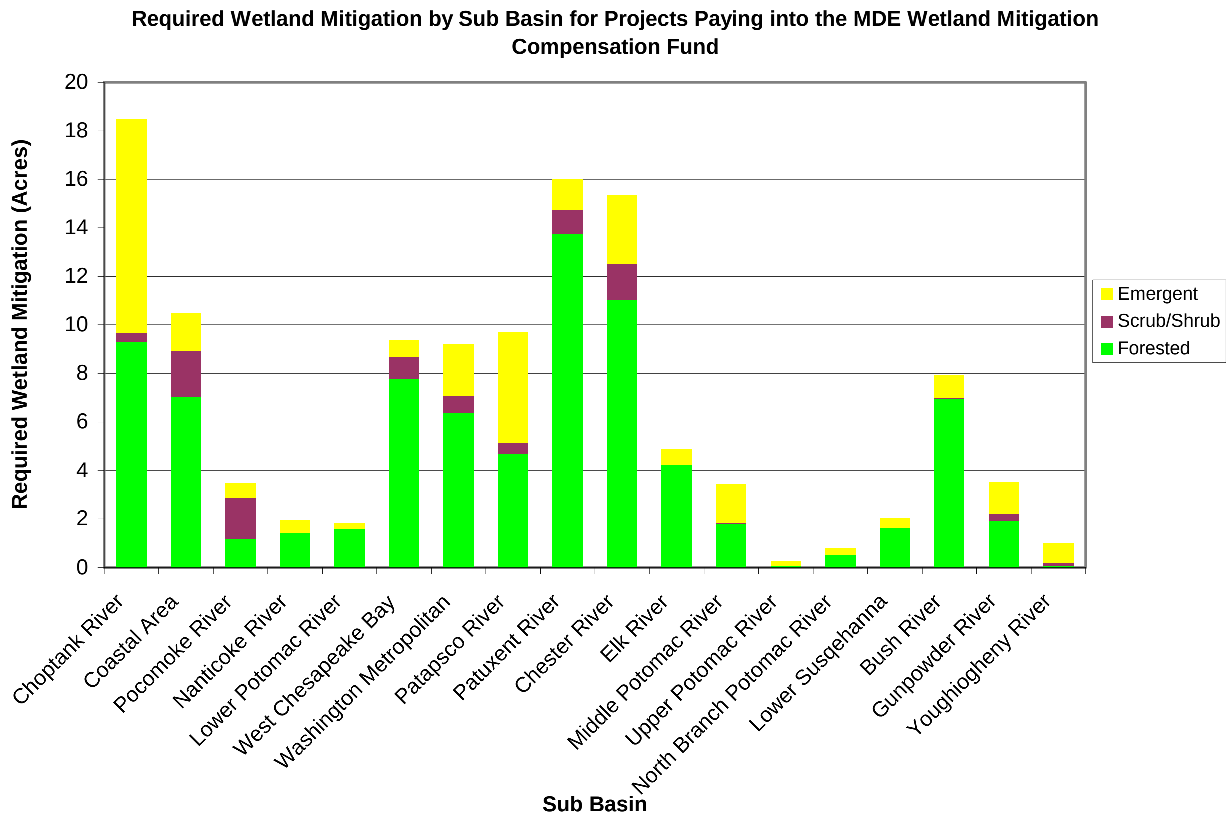

Figure 33: Required Mitigation by Sub-Basin and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund

Table 5: Approved Permanent Impacts by 8-Digit Watershed and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund. Includes all projects issued prior to January 1, 2007.

8-digit Watershed Code	8-digit Watershed Name	Approved Permanent Wetland Impacts						Conversion Impacts		# proj.
		FO	SS	EM	Farm	LMA	Total	FO to EM	FO to SS	
02-12-02-01	LOWER SUSQUEHANNA RIVER	0.44	0	0.27	0	0	0.71	0	0	3
02-12-02-02	DEER CREEK	0.39	0	0.12	0	0	0.51	0	0	13
02-13-01-03	ISLE OF WIGHT BAY	1.97	0.93	1.60	0	0	4.51	0	0	31
02-13-01-04	SINEPUXENT BAY	0.65	0	0	0	0	0.65	0	0	3
02-13-01-05	NEWPORT BAY	0.78	0	0	0	0	0.78	0	0	2
02-13-01-06	CHINCOTEAGUE BAY	0.01	0	0	0	0	0.01	0	0	1
02-13-02-01	POCOMOKE SOUND	0.03	0	0	0	0	0.03	0	0	1
02-13-02-02	LOWER POCOMOKE RIVER	0.00	0.74	0.06	0	0	0.80	0	0	5
02-13-02-03	UPPER POCOMOKE RIVER	0.14	0	0.00	0	0	0.14	0.57	0	3
02-13-02-06	TANGIER SOUND	0.09	0	0.42	0	0	0.51	0	0	5
02-13-02-07	BIG ANNEMESSEX RIVER	0.13	0	0	0	0	0.13	0	0	2
02-13-02-08	MANOKIN RIVER	0	0.11	0.04	0	0	0.15	0	0	2
02-13-03-01	LOWER WICOMICO RIVER	0.03	0	0.41	0	0	0.44	0	0	5
02-13-03-04	WICOMICO RIVER HEADWATERS	0.44	0	0	0	0	0.44	0	0	1
02-13-03-07	FISHING BAY	0.05	0	0.12	0	0	0.17	0	0	3
02-13-03-08	TRANSQUAKING RIVER	0.19	0	0	0	0	0.19	0	0	1
02-13-04-01	HONGA RIVER	0.37	0.02	0.22	0	0	0.61	0	0	5
02-13-04-02	LITTLE CHOPTANK RIVER	2.12	0.03	1.77	0	0	3.91	0	0	26
02-13-04-03	LOWER CHOPTANK RIVER	1.47	0.04	4.37	0	0	5.87	0	0	42
02-13-04-04	UPPER CHOPTANK RIVER	0.73	0.09	0.59	1.96	0	3.38	0	0	9
02-13-04-05	TUCKAHOE CREEK	0.11	0	0	0	0	0.11	0	0	1
02-13-05-01	EASTERN BAY	0.22	0.05	0.23	0	0	0.50	0	0	7
02-13-05-02	MILES RIVER	0.34	0.01	0.87	0	0	1.22	0	0	14
02-13-05-03	WYE RIVER	0.22	0	0.41	0	0	0.63	0	0	7
02-13-05-04	KENT NARROWS - PROSPECT BAY	0.04	0	0	0	0	0.04	0	0	1
02-13-05-05	LOWER CHESTER RIVER	0.62	0	0.74	0.16	0	1.51	0	0	21
02-13-05-07	CORSICA RIVER	0.24	0	0.20	0.11	0	0.54	0	0	6

02-13-05-08	SOUTHEAST CREEK	0.09	0	0	0	0	0.09	0	0	1
02-13-05-11	KENT ISLAND BAY	3.89	0.67	0.25	0	0	4.81	0	0	53
02-13-06-03	UPPER ELK RIVER	0	0	0	0.16	0	0.16	0	0	1
02-13-06-06	BIG ELK CREEK	0.29	0	0.45	0	0	0.74	0	0	1
02-13-06-08	NORTHEAST RIVER	1.42	0	0	0	0	1.42	0	0	5
02-13-06-09	FURNACE BAY	0.30	0	0.01	0	0	0.32	0	0	2
02-13-06-11	STILLPOND - FAIRLEE	0.11	0	0	0	0	0.11	0	0	1
02-13-07-01	BUSH RIVER	0.16	0	0.06	0	0	0.22	0	0	2
02-13-07-02	LOWER WINTERS RUN	0.07	0	0	0	0	0.07	0	0	1
02-13-07-03	ATKISSON RESERVOIR	1.88	0.02	0.30	0	0	2.20	0	0	23
02-13-07-04	BYNUM RUN	1.05	0	0.09	0	0	1.15	0	0	12
02-13-07-06	SWAN CREEK	0.33	0	0.48	0	0	0.81	0	0	4
02-13-08-01	GUNPOWDER RIVER	0.14	0.02	0.15	0	0	0.31	0	0	3
02-13-08-03	BIRD RIVER	0.25	0.03	0.58	0	0	0.86	0	0	12
02-13-08-04	LITTLE GUNPOWDER FALLS	0.47	0	0.02	0	0	0.49	0	0	3
02-13-08-05	LOCH RAVEN RESERVOIR	0.04	0.11	0.34	0	0	0.49	0	0	8
02-13-08-06	PRETTYBOY RESERVOIR	0.06	0	0.16	0	0	0.22	0	0	2
02-13-08-07	MIDDLE RIVER - BROWNS CREEK	0.04	0	0	0	0	0.04	0	0	2
02-13-09-01	BACK RIVER	0.14	0	1.33	0	0	1.47	0	0	8
02-13-09-02	BODKIN CREEK	0.01	0	0	0	0	0.01	0	0	1
02-13-09-03	BALTIMORE HARBOR	0.12	0.17	1.51	0	0	2.00	0	0	9
02-13-09-04	JONES FALLS	0.36	0.01	0.11	0	0	0.49	0	0	8
02-13-09-05	GWYNNS FALLS	0.01	0.01	0.90	0	0	0.92	0	0	5
02-13-09-06	PATAPSCO RIVER - L. N. BRANCH	1.12	0	0.53	0	0	1.65	0	0	9
02-13-09-07	LIBERTY RESERVOIR	0.05	0	0.09	0	0	0.14	0	0	2
02-13-09-08	SOUTH BRANCH PATAPSCO RIVER	0.44	0	0.27	0	0	0.71	0	0	7
02-13-10-01	MAGOTHY RIVER	0.39	0	0.12	0	0	0.51	0	0	3
02-13-10-02	SEVERN RIVER	1.97	0.93	1.60	0	0	4.51	0	0	30
02-13-10-03	SOUTH RIVER	0.65	0	0	0	0	0.65	0	0	15
02-13-10-04	WEST RIVER	0.78	0	0	0	0	0.78	0	0	7
02-13-10-05	OTHER DRAINAGE W. CHESAPEAKE	0.01	0	0	0	0	0.01	0	0	16
02-13-11-01	PATUXENT RIVER LOWER	0.03	0	0	0	0	0.03	0	0	11

02-13-11-02	PATUXENT RIVER MIDDLE	0.00	0.74	0.06	0	0	0.80	0	0	3
02-13-11-03	WESTERN BRANCH	0.14	0	0.00	0	0	0.14	0.57	0	8
02-13-11-04	PATUXENT RIVER UPPER	0.09	0	0.42	0	0	0.51	0	0	2
02-13-11-05	LITTLE PATUXENT RIVER	0.13	0	0	0	0	0.13	0	0	6
02-13-11-06	MIDDLE PATUXENT RIVER	0	0.11	0.04	0	0	0.15	0	0	2
02-13-11-07	ROCKY GORGE DAM	0.03	0	0.41	0	0	0.44	0	0	4
02-13-11-08	BRIGHTON DAM	0.44	0	0	0	0	0.44	0	0	8
02-14-01-03	ST. MARY'S RIVER	0.05	0	0.12	0	0	0.17	0	0	3
02-14-01-04	BRETON BAY	0.19	0	0	0	0	0.19	0	0	2
02-14-01-08	ZEKIAH SWAMP	0.37	0.02	0.22	0	0	0.61	0	0	2
02-14-01-11	MATTAWOMAN CREEK	2.12	0.03	1.77	0	0	3.91	0	0	1
02-14-02-01	POTOMAC RIVER UPPER	1.47	0.04	4.37	0	0	5.87	0	0	2
02-14-02-02	POTOMAC RIVER MONTGOMERY CO.	0.73	0.09	0.59	1.96	0	3.38	0	0	2
02-14-02-03	PISCATAWAY CREEK	0.11	0	0	0	0	0.11	0	0	1
02-14-02-04	OXON CREEK	0.22	0.05	0.23	0	0	0.50	0	0	1
02-14-02-05	ANACOSTIA RIVER	0.34	0.01	0.87	0	0	1.22	0	0	16
02-14-02-06	ROCK CREEK	0.22	0	0.41	0	0	0.63	0	0	5
02-14-02-08	SENECA CREEK	0.04	0	0	0	0	0.04	0	0	4
02-14-03-02	LOWER MONOCACY RIVER	0.62	0	0.74	0.16	0	1.51	0	0	8
02-14-03-03	UPPER MONOCACY RIVER	0.24	0	0.20	0.11	0	0.54	0	0	4
02-14-03-04	DOUBLE PIPE CREEK	0.09	0	0	0	0	0.09	0	0	9
02-14-03-05	CATOCTIN CREEK	3.89	0.67	0.25	0	0	4.81	0	0	6
02-14-05-02	ANTIETAM CREEK	0	0	0	0.16	0	0.16	0	0	2
02-14-05-04	CONOCOCHEAGUE CREEK	0.29	0	0.45	0	0	0.74	0	0	1
02-14-05-07	TONOLOWAY CREEK	1.42	0	0	0	0	1.42	0	0	1
02-14-10-01	L. N. BRANCH POTOMAC RIVER	0.30	0	0.01	0	0	0.32	0	0	1
02-14-10-03	WILLS CREEK	0.11	0	0	0	0	0.11	0	0	2
05-02-02-01	YOUGHIOGHENY RIVER	0.16	0	0.06	0	0	0.22	0	0	7
05-02-02-02	LITTLE YOUGHIOGHENY RIVER	0.07	0	0	0	0	0.07	0	0	5
05-02-02-03	DEEP CREEK LAKE	1.88	0.02	0.30	0	0	2.20	0	0	7
05-02-02-04	CASSELMAN RIVER	1.05	0	0.09	0	0	1.15	0	0	1
Total		0.33	0	0.48	0	0	0.81	0	0	613

Table 6: Required Mitigation by 8-Digit Watershed and Vegetative Type for Projects Paying into the MDE Wetland Mitigation Compensation Fund. Includes all projects issued prior to January 1, 2007.

8-digit Watershed Code	8-digit Watershed Name	Required Wetland Mitigation			
		Forested	Scrub/ Shrub	Emergent	Total
02-12-02-01	LOWER SUSQUEHANNA RIVER	0.88	0	0.27	1.14
02-12-02-02	DEER CREEK	0.77	0	0.12	0.90
02-13-01-03	ISLE OF WIGHT BAY	4.17	1.86	1.58	7.62
02-13-01-04	SINEPUXENT BAY	1.30	0	0	1.30
02-13-01-05	NEWPORT BAY	1.55	0	0	1.55
02-13-01-06	CHINCOTEAGUE BAY	0.02	0	0	0.02
02-13-02-01	POCOMOKE SOUND	0.07	0	0	0.07
02-13-02-02	LOWER POCOMOKE RIVER	0.00	1.49	0.06	1.55
02-13-02-03	UPPER POCOMOKE RIVER	0.85	0	0.00	0.85
02-13-02-06	TANGIER SOUND	0	0	0.51	0.51
02-13-02-07	BIG ANNEMESSEX RIVER	0.26	0	0	0.26
02-13-02-08	MANOKIN RIVER	0	0.22	0.04	0.26
02-13-03-01	LOWER WICOMICO RIVER	0.06	0	0.41	0.47
02-13-03-04	WICOMICO RIVER HEADWATERS	0.88	0	0	0.88
02-13-03-07	FISHING BAY	0.10	0	0.12	0.22
02-13-03-08	TRANSQUAKING RIVER	0.38	0	0	0.38
02-13-04-01	HONGA RIVER	0.75	0.05	0.22	1.01
02-13-04-02	LITTLE CHOPTANK RIVER	4.24	0.05	1.77	6.06
02-13-04-03	LOWER CHOPTANK RIVER	2.79	0.08	4.28	7.15
02-13-04-04	UPPER CHOPTANK RIVER	1.49	0.17	2.55	4.22
02-13-04-05	TUCKAHOE CREEK	0.03	0	0	0.03
02-13-05-01	EASTERN BAY	0.43	0.10	0.23	0.77
02-13-05-02	MILES RIVER	0.68	0.02	0.87	1.57
02-13-05-03	WYE RIVER	0.44	0	0.41	0.84
02-13-05-04	KENT NARROWS - PROSPECT BAY	0.07	0	0	0.07
02-13-05-05	LOWER CHESTER RIVER	1.17	0	0.89	2.06
02-13-05-07	CORSICA RIVER	0.47	0	0.20	0.67
02-13-05-08	SOUTHEAST CREEK	0.19	0	0	0.19
02-13-05-11	KENT ISLAND BAY	7.59	1.35	0.25	9.19
02-13-06-03	UPPER ELK RIVER	0	0	0.16	0.16
02-13-06-06	BIG ELK CREEK	0.58	0	0.45	1.03
02-13-06-08	NORTHEAST RIVER	2.83	0	0	2.83
02-13-06-09	FURNACE BAY	0.61	0	0.01	0.62
02-13-06-11	STILLPOND - FAIRLEE	0.22	0	0	0.22
02-13-07-01	BUSH RIVER	0.32	0	0.11	0.43
02-13-07-02	LOWER WINTERS RUN	0.15	0	0	0.15
02-13-07-03	ATKISSON RESERVOIR	3.70	0.04	0.30	4.04
02-13-07-04	BYNUM RUN	2.10	0	0.09	2.20
02-13-07-06	SWAN CREEK	0.67	0	0.44	1.10
02-13-08-01	GUNPOWDER RIVER	0.28	0.04	0.15	0.46

02-13-08-03	BIRD RIVER	0.42	0.05	0.62	1.10
02-13-08-04	LITTLE GUNPOWDER FALLS	0.93	0	0.02	0.95
02-13-08-05	LOCH RAVEN RESERVOIR	0.07	0.23	0.34	0.64
02-13-08-06	PRETTYBOY RESERVOIR	0.12	0	0.16	0.28
02-13-08-07	MIDDLE RIVER - BROWNS CREEK	0.09	0	0	0.09
02-13-09-01	BACK RIVER	0.27	0	1.33	1.60
02-13-09-02	BODKIN CREEK	0.02	0	0	0.02
02-13-09-03	BALTIMORE HARBOR	0.24	0.35	1.51	2.10
02-13-09-04	JONES FALLS	0.73	0.02	0.11	0.86
02-13-09-05	GWYNNS FALLS	0.03	0.02	0.90	0.95
02-13-09-06	PATAPSCO RIVER - L. N. BRANCH	2.23	0	0.53	2.77
02-13-09-07	LIBERTY RESERVOIR	0.12	0	0.09	0.21
02-13-09-08	SOUTH BRANCH PATAPSCO RIVER	1.06	0.04	0.11	1.21
02-13-10-01	MAGOTHY RIVER	0.23	0	0.02	0.25
02-13-10-02	SEVERN RIVER	3.20	0.85	0.09	4.13
02-13-10-03	SOUTH RIVER	0.86	0.02	0.22	1.10
02-13-10-04	WEST RIVER	0.18	0.04	0.02	0.24
02-13-10-05	OTHER DRAINAGE W. CHESAPEAKE	3.32	0	0.35	3.67
02-13-11-01	PATUXENT RIVER LOWER	4.14	0	0.29	4.43
02-13-11-02	PATUXENT RIVER MIDDLE	1.03	0	0	1.03
02-13-11-03	WESTERN BRANCH	5.02	0.14	0.46	5.62
02-13-11-04	PATUXENT RIVER UPPER	0.41	0	0.03	0.43
02-13-11-05	LITTLE PATUXENT RIVER	1.93	0.44	0.33	2.71
02-13-11-06	MIDDLE PATUXENT RIVER	0.65	0.33	0	0.98
02-13-11-07	ROCKY GORGE DAM	0.34	0.08	0.11	0.54
02-13-11-08	BRIGHTON DAM	0.22	0	0.05	0.27
02-14-01-03	ST. MARY'S RIVER	0.18	0	0.14	0.32
02-14-01-04	BRETON BAY	0.74	0	0	0.74
02-14-01-08	ZEKIAH SWAMP	0.37	0	0	0.37
02-14-01-11	MATTAWOMAN CREEK	0.30	0	0.10	0.40
02-14-02-01	POTOMAC RIVER UPPER	0.89	0	0.18	1.07
02-14-02-02	POTOMAC RIVER MONTGOMERY CO.	0.33	0.03	0.06	0.42
02-14-02-03	PISCATAWAY CREEK	0.42	0	0	0.42
02-14-02-04	OXON CREEK	0.13	0	0	0.13
02-14-02-05	ANACOSTIA RIVER	2.91	0.03	1.57	4.51
02-14-02-06	ROCK CREEK	0.33	0.48	0.13	0.94
02-14-02-08	SENECA CREEK	1.36	0.17	0.21	1.74
02-14-03-02	LOWER MONOCACY RIVER	1.03	0	0.25	1.29
02-14-03-03	UPPER MONOCACY RIVER	0.23	0	0.17	0.40
02-14-03-04	DOUBLE PIPE CREEK	0.56	0.03	0.44	1.03
02-14-03-05	CATOCTIN CREEK	0	0	0.71	0.71
02-14-05-02	ANTIETAM CREEK	0.06	0	0.03	0.09
02-14-05-04	CONOCOCHEAGUE CREEK	0	0	0.15	0.15
02-14-05-07	TONOLOWAY CREEK	0	0	0.03	0.03
02-14-10-01	L. N. BRANCH POTOMAC RIVER	0.54	0	0	0.54

02-14-10-03	WILLS CREEK	0	0	0.28	0.28
05-02-02-01	YOUGHIOGHENY RIVER	0.03	0.11	0.31	0.45
05-02-02-02	LITTLE YOUGHIOGHENY RIVER	0	0	0.10	0.10
05-02-02-03	DEEP CREEK LAKE	0.03	0.02	0.39	0.44
05-02-02-04	CASSELMAN RIVER	0	0	0.01	0.01
Total		81.39	8.96	29.48	119.83

PROGRAMMATIC MITIGATION SITES

As mentioned previously, MDE allows some applicants to satisfy their mitigation requirement by paying into the MDE Nontidal Wetland Compensation Fund. MDE then is required to complete wetland mitigation using this money. The MDE programmatic sites, listed in chronological order.

* Sites formally assessed by MDE using a new draft protocol with a 100-point scale. While stem counts and visual observations were made, the protocol also relies on best professional judgment. Sites were verified to be wetland according to all three required parameters of hydrology, soils, and vegetation. Points were deducted for invasive species, stress on planted/volunteer species, and presence of limiting factors in soils that might inhibit vegetative growth and survival. Best professional judgment is also used to determine if the wetland is providing moderate to high functional benefit by evaluating features associated with certain functions. Bonus points are added for the presence of rare species. Sites with a total score of 60 and above were considered to be successful.

Sites lacking an * were evaluated for presence of wetland parameters and progress toward a mature wetland system as designed. A formal assessment using a scoring protocol will take place in the future.

Table 7: Programmatic Mitigation Sites

Site	Size, acres	Landuse	Watershed	Type	Cooperator	Construction Date	Status
Wye Island NRMA	6	Agriculture	02-13-05-03 Chester River	FO restoration	Eastern Shore RC&D	1994	Successful
Robinson Tract	2.2	Surface mine	02-14-02-03 Washington Metro-Piscataway Creek	1.0 ac. FO 1.2 ac. EM creation	MNCPPC	1992, amendments 1994	Remediation 1995, successful
Cloverfields I	2.92	Agriculture	02-13-05-01 Chester River-Eastern Bay	FO creation	Queen Anne's County DPW	1992, additional planting 1993-94, 1996-2000	Successful, has Phragmites
Hashawha Environmental Center	2	Grass Floodplain	02-14-03-04 Middle Potomac River-Double Pipe Creek	0.125 SS, 1.875 ac. EM creation	Carroll SCD	1992, planted 1993	Remediation for cattail 1995. successful, some cattail remains
Strawberry Property	1.3	Agriculture	02-13-04-05 Choptank River-Tuckahoe Creek	EM creation	Queen Anne's SCD	1993, planted second time 1994	Uncertain
Stephen Decatur Park	.5	Disturbed area	02-13-01-05 Newport Bay	EM creation	Town of Berlin	1993	More water than desired
Merkle WMA	9	Farmed, wildlife management	02-13-11-06 Patuxent River – Middle Area	FO creation	Prince George's SCD	1993, planted 1994	Successful

Little Patuxent Ridge	2.75	Grass floodplain	02-13-11-05 Little Patuxent River	2.25 ac. FO, 0.5 ac. EM	Environmental Systems Analysis, Inc.	1993, planted 1994	Needs follow up
Thompson property	14	Pasture	02-13-04-03 Lower Choptank River	12 ac. FO, 2.0 ac. EM restoration	Talbot SCD, landowner	1994, planted 1995	Remediation to remove invasive plants 2000, successful
Spruill	1.3	Agriculture	02-13-10-05 West Chesapeake Bay	1.0 ac. FO, 0.3 ac. EM creation	Anne Arundel SCD, landowner	1994, planted 1995	Successful
Hashawha Environmental Center II	0.75	Grass Floodplain	02-14-03-04 Middle Potomac River-Double Pipe Creek	FO, creation	Carroll SCD	1994, planted 1995	Uncertain
North Point State Park	8.5	Agriculture	02-13-09-03 Patapsco River – Baltimore Harbor	5.1 ac. FO, 3..0 ac. SS, 0.4 ac. EM creation	Baltimore SCD, MD NRCS	1995	Successful
Herring Creek Nature Park	5	Fallow field	02-13-01-03 Isle of Wight	4.0 ac. FO, 1.0 ac. EM	Worcester SCD	1995, planted 1996, 1998-99.	Excess hydrology, but is slowly developing toward mixed forest/emergent
Millington WMA	4.2	Agriculture	02-13-05-10 Upper Chester River	FO	Kent SCD	1995, planted 1996	Successful
YMCA	1.3	Old field	02-13-02-02	FO	Worcester SCD	1995, planted 1996	Successful
Challedon	3	Fallow field	02-13-09-08	FO	Environmental Systems Analysis	1995, planted 1996	Unsuccessful
Powell	3	Agriculture	02-13-04-02	2.75 ac. FO, .25 ac. EM, restoration	Eastern Shore RC&D	1995	Successful
Cedar Ridge Children's Home	.25	Landscape Management Area	02-14-05-04 Upper Potomac River-Conococheague Creek	0.2 ac. SS, .05 ac. EM, enhancement	Landowner	1996	Successful
Sandy Point State Park	.25	Landscape Management Area	02-13-10-02 West Chesapeake Bay Severn River	FO, enhancement	DNR	1996	Successful

McKee Beshers WMA	5	Agriculture	02-14-02-02 Washington Metro-Potomac River	3.0 ac. FO, 2 .0 ac. SS, 1.0 ac. EM, creation	NRCS, Eastern Shore RC&D, Montgomery SCD	1997	Some areas too dry or wet, needs additional scoring on wetland extent
Davis	2.2	Agriculture	02-13-07-06 Bush River-Swan Creek	1.2 ac. FO, 1.0 ac. EM	Landowners, Harford SCD	1997, planted 1998	More hydrology due to beaver, successful emergent system
Gunpowder State Park-Days Cove	4.5	Fallow field	02-13-08-03 Gunpowder River-Bird River	FO	DNR	1997, additional planting 1998	Successful
Federalsburg Phase I*	6	Floodplain/surface mine	02-13-03-06 Nanticoke River-Marshyhope Creek	1.0 ac. FO, 2.0 ac. SS, 3.0 ac. EM tidal/nontidal restoration	Town of Federalsburg, DNR, National Guard	1998	Successful
Federalsburg Phase II	6	Landscape Management Area/ floodplain, surface mine	02-13-03-06 Nanticoke River-Marshyhope Creek	3.0 ac. SS, 3.0 ac. EM tidal/nontidal restoration	Town of Federalsburg, DNR, National Guard	1999	Successful
Hood	37.5	Pasture	02-14-03-02 Middle Potomac River-Lower Monocacy River	FO restoration	DNR, Landowner, Morris & Associates	1999	Successful
New Windsor Middle School	3	Landscape Management Area	02-14-03-04 Middle Potomac River-Double Pipe Creek	1.0 ac. FO, 1.0 ac. SS, 1.0 ac. EM creation	DNR, School	1999	Some areas too dry, needs scoring to verify extent
Baile	7.58	Pasture	02-14-03-04 Middle Potomac – Double Pipe Creek	5 ac. FO, 1.0 ac. SS, 1.58 ac. EM restoration	Landowners, DNR, Morris Environmental	1999	Successful
Rum Pointe Golf Course*	3	Landscape Management Area	02-13-01-04 Sinepuxent Bay	1.0 ac. FO, 1.0 ac. SS, 1.0 ac. EM restoration	Worcester County SCD, Landowner	1999, planted 2000.	May be failure. Additional monitoring to be done spring 2008.
Union Bridge*	6	Floodplain/Pasture	02-14-03-04 Middle Potomac – Double Pipe Creek	2.0 ac. FO, 2.0 ac. SS, 3.0 ac. EM creation and stream restoration	Town of Union Bridge, DNR	2000	Successful, has some cattail

Boonsboro School*	1	Dry Stormwater Management Pond	02-14-05-02 Upper Potomac – Antietam Creek	1.0 ac. EM, w/ SS fringe creation	Washington County SCD, school	2000	Successful
Adkins Arboretum	1	Pond	02-14-04-05 Choptank River Area-Tuckahoe Creek	0.1 ac. FO, 0.4 ac. SS, 0.5 ac. EM restoration	Adkins Arboretum, SHA, Eastern Shore RC&D	2000, planted 2001	Successful
Octoraro Lakes Property	2	Lake with high hazard dam	02-12-02-03 Lower Susquehanna River-Octoraro Creek	1.0 ac. SS, 1.0 ac. EM creation	WMA Dam Safety Division, Eastern Shore RC&D	1999/2000	Status unknown, needs follow up
Shockley	50	Drained forest land	02-13-02-03 Pocomoke River-Upper Pocomoke	44.0 ac. FO 2.0 ac. SS 4.0 EM restoration	Landowner, Worcester SCD	2001	Successful
Drennan	2.5	Agriculture	02-13-08-04 Gunpowder River-Little Gunpowder Falls	SS	DNR, Ecotone, Inc.	2001	Successful
Rowland	6.1	Agriculture	02-13-01-06 Chincoteague Bay	3.0 ac. FO, 1.0 ac. SS, 2.1 ac. EM restoration	Landowner, Worcester SCD	2001, planted 2002	May have too much open water, needs follow up
Hastings	5.3	Drained forest land	02-13-01-06 Chincoteague Bay	5.0 ac. FO, 0.3 ac. SS restoration	Landowner, Worcester SCD	2002	Successful
Rosewood	10	Agriculture	02-13-09-04 Patapsco River-Jones Falls	2.5 ac. FO, 2.5 ac. SS, 5.0 ac. EM restoration	Irvine Nature Center, Eastern Shore RC&D	2002	Status unknown, needs follow up
SHA/Bounds Property	20	Agriculture	02-13-02-02 Pocomoke River-Upper Pocomoke River	10.0 ac. FO, 5.0 ac. SS, 5.0 ac. EM, restoration	SHA	2001, planted 2002	Needs additional planting in 2008
Myrtle Grove WMA	13.5	Drained forest land	02-14-01-11 Lower Potomac River – Mattawoman Creek	FO	DNR, Charles Soil and Water Conservation District	2001	Successful
Jackson Lane Preserve*	92	Agriculture	02-13-04-04 Upper Choptank River	70.0 ac. FO, 22.0 ac. EM, restoration	TNC, USFWS	2003, planted 2003 and 2004	Successful

DNR WSSC #1	59	Wetland	42 ac. : 02-13-04-05 Upper Choptank River 5 ac.: 02-13-05-10 Upper Chester River 12 ac.: 02-13-04-05 Tuckahoe Creek	Enhancement through invasive species management in Delmarva Bays & other Nontidal Wetlands of Special State Concern	DNR	Repeated treatments 2002-2006	Successful, follow up planned
DNR WSSC #2	36	Wetland	02-13-04-05 Upper Choptank River 02-13-05-10 Upper Chester River 02-13-04-05 Tuckahoe Creek 02-13-03-00 Nanticoke River-Chesapeake Forest Lands	Enhancement through invasive species management in Delmarva Bays 7 other Nontidal Wetlands of Special State Concern	DNR	Repeated treatments 2003-2007	Successful, follow up planned
Hedderick*	0.5	Unvegetated disturbed land	02-14-10-02 N. Branch Potomac River-Evitts Creek	EM creation	Allegany SCD, landowner	2004	Successful
Holland	5.3	Old field, previous timber harvest	02-13-01-06 Chincoteague Bay	5.0 ac. FO, 0.3 ac. EM, restoration	Landowner, Worcester SCD	2004	Successful
Millington WMA II	1.5	Agriculture	02-13-05-10 Upper Chester River	1.0 ac. FO, 0.5 ac. EM restoration	Kent SCD	2004	Successful
Allison/Hall	1.6 2.0	Agriculture	Allison: 02-14-01-08 Lower Potomac River-Zekiah Swamp Hall: 02-14-01-07 Gilbert Swamp	FO restoration	Landowners, Charles SCD	2004	Successful
Puckum Branch	17	Forested floodplain, incised stream channel	02-13-03-06 Marshyhope Creek	FO restoration	DNR	2004	Successful
McGuigan Farm*	6	Agriculture	02-12-02-05 Broad Creek	FO restoration	Harford SCD	2005	Successful

Amish Road Mine Site*	1	Mined land	05-02-02-04 Casselman River	EM creation	MDE Bureau of Mines	2005	Successful
Hidden Pond	2.5	Former pond, dam breached	02-13-10-02 Severn River	EM, tidal restoration	DNR	2005	Status unknown, needs follow up
Beaver Creek	1700 linear ft. of stream	Degraded stream bank	02-14-05-02 Antietam Creek	Stream restoration	Western MD RC&D, landowner	2006	Successful
Middletown School	0.66	School grounds	02-14-03-05 Middle Potomac River-Catoctin Creek	EM creation	School	2006	Too early to determine success
Radcliffe Creek School	0.2	Stormwater management pond	02-13-05-09 Middle Chester River	EM creation	USFWS, school	2006	Too early to determine success
Puckum Branch Dam Removal	6	Pond	02-13-03-06 Marshyhope Creek	EM, SS ac. unspecified, dam removal and fish passage	DNR, Eastern Shore RC&D, USFWS	2007	Too early to determine success
Lynn Farm	8	Agriculture	02-12-02-02 Lower Susquehanna River-Deer Creek	FO restoration	Harford SCD, landowner	2007	Too early to determine success

FUNCTIONAL ASSESSMENT USING GIS

MDE conducted an additional analysis of two mitigation sites to test a desktop method for assessing a wetland's function from a landscape perspective. In 1995, FUGRO EAST, Inc. prepared the document entitled *A Method for the Assessment of Wetland Function,* funded by The Maryland Department of the Environment. This (FUGRO) document included both field and desktop methods for assessing function at a watershed or landscape scale. Using the desktop method, we evaluated the functions of two programmatic wetland mitigation sites, Hedderick and North Point State Park. We utilized available GIS data, desktop references, and the site scoring sheets. Both sites were included in our more intensive site monitoring effort.

The list of evaluated wetland functions and their associated indicators is found below. After each indicator, MDE has included comments as to where this information can be found or desirable data that would be helpful for future use of this method. While we did not include roads in this model, it may be incorporated in future functional methods, as it may contribute pollutants and reduce diversity.

Ground Water Discharge:

1. *Direct indicators of dysfunction (inlet/outlet; potentiometric surface)?*
   Observations, plans. Need nested piezometer data.
2. *Direct indicators of function (springs/seeps; potentiometric surface; inlet/outlet)?*
   Observations/plans. Need nested piezometer data.
3. *Histosol?*
   Scoring sheet, soil survey.
4. *Inlet/outlet class?*
   Observations, plans.
5. *Type of surface water connection?*
   Observations, aerial photos, plans.
6. *Surficial geologic deposit?*
   Geology maps.
7. *Water regime?*
   Scoring sheet.
8. *HGM class?*
   Aerial photography, elevation data, plans, observations.
9. *Does the wetland contain a wetter regime within a drier regime?*
   Scoring sheet, observations.
10. *At base of steep slope?*
    Observations, elevation data, aerial photography.
11. *Contain an incised stream channel?*
    Observations, plans.
12. *Wetland ditched?*
    Observations, plans.

Total score=22

Flood Flow Attenuation:

1. *Direct indicator (outlet)?*
   Observations, plans.

2. *Inlet/outlet class?*
Observations, plans.
3. *Degree of outlet restriction?*
Observations, plans.
4. *Wetland topographic gradient?*
Observations, plans.
5. *Wetland water regime type?*
Scoring sheet.
6. *Frequency of overbank flooding?*
Aerial photography, observations. Suggest developing a 2-yr floodplain line.
7. *Adjacent to a water body?*
Soil survey, aerial photography, observations, and plans.
8. *Ratio of wetland area to watershed area?*[1]
Elevations (DEMs, contour lines, USGS topo maps), wetland watershed shapefile.
9. *Stem density?*
Observations.
10. *HGM class?*
Aerial photography, elevation data, observations, plans.
11. *Wetland ditched?*
Observations, plans.

Total score=28

Modification of Water Quality:

1. *Frequency of overbank flooding?*
Aerial photography, observations. Suggest developing a 2-yr floodplain line.
2. *Wetland land use?*
Scoring sheet, assume low intensity.
3. *Wetland topographic gradient?*
Observations, plans.
4. *Degree of outlet restriction?*
Observations, plans.
5. *Topographic position of wetland in watershed?*
Aerial photography, elevation data.
6. *Percent of wetland watershed that is an upland sediment source?*[1,2]
Wetland watershed and land use shapefiles.
7. *Wetland's water regime?*
Scoring sheet.
8. *Inlet/outlet class?*
Observations, plans.
9. *Stream sinuosity in wetland?*
Observations, plans.
10. *Wetland ditched or contain down cut stream channel?*
Observations, plans.

11. *Dominant vegetation type?*
    Observations.
12. *Vegetative cover distribution of the wetland?*
    Observations.
13. *Soil type?*
    Soil survey, scoring sheet.
14. *HGM?*
    Aerial photography, elevation data, observations, plans.

Total score=42

Sediment Stabilization:

1. *HGM?*
    Aerial photography, elevation data, observations, plans.
2. *Frequency of overbank flooding?*
    Aerial photography, observations. Suggest develop a 2-yr floodplain line.
3. *Overland flows from surrounding uplands?*
    Elevation and landuse data.
4. *Stem density?*
    Observations.
5. *Percent of wetland watershed that is an upland sediment source?*[1,2]
    Wetland watershed and land use shapefiles.
6. *Ratio of wetland area to watershed area?*[1]
    Elevations (DEMs, contour lines, USGS topo maps), wetland watershed shapefile.

Total score=17

Aquatic diversity:

Note: MDE will update the model for this function, as it does not include indirect benefits to aquatic habitat. In addition to directly supporting aquatic habitat, a revised model should score an adjacent wetland for the habitat support it provides to a stream (shade, food source, bank stabilization etc.)

1. *HGM?*
    Aerial photography, elevations, observations, plans.
2. *Association with open water?*
    Aerial photography, plans, observations, stream shapefile, soil survey.
3. *Wetland's water regime?*
    Scoring sheet.
4. *Stream sinuosity?*
    Observations, plans.
5. *Wetland's dominant vegetation type?*
    Scoring sheet.
6. *Wetland's class richness?*
    Scoring sheet.
7. *Wetland's interspersion of open water and vegetative cover?*
    Observations.

8. *Density of wetland vegetation?*
Scoring sheet, observations.

9. *Proximity to other wetlands?*
Wetland shapefile.

10. *Wetland or adjacent water body habitat for fish?*
Wetland and stream shapefiles, soil survey, observations, aerial photography, plans.MBSS results

11. *Wetland habitat for reptiles, amphibians, or aquatic invertebrates listed?*
Scoring sheet.MBSS results

12. *Wetland's land use?*
Scoring sheet, assume low intensity.

13. *Wetland adjacent to undisturbed upland habitat?*
Aerial photography and land use shapefiles.

14. *Wetland adjacent to known upland wildlife habitat?*
Protected lands shapefile.

15. *Wetland is a buffer to a water body***?**
Observations, plans, stream shapefile, soil survey, and aerial photography.

16. *Wetland within or adjacent to Chesapeake Bay Critical Area***?**
Chesapeake Bay Critical Area shapefile.

Total score=50

Wildlife Diversity:

1. *Wetland size?*
Scoring sheets, plans, database, aerial photography.

2. *Wetland class richness?*
Scoring sheets.

3. *Wetland class rarity?*
DNR wetland shapefile, wetland prioritization document (to determine scarcity for the watershed),Wildlife conservation plan

4. *Wetland class edge?*
Observations, plans.

5. *Surrounding habitat class?*[3]
Mitigation site 600m buffer and land use shapefiles.

6. *Proximity to other wetlands?*
Wetland and stream shapefiles.

7. *Adjacent to designated Wildlife Habitat Area?*
Protected lands shapefiles, ADC map.

8. *Wetland water regime?*
Scoring sheet.

9. *Wetland land use?*
Scoring sheet, plans, assume low intensity.

10. *Springs or seeps present?*
Observations, plans.

11. *Wetland vegetative interspersion?*
Observations.

12. *Connected to known wildlife corridor?*

Green infrastructure shapefile.

13. *Wetland's interspersion of open water and vegetative cover?*

Observations.

14. *Wetland contains islands of uplands?*

Observations, as-builts.

15. *A fragment of a once larger wetland?*

Soil survey for hydric soils.

16. *Contains RTE species?*

Within Sensitive Species Project Review Areas shapefile or known occurance.

17. *Surrounding land use?*[3,4]

Wetland mitigation buffer and land use shapefiles.

18. *Regionally significant feature?*

Sensitive Species Project Review Area shapefile or if otherwise known that it contains rare, threatened, or endangered species (RTE) species.

Total score=51

Notes:
1.) Using elevation data, delineate actual wetland watershed to create layer of wetland watershed.
2.) This indicator was modified. It originally asked for the percentage wetland edge bordering an upland sediment source, rather than for the watershed.
3.) Mitigation site is buffered by 600 meters.
4.) This indicator was modified from only looking at the surrounding watershed to looking at the surrounding area within a buffer around the mitigation site.

The method was tested at two mitigation sites visited by staff, Hedderick and North Point State Park.

The watershed of the North Point State Park site was delineated using Baltimore County digital two-foot contour lines. It was important that this detailed information is available since the topographic relief was low and watershed delineations based on the digital USGS 7.5' Topographic Quadrangle maps were poor. This watershed layer was overlain with the land use layer. MDE also created a 600 meter buffer layer around the wetland site and overlaid this layer with the land use layer.

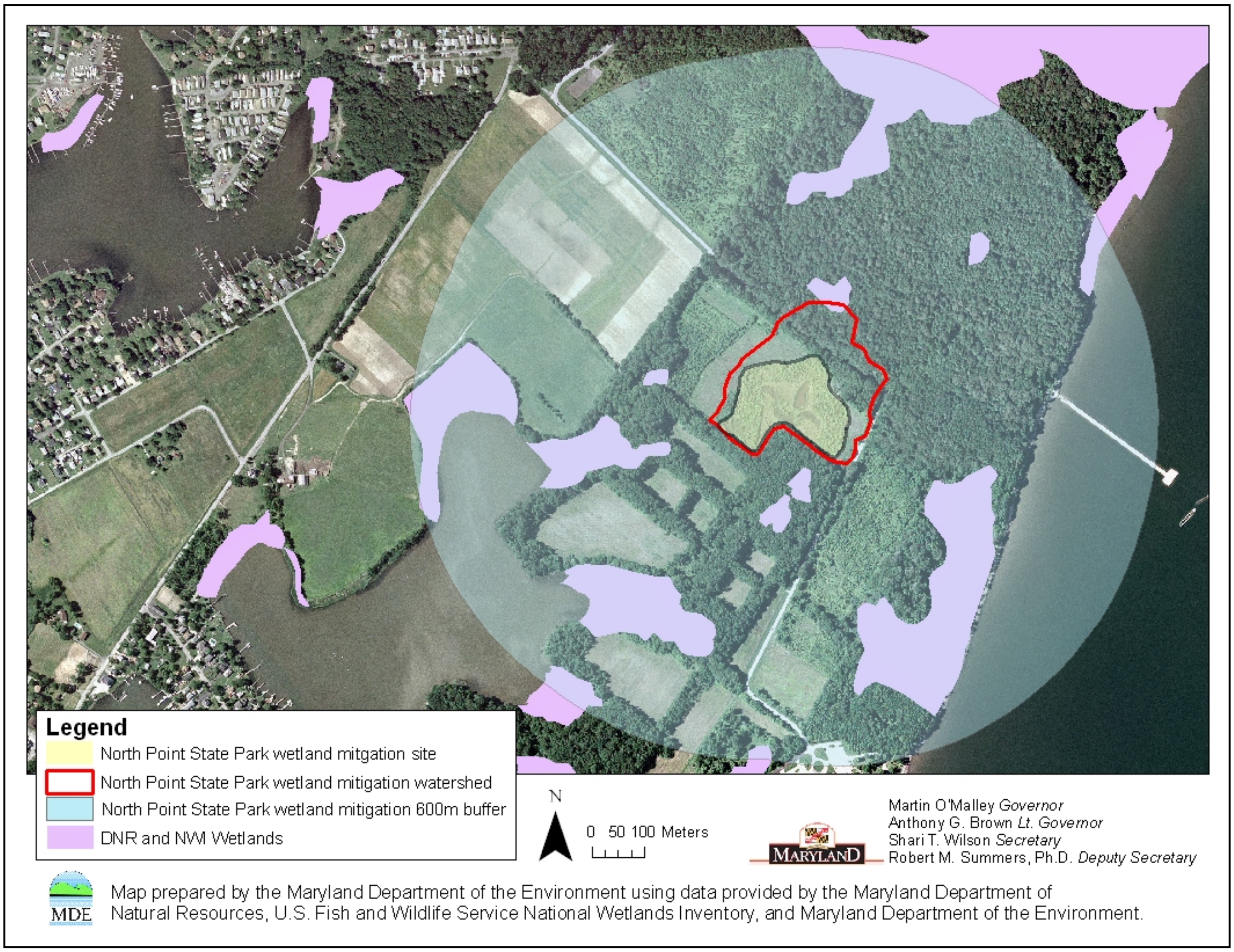

Figure 34. North Point State Park wetland mitigation site, contributing watershed, 600 meter buffer, nearby wetlands, and Aerials Express 2005 photography.

MDE delineated the watershed for the Hedderick mitigation site wetland using the digital USGS 7.5' Topographic Quadrangle maps. Since this area has high topographic relief, it was easy to delineate the wetland basins using this layer. More accurate elevation data, including LIDAR, would be helpful for the entire State, but would not be necessary in this example. Using current 10m DEMs (Digital Elevation Model data) available for this site or future data derived from LIDAR, MDE could also delineate the wetland's watershed using the hydrology tool within Spatial Analyst. MDE overlaid the delineated watershed layer with the land use layer. Some questions related to functional indicators could not be answered based on the GIS layers, maps, and scoring sheet that staff had readily available.

Hedderick was a good example of a project evaluation in which the site was visited by different person than the person doing the GIS analysis. Therefore, for detailed site information, the GIS analyst had to rely solely on the above-mentioned resources. Additionally, MDE does not have detailed plans for this site, which is a common occurrence for mitigation projects. The most obvious missing information was in reference to inlets/outlets, waterway connections, and vegetative structure/communities. Additional guidance on the scoring sheet, better photographs, and detailed plans may have helped.

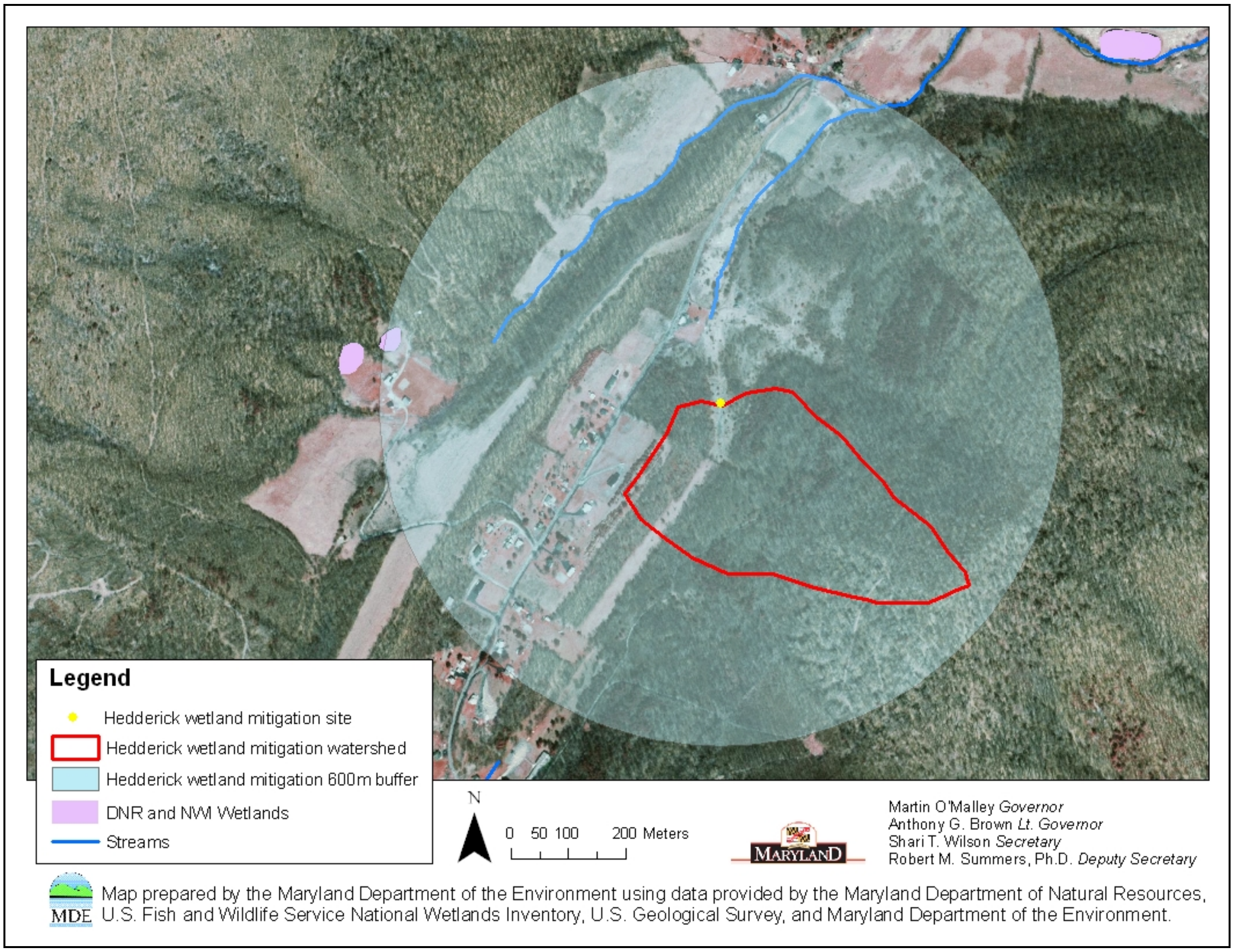

Figure 35. Hedderick wetland mitigation site, contributing watershed, 600 meter buffer, nearby wetlands and streams, and Color Digital Orthophoto Quarter Quads.

Field and GIS data were more complete for the North Point site. Staff was able to estimate all the indicators for this site and not for Hedderick. North Point had equal or higher percentage scores for all functions (Table 8). MDE's current desktop data is not adequate for completing this assessment at all mitigation sites. This assessment could be improved by recording more field observations in the scoring sheets so that the person completing the desktop evaluation does not need to be that same person conducting the field visit.

The Virginia Institute of Marine Science (VIMS) has developed an approach using a GIS analysis to identify the amount of stressors in surrounding land use for each mapped wetland polygon, and predict remaining water quality and wildlife habitat functions. The analysis has been completed for existing mapped nontidal wetlands in Virginia and will be completed in Maryland by March 2008. Habitat and water quality scores were calculated for wetlands based on wetland type, size, hydro-period, surrounding landuse, and proximity to roads or other wetlands. The 8-digit (HUC) watersheds data was used to clip the wetlands, roads, and landuse. Percent land cover was determined for each watershed. Using U.S. Geological Survey elevation data and Light Detection and Ranging (LIDAR) data, wetland drainages were delineated. Land use was intersected with wetland buffers (3m, 200m, and 1000m) and wetland drainage. The land use types were assigned a cover value based on their influence as a stressor to wetland function. This cover value was multiplied by the percent area of that type within each wetland buffer and within the wetland drainage area. Roads were evaluated to determine proximity to wetlands and if they crossed the wetland drainage or were only on one side of the drainage. This process resulted in scores for estimated remaining water quality and habitat for each nontidal wetland polygon within Maryland. MDE will evaluate the suitability of the method for its applicability for landscape assessment of mitigation sites.

	Hedderick		North Point	
	Actual score	Percent score	Actual score	Percent score
Ground Water Discharge	3/13	0.23	7/22	0.32
Flood water Attenuation	10/16	0.63	24/28	0.86
Modification of Water Quality	18/27	0.67	28/42	0.67
Sediment Stabilization	10/17	0.59	12/17	0.71
Aquatic Diversity/Abundance	22/37	0.59	34/50	0.68
Wildlife Diversity/Abundance	17/39	0.44	32/51	0.63

Table 8. Functional indicator scores, as derived from the FUGRO desktop method, for the wetland mitigation sites Hedderick and North Point. The “Actual Score” is the estimated score out of the total number possible for that function. We estimated as many indicators as possible from each of the two sites, given the amount of readily available data.

CONCLUSIONS AND RECOMMENDATIONS FOR MDE WETLAND MITIGATION PROGRAM IMPOVEMENTS

After completing a review of the program and the mitigation projects, a few obvious conclusions can be made about the mitigation program in general:

- **The mitigation program is significantly understaffed**. There are not enough staff in the mitigation program to for performing sufficient follow-up on projects necessary to achieve higher success. If the Phase II plans, construction, or monitoring reports are late, follow-up is limited. This follow-up appears to be much better in regions where the mitigation manager has fewer mitigation projects, and therefore more time to devote to each project.

- **Too much data entry**. As mentioned above, the mitigation program is significantly understaffed. Taking this into account, it is especially important to reduce the amount of data entry to a minimum. At this time, the same piece of data is entered into: the mitigation folder, the mitigation worksheet, the ledger book (containing a summary all projects), two separate computer databases, and sometimes ArcGIS. This repetition is extremely time consuming, and introduces many opportunities for mistakes or omissions. In addition, this information is not currently available to staff in the field offices and is confusing to permit reviewers unfamiliar with the program. Some data entry is necessary to monitor status of the project and for future inquiries from outside agencies. At present, the Maryland Environmental Service is working to develop a database that will be housed on the network and will be accessible to all the mitigation managers and permit reviewers, including those in field offices. Since this database will have frequent back-up, it should be the sole source of data updates. The mitigation folder should still contain paper copies of correspondences, plans, phase II approval letters, site visit notes, etc. MDE recommends that the only place for recording status updates (e.g.: Phase II approval dates, monitoring report received dates, etc) should be in the new database. Additionally, this new database should allow the permit reviewer to enter data directly into the system prior to issuing the permit, rather than onto a "Mitigation Reporting Form" which currently is still entered into the database by the mitigation manager. This will also reduce the amount of data entry and replication completed by the mitigation manager.
- **More (including a bond) should be required of the applicant BEFORE the Permit/LOA is issued**. In general, applicants that are awaiting their Permit/LOA will provide MDE with whatever is requested, including items related to mitigation. However, once MDE issues the Permit/LOA, the permitttee response is much slower. MDE must continuously remind permittees to submit items, or conduct certain activities, related to mitigation, though it is required as a condition of the permit. It is very time consuming for the mitigation staff to make repeated reminder calls or send correspondence to get required bonds after the permit has been issued. These bonds are rarely received. MDE recommends adopting formal regulations to require that a bond be submitted before the Permit/LOA is issued, to further motivate permittee to quickly provide them without repeated reminders.
- **The Compliance Program is significantly understaffed, which leads to inadequate enforcement.** When a permittee does not do their mitigation, even repeat offenders, MDE has difficulty taking enforcement action. Generally, only large enforcement actions are pursued through the Office of the Attorney General. Otherwise, MDE continues correspond with permittees. There are a few applicants that are repeat offenders that have been negligent in completing mitigation for multiple projects. However, even with these applicants, if they apply for a permit on an unrelated piece of property (as would be the case with many developers), MDE is not legally allowed to delay their application for the new authorization based on the outstanding mitigation requirement, unless permittees request a modification to the original authorization.
- **No regular periodic review of project status occurs.** The mitigation program has no schedule for review of active projects. Active projects (those not already closed, terminated, or written-off) require repeated follow-up by staff and permittees. It seems

that this type of reminder is important for the staff, when the tasks of contacting permittees and consultants, or visiting sites, are easily replaced by higher priority items.

Specific problems noted during this project and recommendations are addressed below:

- **Sites failed because they were not built as planned and there is poor monitoring on the part of MDE staff.** With the exception of programmatic sites, no MDE employee is on-site during mitigation construction. Many sites are not visited for years, so differences in actual grading versus the planned grading are more difficult to correct. Some sites were never even graded, only planted, but no follow-up revealed this until years after the event. Other sites were never planted, but this is difficult to prove years later when the site is performing poorly according to required standards.
  Recommendation: MDE should acquire and dedicate additional staff to the Mitigation Section. The Section should hold regular quarterly review meetings to ensure that the necessary actions are taken so that mitigation proceeds on schedule.
- **Sites were built as planned, but do not achieve wetland hydrology or have complete failure of the vegetation.** Once again, unless there is a site visit during construction and follow-up soon after the mitigation site is built, it is difficult to get permittees and their consultants to fix the problem. Monitoring reports may also help in this area, assuming the consultant's report is an accurate representation of the site and there is follow-up in during the monitoring period.
  Recommendation: MDE should require a bond of permittees to hold throughout the entire monitoring period, with partial release when certain achievements are accomplished. Additional enforcement action should also be pursued as an option.
- **Sites have often relatively sterile or extremely gravelly soil, so vegetative development is severely inhibited.** (Figure 36)
  Recommendation: MDE should consider requiring soil tests prior to Phase II approval. Soils that do not have adequate amounts of soil organic matter (4%) or have pH levels that will inhibit normal wetland vegetative growth should receive proper amendments prior to planting.
- **Monitoring reports are absent or not informative.** When no monitoring reports are submitted, it is difficult for the mitigation manager to know how the site is performing, without conducting yearly site visits. There are too many sites for the current staff to visit in one year.
  Recommendation: Monitoring reports should be more standardized and should follow the MDE protocol. If the reports discuss problems with the mitigation site, the MDE reviewer should follow-up to be sure these problems are remedied. More applicants should be required to install wells or IRIS tubes, since the hydrology is often hard to evaluate based on a single annual site visit and is often questionable.
- **Easements/Protection mechanisms are not always obtained.**
  Recommendation: MDE should get an easement or other protection mechanism on each mitigation site. This would ensure the site is maintained as a wetland in perpetuity.
- **Change of property ownership.** The original permittee is responsible for the mitigation, unless it is clearly specified otherwise. However, some properties with mitigation sites have changed ownership and it has difficult to locate the original owner(s) and make them complete the project.

Recommendation: Property deeds should clearly designate presence of mitigation sites and associated restrictions and protection measures. MDE should require that this official and recorded information be submitted prior to permit issuance. A bond should be held by MDE throughout the term of the mitigation project to create further incentives for timely completion of mitigation projects.

- **Mowing/destruction of the project in the short and long-term**. (Figure 37) Several projects have portions that were mowed down or otherwise encroached upon. This is situation is difficult to resolve, other than ensuring sure that the protection mechanisms are in place and hoping the landowner is aware of them. This is more of a concern in wetland mitigation sites adjacent to or within back yards. In some cases, the homeowner is completely unaware of the wetland mitigation project. The realtor or developer does not accurately communicate that these areas should not be disturbed.
  Recommendation: In locations where encroachment may prevent successful establishment of a wetland, additional protective measures should be required. These measures may include signage and fencing to prevent disturbances. Protected wetlands should be identified in deeds or homeowner association documents that describe restrictions and permissible uses of the mitigated wetlands.
- **No mitigation or the incorrect amount of mitigation was required as a condition of the permit/LOA**. In these cases, there is nothing that can be done. While this does not happen too frequently, the permit reviewer should be aware of this issue so it never occurs.
  Recommendation: MDE should institute a proper system of checks and balances to verify mitigation requirements, and confirm that they are part of the permit.
- **Projects that were supposed to pay into the Compensation Fund or Consolidated Wetland site and never did.**
  Recommendation: If the permittee proposes to pay into the Compensation Fund or a consolidated wetland site, they should be required to do so prior to receiving their permit. This will ensure it is completed in a timely manner and will save time on the part of the mitigation section. The permit reviewers should be aware of this policy. MDE should institute a proper system of checks and balances to verify mitigation requirements, and confirm that they are part of the permit.
- **Situations in which project status is unknown.** In some instances, it cannot be determined whether or not projects were completed because information in the file/plans was purged or staff ceased monitoring progress toward completion.
  Recommendation: MDE should improve file management and retain paper and/or electronic records of project history, condition, and status. Quarterly reviews, as mentioned earlier in the section, should be conducted and necessary actions taken promptly.

Figure 36. Example of a wetland mitigation site with relatively sterile, gravelly soil, which is inhibiting vegetation growth.

Figure 37. Example of a wetland mitigation site that has been encroached upon and partially destroyed by way of mowing.

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ACCRONYMS

DNR: Maryland Department of Natural Resources

DPW: Department of Public Works

EM: Emergent

FO: Forested

HGM: Hydrogeomorphic (method)

IBI: Index of Biological Integrity

IMTF: Interagency Mitigation Task force

LIDAR: Light Detection and Ranging

LMA: Landscape Management Area

LOA: Letter of Authorization

MDE: Maryland Department of the Environment

M-NCPPC: Maryland-National Capitol Park and Planning Commission

NRCS: Natural Resources Conservation Service

NRMA: Natural Resources Management Area

PEM: Palustrine Emergent

PFO: Palustrine Forested

PSS: Palustrine Scrub/Shrub

RC&D: Resource Conservation and Development Council, Inc.

SCD: Soil Conservation District

SHA: State Highway Administration

SS: Scrub/Shrub

TNC: The Nature Conservancy

USACOE: U.S. Army Corps of Engineers

USFWS: United States Fish and Wildlife Service

WET: Wetland Evaluation Technique

WMA: Wildlife Management Area

WSSC: (Nontidal) Wetland of Special State Concern

Appendix A.1: Mitigation Site Scoring Method worksheet

Mitigation Site Scoring Method Worksheet Revised 8/9/07

Field Investigator(s): ______________________________ Date: ______________
Project Name: ______________________ NT #/ L # ______________________
Area # ___________ Date Project was Completed: ______________________
Planned wetland types (acres of each): ______________________________
++
Complete a form for each area within the larger site. For different vegetative types within a single area, you may want to score them separately.

V. Vegetation:
Actual vegetation type, projected into future (if multiple types, give % of each): __________
Are any species a concern for future success (e.g. invasive spp)? Yes ☐ No ☐
If so, which species? ______________________________
List any distinct vegetative communities: ______________________________

Dominant emergent species (estimate % cover of dominants): ______________________

Dominant tree/shrub species (estimate % cover of dominants):	ht. range of trees/shrubs (ft):	median ht. for each species (ft):

Success of planted species, if known: ______________________________
Comments: ______________________________

Do any species have observed morphological adaptations for occurrence in wetlands? Which ones?

Vegetation score:
1. % cover by native wetland species (% cover x .10 = score) (out of 10 pts) __________
2. % cover by non-native species (<5% = 5 pts; 5-10% = 4 pts; 10-15% = 3 pts; >15% = 0 pts) (out of 5 pts) __________
3. Diversity for planned wetland type (out of 5 pts) __________
4. Plant density of planned wetland type (out of 5 pts):

Emergent = (% cover wetland species x .10 = score) __________
Scrub/shrub or forest: trees/shrubs $\geq$ 10 in ht., OBL, FACW, FAC ($\geq$600 = 5 pts; 500-599 = 4 pts; 400-499 = 3pts; 300-399 = 2 pts; 200-299 = 2pts; 100-199 = 1 pt; <100 = 0pts) __________

5. Achieve expected growth of volunteer/planted species based on age (take into account stress on vegetation) (out of 5 pts; *cannot exceed score from V4*) __________

__________ Vegetation score (out of 30 points)

S. Soil:

Is hydric soil present? Yes ☐ No ☐

Are any redoximorphic features present in the soil? Describe: ____________________

Based on hydrology, would you expect hydric soils to develop? Yes ☐ No ☐ Unclear ☐

Depth of detritus on surface (in.): ______ Other sources of organic matter onsite? __________

Are any impermeable layers of soil present that may limit ground water movement? Yes ☐ No ☐ Description/depth: __________

Other comments: ____________________

Soils score:

How much of planned vegetated area has soil that may be limiting vegetative growth/establishment (due to too much clay, gravel, glauconite, or very low organic matter, etc.) or has erosion problems? Describe:

__________ Soils score (out of 20 points)

H. Hydrology:

Hydrology source (choose all that apply):

☐ Perennial watercourse
☐ Intermittent watercourse
☐ Floodwater
☐ Pond/lake
☐ Surface Runoff
☐ Groundwater/Perched water table
☐ Not determined

Hydrologic Connection: ☐ Connected ☐ Isolated

Is soil surface (check all that apply):

☐ inundated? % of area: ______ Surface water depth (in.): __________
☐ saturated? % of area: ______ Depth to water in pit (in.): __________
☐ moist? % of area: ______
☐ dry? % of area: ______

List other field evidence of wetland hydrology: ____________________

Note weather conditions that may have affected hydrology: ____________________

Note presence of microtopography: ____________________

Wetland hydrology score (10 pts each):
1. How much of planned vegetated area has wetland hydrology (i.e., not upland but open water is acceptable)?
2. How much of planned vegetated area has wetland hydrology but is unvegetated open water (SAV is not acceptable)? (less water gets a higher score; *cannot exceed the score for H1*)
3. How much of planned vegetated area has wetland hydrology but is too wet (SAV is not acceptable) or too dry to support planned wetland vegetative type? (less area gets a higher score; *cannot exceed the score for H1*)

____________________ Wetland hydrology score (out of 30 points)

F. Wetland Functional Gains:

Wetland Functions score:

Check all that apply:

Biological functions

☐ Providing habitat
- ☐ Rare, threatened, or endangered wildlife
- ☐ Rare, threatened, or endangered plants
- ☐ Forest interior dwelling birds
- ☐ Other non-wetland dependent wildlife
- ☐ Reptiles and amphibians
- ☐ Other wetland dependent wildlife
- ☐ Fish and other aquatic wildlife

☐ Furnishing organic material to the aquatic food webs

Water quality functions

☐ Filtering sediments, pollutants, and excess nutrients
☐ Reducing erosion (e.g., streambanks and drainageways)

Hydrologic functions

☐ Headwater wetland – storing, slowing, or reducing floodwater flow
☐ Floodwater wetland – storing, slowing, or reducing floodwater flow
☐ Discharging groundwater
☐ Recharging groundwater

Human Values

☐ Providing recreational opportunities
☐ Providing harvestable natural resources (e.g., timber, fish, forbearing mammals)
☐ Providing educational opportunities
☐ Providing aesthetic qualities
☐ Representing a rare ecosystem

Does the area provide moderate to high functions? (*Score cannot exceed H1 x 2. H1/10 x functional score = wetland functional score*).

_______________ Functional score (out of 20 points)

Bonus score:
Rare species planted in or colonized the site?
_______________ Bonus score (up to 10 bonus points). If yes, explain: ________________________

Other:
Other comments (e.g. stressors, deer, beaver, mowing, etc.): ________________________

Observed faunal species: ________________________

Remediation actions recommended: ________________________

Was it built as shown in the plans? Yes ☐ No ☐ Unclear ☐
If not, how does it differ?

Total score for area: _______________

Different areas and different planned vegetative types (FO/SS versus EM) should be scored separately, then combined to get one score for the entire site: Only one site table (below) should be completed.

Area #	Score	Portion of total area	Subscore
Site Total		1.0	

Example of calculations used to get final site score:

Area #	Score	Portion of total area	Subscore
1	90	.20	18
2	95	.40	38
3	30	.20	6
4	100	.10	10
5	90	.10	9
Site Total		1.0	81

Appendix A.2 Instructions for the Completing the Mitigation Site Scoring Method Worksheet

INSTRUCTIONS FOR COMPLETING THE MITIGATION SITE SCORING METHOD WORKSHEET

August 9, 2007

Scoring can be separated by areas with different wetland types, different areas or cells of one project, or different observers. Some parts of the scoring can be scored the same across all areas, while other parts of the scoring can be scored separately. At the end, combine these area scores to get one final score for the site, based on square footage of each area. At sites where one area within the site is restoration/creation and another area is enhancement, the enhancement should be given less weight (based on the credits given in the mitigation worksheet) when determining the final site score.

Sites should be visited during the growing season (between May 1 and September 31 for forested and scrub-shrub systems and between June 15 and September 31 for emergent systems), preferably during a period with normal precipitation and groundwater levels.

If the planned wetland type has shifted into an adjacent area, score the site based on the percentage of proposed and actual wetland area by wetland type rather than the actual footprint of where it is supposed to be. For example, a beaver dam turns the forested wetland into open water but results in intermingled upland areas turning into forested wetland, score the new forested wetlands. This assumes the new wetland area will continue to be a wetland.

V. Vegetation

1. **What is the % cover by native wetland plant species (SAV is not acceptable vegetation)?**
   Estimate the percentage of the planned vegetated area of the site that is vegetated (% cover) by native wetland plant species (combining all strata layers) and multiply by 0.1. Determination of native and non-native species will be based on the NRCS Plants Database (http://plants.usda.gov/) nativity classification. An exception is *Phragmites australis*, which will be treated as an introduced species unless identified as the native genotype in the field. Percent cover will be the relative vegetative cover, with a maximum of 100%, as seen from above the vegetation. The 100% cover total may include some unvegetated areas.
2. **What is the % cover by non-native plant species?**
   Estimate the percentage of the planned vegetated area of the site that is vegetated (% relative cover) by non-native plant species and award points as follows: <5% = 5 pts; 5-10% = 4 pts; 10-15% = 3 pts; >15% = 0 pts.
3. **Diversity (richness and evenness combined) of <u>planned wetland type</u>.**
   Estimate the percentage of the planned vegetated area of the site that is vegetated (relative % cover) by native wetland plant species as in 1, but using only species in the planned wetland type. Award base points for each native wetland species (with at least 5% relative cover) in the planned wetland type up to a maximum of five points. Subtract from the base points if any of the following circumstances occur, subtracting the maximum number of points. If one species has greater than 80% relative cover, subtract 4 points from the number of base points. If one species has greater than 70% relative cover, subtract 3 points from the number of base

points. If one species has greater than 60% relative cover, subtract 2 points from the number of base points. If one species has greater than 50% relative cover, subtract 1 point from the number of base points.

4. **Plant density of planned wetland type.**

For a planned forested or scrub-shrub wetland, award points for native trees and/or shrubs (OBL, FACW, FAC) with the following spacing:

POINTS	DENSITY	SPACING
5 points	≥600/ac	8.5 feet
4 points	500-599/ac	8.5 feet-9.2 feet
3 points	400-499/ac	9.2 feet-10.4 feet
2 points	300-399/ac	10.4 feet-12.0 feet
1 point	200-299/ac	12.0 feet-14.8 feet

For a planned emergent wetland, estimate the percentage of the planned vegetated area of the site that is vegetated (% cover) by native emergent wetland (OBL, FACW, FAC; SAV is not acceptable vegetation) plant species and multiply by 0.05.

5. **Achieve expected growth of species based on age (take into account stress on vegetation).**

Score cannot exceed V4. This score is largely to evaluate the future sustainability of the system. If the growth of the wetland species is high, it is likely the vegetative community will be sustainable. The expected growth of species is based on the growth rates described on NRCS Plants Database (http://plants.usda.gov/). Additionally, we are taking data on growth rates within the mitigation sites. This will allow us to make more accurate estimates in the future of expected plant growth in mitigation sites for different species.

S. Soil

How much of the planned vegetated area has soil that may be limiting vegetative growth/establishment (due to too much clay, gravel, glauconite, or very low organic matter, etc.) or has erosion problems? Soils at sites with consistently dense vegetative cover are NOT considered to be limiting. Vegetated upland soils can get full credit.

H. Hydrology

1. How much of the planned vegetated area has wetland hydrology (i.e., not upland but open water is acceptable)?

Estimate the percentage of the planned vegetated area of the site that has wetland hydrology and multiply by 0.1.

2. How much of the planned vegetated area <u>has</u> wetland hydrology but is un-vegetated open water (submerged aquatic vegetation is not acceptable vegetation)?

Score for H2 cannot exceed the score for H1. Estimate the percentage of the planned vegetated area of the site that is un-vegetated open water and multiply by 0.1, then subtract from 10.

3. How much of the planned vegetated area <u>has</u> wetland hydrology but is too wet (submerged aquatic vegetation is not acceptable vegetation) or too dry to support the <u>planned wetland vegetative type</u>?

Score for H3 cannot exceed the score for H1. Estimate the percentage of the planned vegetated area of the site that has wetland hydrology but is too wet or too dry to support the planned wetland vegetative type and multiply by 0.1, then subtract from 10.

F. Wetland Functional Gains. *Score cannot exceed H1 x 2. H1/10 x functional score = wetland functional score.* Ex: If the score for H1 is 5, the functional score can only be 10 total. If the functional score would have been 16, the wetland functional score should be 8. For each box checked, give that function a score of UP TO ten points. For more details on assessing these functions, refer to the FUGRO functional assessment model.

1. Biological Functions

a. Providing habitat

i. Rare, threatened, or endangered wildlife or plants

Does the site contains any species that were purposely introduced or naturally colonized that are listed on the Department of Natural Resources' list of endangered or threatened species, or species in need of conservation?

ii. Forest interior dwelling birds

Will the site become part of a forest that is at least 50 contiguous acres with 10 or more acres of "forest interior" habitat (i.e., forest greater than 300 feet from the nearest forest edge), which is assumed (although inadequately) if there is an unobstructed point within the forest where a person cannot see out to any edge of the forest?

iii. Other non-wetland dependent wildlife

Sites with higher diversity provide more habitat. Sites with other nearby habitat also provide better maintenance of wildlife communities than sites surrounded by impervious surface.

iv. Reptiles and amphibians

Does the site have emergent vegetation, depressions that could be amphibian breedinghabitat, and/or rocks or logs in open water for basking habitat?

v. Other wetland dependent wildlife

Larger sites with higher diversity provide more habitat. Sites with other nearby wetlands also provide better maintenance of wildlife communities than sites surrounded by impervious surfaces.

vi. Fish and other aquatic wildlife

Does the wetland have inundation for periods long enough to provide aquatic habitat? Sites connected with streams, rivers, and ponds may have higher functioning.

b. Furnishing organic material to the aquatic food web

Is there is a stream/waterway running through/adjacent to the wetland in which the wetland will likely contribute leaves or other detritus?

2. Water Quality Functions

a. Filtering sediments, pollutants and excess nutrients

For this function, there must be a pollutant/sediment source (e.g. surrounding uplands that will provide pollutants, a connected stream channel that overflows, etc.). The wetland should be densely vegetated and slow the velocity of the water (with longer storage times being better) to intercept the most pollutants.

b. Reducing erosion

Does this site have vegetation along a streambank or pond edge with an elevation difference of more than 6 inches?

3. Hydrologic Functions

a. Headwater wetland - storing, slowing, or reducing floodwater flow

Is the site hydrologically connected and have a relatively flat topography and depressions that store *surface runoff* (ephemeral or no distinct inlet) but do not receive overbank flooding?

b. Floodplain wetland - storing, slowing, or reducing floodwater flow

Is the site hydrologically connected and have a relatively flat topography and depressions that store water from *overbank flooding*? Sites with no or restricted outlets have the highest capacity for water storage.

c. Discharging groundwater

Is there groundwater exiting the wetland? Large wetlands adjacent to streams/lakes may serve a critical role in maintaining the hydroperiod of those waters. Other indicators are perennial seeps or springs and/or no inlet but a perennial outlet.

d. Recharging groundwater

Is the surface water infiltrating through the wetland soils into the ground water? The site should be hydrologically connected but not permanently inundated.

4. Human Values

a. Providing recreational opportunities

Is the site known to be used for recreation (e.g., sites with trails)?

b. Providing harvestable natural resources

Is the site known to be used for harvesting timber, fish, or furbearing mammals?

c. Providing educational opportunities

Is the site known to be used by groups for environmental education (e.g., school and park sites with trails and interpretive signs)?

d. Providing aesthetic qualities

Is the site not degraded and visible to multiple people (not including the landowner)?

e. Representing a rare ecotype within the watershed

Does the site include a rare ecotype (e.g., a peatland)?

f. Having historic properties

Does the site include historic properties (e.g., an old mill pond)?

BONUS. Rare Species Bonus

Document if the area is vegetated with rare plants or inhabited by rare animals. Use the DNR list of endangered, threatened, and watch list species, as well as local distribution information. Award UP TO 10 bonus points if the site has habitat for rare plants or animals. If the site creates potential habitat for rare plants or animals that inhabit adjacent land, award UP TO 5 bonus points.

Example 1. A site (planned to be emergent) contains 50% *Leersia* wetland, 20% *Phragmites* wetland, 20% open water with submerged aquatic vegetation, and 10% unvegetated upland with poor clay soil (100% total relative cover). The functions provided by the site include providing amphibian habitat, filtering water, and storing floodwater.

CATEGORY	**MAX. SCORE**	**AREA 1**
V1	10	5.00
V2	5	0.00
V3	5	1.00
V4	5	2.50
V5	5	1.00
VEGETATION SUBSCORE	30	9.50
S	20	18.00
SOIL SUBSCORE	20	18.00
H1	10	9.00
H2	10	8.00
H3	10	7.00
HYDROLOGY SUBSCORE	30	24.00
F	20	15.00
FUNCTION SUBSCORE	20	15.00
TOTAL	100	66.50
BONUS	10	0.00
AREA SCORE	110	66.50

Example 2. A site contains five distinct areas. These areas are scored separately, then given a combined site score. Area #4 is an enhancement area, so is given less credit when determining the total site score. The area's "portion of the total site credit" is multiplied by the "area score" to determine the "area subscore". Then all the area scores are added to determine the site total score

Area #	Area score	Size of area (sf)	Credit (sf)	Portion of total credit	Subscore
1	90	2000	2000	.02	1.8
2	95	3000	3000	.03	2.9
3	30	10000	10000	.10	3
4 (enhancement)	100	30000	15000	.15	15
5	90	70000	70000	.70	63
Site Total		115000	100000	1.0	85.7

Appendix B. Results from the IRIS Tube Monitoring at the Subset Wetland Mitigation Sites

Code	Site	Date In	Date Out	% Reduct. 1	% Reduct. 2	% Reduct. 3	Ave. % Reduct.	Range of Max. Reduct. 1	Range of Max. Reduct. 2	Range of Max. Reduct. 3	Overall Range of ≥20% Reduction	Black Spots?
AR 1-1A	Amish Road	4/12/2007	5/10/2007	90	85	90	88	2-6	3-7	2-6	1-20	N
AR 1-2A	Amish Road	4/12/2007	5/10/2007	100	100	99	100	2-6	4-8	2-6	0-18	N
AR 1-3A	Amish Road	4/12/2007	5/10/2007	100	100	99	100	10-14	10-14	10-14	0-20	N
AR 1-4A	Amish Road	4/12/2007	5/10/2007	99	95	99	98	10-14	10-14	10-14	1-20	N
AR 1-5A	Amish Road	4/12/2007	5/10/2007	90	90	90	90	1-5	1-5	0-4	0-19	N
AR 2-1A	Amish Road	4/12/2007	5/10/2007	60	55	40	52	0-4	3-7	1-5	0-12	N
AR 2-2A	Amish Road	4/12/2007	5/10/2007	55	55	40	50	0-4	0-4	0-4	0-9	N
AR 2-3A	Amish Road	4/12/2007	5/10/2007	80	80	80	80	0-4	0-4	0-4	0-12	N
AR 2-4A	Amish Road	4/12/2007	5/10/2007	50	60	60	57	2-6	2-6	2-6	0-12	N
AR 2-5A	Amish Road	4/12/2007	5/10/2007	45	40	40	42	0-4	0-4	2-6	0-12	N
BO 1-1A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-12	N
BO 1-2A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-10	N
BO 1-3A	Boonsboro	4/11/2007	5/9/2007	99	95	99	98	0-4	0-4	0-4	0-9	N
BO 1-4A	Boonsboro	4/11/2007	5/9/2007	75	80	85	80	0-4	0-4	0-4	0-11	N
BO 1-5A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-12	N
BO 2-1A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-13	N
BO 2-2A	Boonsboro	4/11/2007	5/9/2007	99	100	99	99	0-4	0-4	0-4	0-17	N

BO 2-3A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-15	N
BO 2-4A	Boonsboro	4/11/2007	5/9/2007	99	100	95	98	0-4	0-4	0-4	0-16	N
BO 2-5A	Boonsboro	4/11/2007	5/9/2007	100	100	99	100	0-4	0-4	0-4	0-16	N
CL 1-1A	Clifton	3/28/2007	4/25/2007	75	85	75	78	0-4	0-4	0-4	0-6	N
CL 1-2A	Clifton	3/28/2007	4/25/2007	40	30	40	37	0-4	0-4	2-6	0-6	N
CL 1-3A	Clifton	3/28/2007	4/25/2007	50	50	60	53	0-4	0-4	0-4	0-6	N
CL 1-4A	Clifton	3/28/2007	4/25/2007	45	50	50	48	0-4	0-4	0-4	0-6	N
CL 1-5A	Clifton	3/28/2007	4/25/2007	40	40	40	40	2-6	2-6	0-4	2-8	N
CL 2-1A	Clifton	3/28/2007	4/25/2007	80	80	70	77	4-8	4-8	2-6	0-12	N
CL 2-2A	Clifton	3/28/2007	4/25/2007	85	90	90	88	3-7	2-6	2-6	0-10	N
CL 2-3A	Clifton	3/28/2007	4/25/2007	85	80	75	80	5-9	5-9	4-8	4-10	N
CL 2-4A	Clifton	3/28/2007	4/25/2007	40	40	35	38	3-7	2-6	2-6	2-8	N
CL 2-5A	Clifton	3/28/2007	4/25/2007	50	60	50	53	3-7	3-7	2-6	0-8	N
FE 1-1A	Federalsburg	4/5/2007	5/7/2007	0	0	0	0					N
FE 1-2A	Federalsburg	4/5/2007	5/7/2007	35	30	25	30	4-8	4-8	3-7	4-8	N
FE 1-3A	Federalsburg	4/5/2007	5/7/2007	20	25	20	22	12-16	13-17	10-14	10-16	N
FE 1-4A	Federalsburg	4/5/2007	5/7/2007	60	25	45	43	12-16	12-16	8-12	8-20	N
FE 1-5A	Federalsburg	4/5/2007	5/7/2007	10	15	5	10	12-16	13-17	0-4		N
FE 1-1B	Federalsburg	5/7/2007	5/31/2007	25	30	25	27	10-14	10-14	2-6	6-20	N
FE 1-	Federalsburg	5/7/2007	5/31/2007	20	15	15	17	9-13	12-16	4-8		N

2B												
FE 1-3B	Federalsburg	5/7/2007	5/31/2007	5	5	5	5	0-4	0-4	4-8		N
FE 1-4B	Federalsburg	5/7/2007	5/31/2007	15	20	20	18	14-18	12-16	4-8	8-20	N
FE 1-5B	Federalsburg	5/7/2007	5/31/2007	25	25	25	25	9-13	9-13	6-10	9-20	N
FE2-1A	Federalsburg	4/5/2007	5/7/2007	80	90	80	83	8-12	8-12		4-14	N
FE 2-2A	Federalsburg	4/5/2007	5/7/2007	15	20	20	18	4-8	3-7		3-7	N
FE 2-3A	Federalsburg	4/5/2007	5/7/2007	20	25	30	25	4-8	5-9		5-13	N
FE 2-4A	Federalsburg	4/5/2007	5/7/2007	20	20	20	20	4-8	4-8		4-10	N
FE 2-5A	Federalsburg	4/5/2007	5/7/2007	10	15	15	13	4-8	6-10			N
FE2-1B	Federalsburg	5/7/2007	5/31/2007	65	40	65	57	2-6	0-4		0-8	N
FE 2-2B	Federalsburg	5/7/2007	5/31/2007	90	75	75	80	6-10	6-10		1-16	N
FE 2-3B	Federalsburg	5/7/2007	5/31/2007	95	90	95	93	5-9	4-8		0-16	N
FE 2-4B	Federalsburg	5/7/2007	5/31/2007	45	50	50	48	6-10	6-10		0-14	N
FE 2-5B	Federalsburg	5/7/2007	5/31/2007	80	80	80	80	6-10	6-10		6-11	N
HE 1-1A	Heddereick	4/12/2007	5/10/2007	75	75	55	68	2-6	2-6	1-5	0-18	N
HE 1-2A	Heddereick	4/12/2007	5/10/2007	90	80	80	83	2-6	2-6	2-6	0-18	N
HE 1-3A	Heddereick	4/12/2007	5/10/2007	80	75	60	72	0-4	0-4	0-4	0-16	N
HE 1-4A	Heddereick	4/12/2007	5/10/2007	75	70	65	70	0-4	0-4	1-5	0-13	N
HE 1-5A	Heddereick	4/12/2007	5/10/2007	90	85	85	87	1-5	0-4	1-5	0-12	N
HC 1-1A	Herring Creek	4/10/2007	5/9/2007	100	100	99	100	4-8	4-8	2-6	0-20	N
HC 1-2A	Herring Creek	4/10/2007	5/9/2007	100	100	99	100	4-8	4-8	4-8	0-20	N

HC 1-3A	Herring Creek	4/10/2007	5/9/2007	100	100	99	100	1-5	2-6	1-5	0-20	N
HC 1-4A	Herring Creek	4/10/2007	5/9/2007	95	99	99	98	6-10	6-10	4-8	0-20	N
HC 1-5A	Herring Creek	4/10/2007	5/9/2007	95	95	95	95	6-10	6-10	6-10	0-20	N
HC 2-1A	Herring Creek	4/10/2007	5/9/2007	95	95	95	95	2-6	4-8	2-6	0-20	N
HC 2-2A	Herring Creek	4/10/2007	5/9/2007	90	95	95	93	2-6	2-6	2-6	0-14	N
HC 2-3A	Herring Creek	4/10/2007	5/9/2007	90	90	85	88	6-10	6-10	6-10	0-20	Y
HC 2-4A	Herring Creek	4/10/2007	4/4/1900	95	95	90	93	2-6	4-8	4-8	1-14	N
HC 2-5A	Herring Creek	4/10/2007	5/9/2007	95	99	95	96	2-6	3-7	2-6	0-11	N
JL 1-1A	Jackson Lane	4/5/2007	5/7/2007	65	70	55	63	1-5	0-4	1-5	0-8	N
JL 1-2A	Jackson Lane	4/5/2007	5/7/2007	75	80	60	72	0-4	0-4	0-4	0-6	N
JL 1-3A	Jackson Lane	4/5/2007	5/7/2007	100	95	95	97	0-4	0-4	0-4	0-8	N
JL 1-4A	Jackson Lane	4/5/2007	5/7/2007	80	70	60	70	1-5	0-4	1-5	1-8	N
JL 1-5A	Jackson Lane	4/5/2007	5/7/2007	100	99	95	98	0-4	0-4	0-4	0-5	N
JL 2-1A	Jackson Lane	4/5/2007	5/7/2007	90	90	95	92	0-4	0-4	0-4	0-6	N
JL 2-2A	Jackson Lane	4/5/2007	5/7/2007	95	95	95	95	0-4	0-4	0-4	0-10	N
JL 2-3A	Jackson Lane	4/5/2007	5/7/2007	100	99	95	98	0-4	0-4	0-4	0-8	N
JL 2-4A	Jackson Lane	4/5/2007	5/7/2007	100	100	90	97	1-5	1-5	1-5	0-12	N
JL 2-5A	Jackson Lane	4/5/2007	5/7/2007	95	95	85	92	0-4	0-4	0-4	0-10	N
JL 3-1A	Jackson Lane	4/5/2007	5/7/2007	100	100	99	100	2-6	2-6	0-4	0-18	N
JL 3-	Jackson	4/5/2007	5/7/2007	100	100	99	100	2-6	2-6	1-5	0-14	N

2A	Lane											
JL 3-3A	Jackson Lane	4/5/2007	5/7/2007	100	100	99	100	2-6	2-6	1-5	1-16	N
JL 3-4A	Jackson Lane	4/5/2007	5/7/2007	100	100	99	100	2-6	2-6	1-5	0-12	N
JL 3-5A	Jackson Lane	4/5/2007	5/7/2007	100	100	99	100	2-6	2-6	2-6	1-16	N
LS 1-1A	Lakeside	3/29/2007	4/26/2007	0	0	0	0					N
LS 1-2A	Lakeside	3/29/2007	4/26/2007	0	0	0	0					N
LS 1-3A	Lakeside	3/29/2007	4/26/2007	0	0	0	0					N
LS 1-4A	Lakeside	3/29/2007	4/26/2007	0	0	0	0					N
LS 1-5A	Lakeside	3/29/2007	4/26/2007	0	0	0	0					N
LS 1-1B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 1-2B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 1-3B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 1-4B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 1-5B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 2-1A	Lakeside	3/29/2007	4/26/2007	15	10	10	12	12-16	2-6	2-6		N
LS 2-2A	Lakeside	3/29/2007	4/26/2007	1	1	2	1	5-9	6-10	5-9		N
LS 2-3A	Lakeside	3/29/2007	4/26/2007	10	10	15	12	2-6	2-6	2-6		N
LS 2-4A	Lakeside	3/29/2007	4/26/2007	5	1	7	4	10-14	4-8	6-10		N
LS 2-5A	Lakeside	3/29/2007	4/26/2007	20	15	20	18	16-20	16-20	16-20	16-20	N
LS 2-1B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N

LS 2-2B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 2-3B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 2-4B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 2-5B	Lakeside	4/26/2007	6/1/2007	0	0	0	0					N
LS 3-1A	Lakeside	3/29/2007	4/26/2007	5	10	5	7	4-8	4-8	4-8		N
LS 3-2A	Lakeside	3/29/2007	4/26/2007	10	15	15	13	4-8	4-8	4-8		N
LS 3-3A	Lakeside	3/29/2007	4/26/2007	5	5	5	5	8-12	10-14	8-12		N
LS 3-4A	Lakeside	3/29/2007	4/26/2007	15	10	10	12	4-8	4-8	3-7		N
LS 3-5A	Lakeside	3/29/2007	4/26/2007	5	10	10	8	2-6	4-8	1-5		N
LS 3-1B	Lakeside	4/26/2007	6/1/2007	15	10	10	12	0-4	0-4	0-4		N
LS 3-2B	Lakeside	4/26/2007	6/1/2007	45	40	35	40	12-16	12-16	9-13	2-16	N
LS 3-3B	Lakeside	4/26/2007	6/1/2007	20	45	20	28	14-18	16-20	6-10	0-18	N
LS 3-4B	Lakeside	4/26/2007	6/1/2007	15	15	20	17	2-6	2-6	1-5		N
LS 3-5B	Lakeside	4/26/2007	6/1/2007	35	45	40	40	14-18	14-18	11-15	0-18	N
MC 1-1A	Mcguigan	4/16/2007	5/15/2007	35	30	25	30	0-4	2-6	0-4	0-5	N
MC 1-2A	Mcguigan	4/16/2007	5/15/2007	70	60	70	67	1-5	1-5	1-5	0-16	N
MC 1-3A	Mcguigan	4/16/2007	5/15/2007	10	10	20	13	0-4	0-4	0-4	0-4	N
MC 1-4A	Mcguigan	4/16/2007	5/15/2007	85	85	80	83	1-5	2-6	0-4	0-20	N
MC 1-5A	Mcguigan	4/16/2007	5/15/2007	65	70	60	65	0-4	0-4	0-4	0-4	N
MC 2-	Mcguigan	4/16/2007	5/15/2007	25	20	15	20	0-4	0-4	0-4	0-6	N

1A												
MC 2-2A	Mcguigan	4/16/2007	5/15/2007	25	25	10	20	2-6	2-6	0-4	2-8	N
MC 2-3A	Mcguigan	4/16/2007	5/15/2007	10	10	20	13	0-4	0-4	0-4		N
MC 2-4A	Mcguigan	4/16/2007	5/15/2007	25	25	20	23	0-4	0-4	0-4	0-4	N
MC 2-5A	Mcguigan	4/16/2007	5/15/2007	5	10	5	7	0-4	0-4	0-4		N
MC 2-1B	Mcguigan	5/15/2007	6/26/2007	0	0	0	0					N
MC 2-2B	Mcguigan	5/15/2007	6/26/2007	0	0	0	0					N
MC 2-3B	Mcguigan	5/15/2007	6/26/2007	0	0	0	0					N
MC 2-4B	Mcguigan	5/15/2007	6/26/2007	0	0	0	0					N
MC 2-5B	Mcguigan	5/15/2007	6/26/2007	0	0	0	0					N
MC 3-1A	Mcguigan	4/16/2007	5/15/2007	0	0	0	0					N
MC 3-2A	Mcguigan	4/16/2007	5/15/2007	0	0	0	0					N
MC 3-3A	Mcguigan	4/16/2007	5/15/2007	0	0	0	0					N
MC 3-4A	Mcguigan	4/16/2007	5/15/2007	0	0	0	0					N
MC 3-5A	Mcguigan	4/16/2007	5/15/2007	0	0	0	0					Y
MC 4-1A	Mcguigan	4/16/2007	5/15/2007	70	75	70	72	0-4	0-4	0-4	0-20	N
MC 4-2A	Mcguigan	4/16/2007	5/15/2007	60	65	60	62	0-4	0-4	0-4	0-6	N
MC 4-3A	Mcguigan	4/16/2007	5/15/2007	45	35	35	38	0-4	0-4	0-4	0-6	N
MC 4-4A	Mcguigan	4/16/2007	5/15/2007	35	35	20	30	0-4	0-4	0-4	0-4	N
MC 4-5A	Mcguigan	4/16/2007	5/15/2007	65	65	70	67	0-4	0-4	0-4	0-6	N

BI 1-1A	Bishop	4/10/2007	5/9/2007	40	25	7	24	12-16	12-16	0-4	12-16	N
BI 1-2A	Bishop	4/10/2007	5/9/2007	20	15	20	18	0-4	0-4	0-4	0-4	N
BI 1-3A	Bishop	4/10/2007	5/9/2007	15	15	10	13	0-4	0-4	0-4		N
BI 1-4A	Bishop	4/10/2007	5/9/2007	10	15	15	13	0-4	0-4	0-4		N
BI 1-5A	Bishop	4/10/2007	5/9/2007	5	5	3	4	0-4	0-4	0-4		N
BI 1-1B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 1-2B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 1-3B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 1-4B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 1-5B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 2-1A	Bishop	4/10/2007	5/9/2007	25	30	30	28	16-20	16-20	16-20	16-20	N
BI 2-2A	Bishop	4/10/2007	5/9/2007	20	25	20	22	0-4	0-4	0-4	0-4	N
BI 2-3A	Bishop	4/10/2007	5/9/2007	30	30	35	32	4-8	4-8	4-8	4-8	N
BI 2-4A	Bishop	4/10/2007	5/9/2007	50	40	30	40	12-16	1-5	1-5	0-16	N
BI 2-5A	Bishop	4/10/2007	5/9/2007	10	20	15	15	2-6	2-6	2-6	2-6	N
BI 2-1B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 2-2B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 2-3B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 2-4B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
BI 2-5B	Bishop	5/9/2007	6/5/2007	0	0	0	0					N
HA 1-1A	Hawkins	4/12/2007	5/8/2007	80	70	60	70	8-12	8-12	6-10	0-20	N
HA 1-2A	Hawkins	4/12/2007	5/8/2007	85	90	90	88	2-6	2-6	1-5	0-20	N
HA 1-3A	Hawkins	4/12/2007	5/8/2007	90	90	95	92	1-5	0-4	0-4	0-8	N
HA 1-4A	Hawkins	4/12/2007	5/8/2007	70	75	65	70	6-10	8-12	6-10	2-18	N
HA 1-5A	Hawkins	4/12/2007	5/8/2007	50	50	35	45	4-8	0-4	0-4	0-8	N
HA 2-1A	Hawkins	4/12/2007	5/8/2007	85	80	75	80	10-14	10-14	6-11	4-16	N
HA 2-2A	Hawkins	4/12/2007	5/8/2007	90	85	75	83	9-13	9-13	6-10	2-20	N
HA 2-3A	Hawkins	4/12/2007	5/8/2007	65	65	50	60	2-6	3-7	1-5	2-14	N
HA 2-	Hawkins	4/12/2007	5/8/2007	55	65	50	57	2-6	3-7	2-6	2-20	N

4A												
HA 2-5A	Hawkins	4/12/2007	5/8/2007	45	50	35	43	0-4	3-7	0-4	0-16	N
HA 3-1A	Hawkins	4/12/2007	5/8/2007	100	100	99	100					N
HA 3-2A	Hawkins	4/12/2007	5/8/2007	100	100	99	100					N
HA 3-3A	Hawkins	4/12/2007	5/8/2007	100	100	99	100					N
HA 3-4A	Hawkins	4/12/2007	5/8/2007	100	100	99	100					N
HA 3-5A	Hawkins	4/12/2007	5/8/2007	100	100	99	100					N
HA 4-1A	Hawkins	4/12/2007	5/8/2007	99	99	95	98	3-7	3-7	2-6	0-20	N
HA 4-2A	Hawkins	4/12/2007	5/8/2007	95	95	95	95	2-6	2-6	1-5	1-20	N
HA 4-3A	Hawkins	4/12/2007	5/8/2007	95	99	95	96	4-8	5-9	4-8	1-20	N
HA 4-4A	Hawkins	4/12/2007	5/8/2007	100	100	99	100	2-6	1-5	0-4	0-20	N
HA 4-5A	Hawkins	4/12/2007	5/8/2007	100	100	99	100	3-7	2-6	1-5	0-20	N
HF 1-1A	Horse Farm	4/11/2007	5/8/2007	80	80	75	78	0-4	0-4	0-4	0-10	N
HF 1-2A	Horse Farm	4/11/2007	5/8/2007	45	35	25	35	0-4	0-4	0-4	0-10	N
HF 1-3A	Horse Farm	4/11/2007	5/8/2007	75	65	60	67	4-8	0-4	1-5	0-14	N
HF 1-4A	Horse Farm	4/11/2007	5/8/2007	40	40	25	35	0-4	0-4	1-5	0-12	N
HF 1-5A	Horse Farm	4/11/2007	5/8/2007	85	90	80	85	0-4	0-4	0-4	0-14	N
HF 2-1A	Horse Farm	4/11/2007	5/8/2007	30	25	35	30	0-4	0-4	1-5	0-10	N
HF 2-2A	Horse Farm	4/11/2007	5/8/2007	50	50	45	48	0-4	0-4	1-5	0-14	N
HF 2-3A	Horse Farm	4/11/2007	5/8/2007	45	40	40	42	2-6	2-6	1-5	1-10	N

HF 2-4A	Horse Farm	4/11/2007	5/8/2007	65	50	55	57	0-4	0-4	0-4	0-6	N
HF 2-5A	Horse Farm	4/11/2007	5/8/2007	75	80	80	78	0-4	0-4	1-5	0-16	N
ME 1-1A	Merkle	3/28/2007	4/30/2007	100	100	90	97	3-7	1-5	2-6	3-18	N
ME 1-2A	Merkle	3/28/2007	4/30/2007	95	95	85	92	1-5	1-5	1-5	1-14	N
ME 1-3A	Merkle	3/28/2007	4/30/2007	85	90	80	85	1-5	2-6	2-6	1-7	N
ME 1-4A	Merkle	3/28/2007	4/30/2007	90	90	75	85	0-4	0-4	0-4	0-12	N
ME 1-5A	Merkle	3/28/2007	4/30/2007	90	90	90	90	0-4	0-4	0-4	0-10	N
ME 2-1A	Merkle	3/28/2007	4/30/2007	100	100	99	100	1-5	1-5	1-5	1-17	N
ME 2-2A	Merkle	3/28/2007	4/30/2007	100	100	99	100	1-5	1-5	1-5	0-20	N
ME 2-3A	Merkle	3/28/2007	4/30/2007	100	100	99	100	1-5	1-5	1-5	0-9	N
ME 2-4A	Merkle	3/28/2007	4/30/2007	100	100	99	100	1-5	1-5	1-5	0-20	N
ME 2-5A	Merkle	3/28/2007	4/30/2007	100	100	99	100	1-5	1-5	1-5	0-20	N
MD 1-1A	Miller Dobson	3/27/2007	4/30/2007	50	50	50	50	0-4	0-4	0-4	0-13	N
MD 1-2A	Miller Dobson	3/27/2007	4/30/2007	40	35	25	33	4-8	5-9	4-8	0-10	N
MD 1-3A	Miller Dobson	3/27/2007	4/30/2007	70	60	60	63	9-13	9-13	6-10	2-13	N
MD 1-4A	Miller Dobson	3/27/2007	4/30/2007	75	55	55	62	0-4	0-4	0-4	0-12	N
MD 1-5A	Miller Dobson	3/27/2007	4/30/2007	85	75	45	68	14-18	14-18	0-4	0-18	N
MD 1-1B	Miller Dobson	4/30/2007	5/30/2007	35	20	25	27	0-4	0-4	0-4	0-10	N
MD 1-2B	Miller Dobson	4/30/2007	5/30/2007	5	5	3	4	0-4	0-4	0-4		N
MD 1-	Miller	4/30/2007	5/30/2007	10	10	5	8	0-4	0-4	0-4		N

3B	Dobson											
MD 1-4B	Miller Dobson	4/30/2007	5/30/2007	5	10	5	7	0-4	0-4	0-4		N
MD 1-5B	Miller Dobson	4/30/2007	5/30/2007	20	20	20	20	0-4	0-4	0-4	0-4	N
MD 2-1A	Miller Dobson	3/27/2007	4/30/2007	1	5	7	4	11-15	10-14	6-10		N
MD 2-2A	Miller Dobson	3/27/2007	4/30/2007	5	5	5	5	16-20	16-20	12-16		N
MD 2-3A	Miller Dobson	3/27/2007	4/30/2007	5	5	10	7	16-20	16-20	6-10		N
MD 2-4A	Miller Dobson	3/27/2007	4/30/2007	1	2	0	1	16-20	16-20			N
MD 2-5A	Miller Dobson	3/27/2007	4/30/2007	15	15	30	20	0-4	0-4	2-6		N
MD 2-1B	Miller Dobson	4/30/2007	5/30/2007	0	0	2	1			1-5		N
MD 2-2B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 2-3B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 2-4B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 2-5B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 3-1A	Miller Dobson	3/27/2007	4/30/2007	20	15	70	35	0-4	0-4	4-8	0-4	N
MD 3-2A	Miller Dobson	3/27/2007	4/30/2007	5	25	20	17	0-4	0-4	1-5	0-6	N
MD 3-3A	Miller Dobson	3/27/2007	4/30/2007	15	10	7	11	0-4	0-4	0-4		N
MD 3-4A	Miller Dobson	3/27/2007	4/30/2007	25	15	30	23	0-4	0-4	0-4	0-4	N
MD 3-5A	Miller Dobson	3/27/2007	4/30/2007	20	15	25	20	0-4	0-4	1-5	0-4	N
MD 3-1B	Miller Dobson	4/30/2007	5/30/2007	0	1	0	0	4-8	4-8			N
MD 3-2B	Miller Dobson	4/30/2007	5/30/2007	1	2	2	2	4-8	4-8	4-8		N

MD 3-3B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 3-4B	Miller Dobson	4/30/2007	5/30/2007	5	5	5	5	0-4	0-4	0-4		N
MD 3-5B	Miller Dobson	4/30/2007	5/30/2007	5	5	5	5	0-4	0-4	0-4		N
MD 4-1A	Miller Dobson	3/27/2007	4/30/2007	20	20	15	18	0-4	0-4	0-4	0-6	N
MD 4-2A	Miller Dobson	3/27/2007	4/30/2007	5	5	5	5	2-6	0-4	2-6		N
MD 4-3A	Miller Dobson	3/27/2007	4/30/2007	30	20	40	30	8-12	10-14	8-12	6-12	N
MD 4-4A	Miller Dobson	3/27/2007	4/30/2007	60	40	50	50	4-8	4-8	4-8	0-14	N
MD 4-5A	Miller Dobson	3/27/2007	4/30/2007	65	55	55	58	0-4	1-5	1-5	0-18	N
MD 4-1B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 4-2B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 4-3B	Miller Dobson	4/30/2007	5/30/2007	10	5	3	6	0-4	0-4	0-4		N
MD 4-4B	Miller Dobson	4/30/2007	5/30/2007	0	0	2	1			0-4		N
MD 4-5B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 5-1A	Miller Dobson	3/27/2007	4/30/2007	15	10	10	12	10-14	10-14	4-8		N
MD 5-2A	Miller Dobson	3/27/2007	4/30/2007	5	5	10	7	12-16	12-16	8-12		N
MD 5-3A	Miller Dobson	3/27/2007	4/30/2007	0	0	5	2			10-14		N
MD 5-4A	Miller Dobson	3/27/2007	4/30/2007	15	20	25	20	6-10	6-10	4-8	6-12	N
MD 5-5A	Miller Dobson	3/27/2007	4/30/2007	0	0	20	7			10-14		N
MD 5-1B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 5-	Miller	4/30/2007	5/30/2007	0	0	0	0					N

2B	Dobson											
MD 5-3B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 5-4B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 5-5B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 6-1A	Miller Dobson	3/27/2007	4/30/2007	0	0	0	0					N
MD 6-2A	Miller Dobson	3/27/2007	4/30/2007	0	0	0	0					N
MD 6-3A	Miller Dobson	3/27/2007	4/30/2007	0	0	0	0					N
MD 6-4A	Miller Dobson	3/27/2007	4/30/2007	0	0	0	0					N
MD 6-5A	Miller Dobson	3/27/2007	4/30/2007	0	0	0	0					N
MD 6-1B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 6-2B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 6-3B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 6-4B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 6-5B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 7-1A	Miller Dobson	3/27/2007	4/30/2007	5	5	5	5	2-6	2-6	2-6		N
MD 7-2A	Miller Dobson	3/27/2007	4/30/2007	20	20	20	20	2-6	2-6	1-5	2-12	N
MD 7-3A	Miller Dobson	3/27/2007	4/30/2007	10	15	50	25	2-6	4-8	8-12		N
MD 7-4A	Miller Dobson	3/27/2007	4/30/2007	5	5	5	5	0-4	2-6	0-4		N
MD 7-5A	Miller Dobson	3/27/2007	4/30/2007	20	20	30	23	6-10	6-10	4-8	4-14	N
MD 7-1B	Miller Dobson	4/30/2007	5/30/2007	1	0	0	0	6-10				N

MD 7-2B	Miller Dobson	4/30/2007	5/30/2007	0	0	0	0					N
MD 7-3B	Miller Dobson	4/30/2007	5/30/2007	1	1	3	2	12-16	0-4	0-4		N
MD 7-4B	Miller Dobson	4/30/2007	5/30/2007	5	5	5	5	16-20	16-20	16-20		N
MD 7-5B	Miller Dobson	4/30/2007	5/30/2007	2	5	3	3	12-16	10-14	10-14		N
NP 1-1A	North Point	4/18/2007	5/16/2007	15	15	20	17			6-10		N
NP 1-2A	North Point	4/18/2007	5/16/2007	5	2	3	3			4-8		N
NP 1-3A	North Point	4/18/2007	5/16/2007	15	10	10	12			1-5		N
NP 1-4A	North Point	4/18/2007	5/16/2007	10	10	15	12			1-5		N
NP 1-5A	North Point	4/18/2007	5/16/2007	5	10	7	7			1-5		N
NP 1-1B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 1-2B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 1-3B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 1-4B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 1-5B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 2-1A	North Point	4/18/2007	5/16/2007	50	40	50	47	5-9	5-9	4-8	0-12	N
NP 2-2A	North Point	4/18/2007	5/16/2007	35	30	25	30	0-4	0-4	0-4	0-12	N
NP 2-3A	North Point	4/18/2007	5/16/2007	25	25	35	28	10-14	10-14	9-13	0-14	N
NP 2-4A	North Point	4/18/2007	5/16/2007	60	35	35	43	5-9	5-9	4-8	0-16	N
NP 2-5A	North Point	4/18/2007	5/16/2007	20	20	20	20	0-4	0-4	0-4	0-4	N
NP 2-	North Point	5/16/2007	6/22/2007	0	0	0	0					N

1B												
NP 2-2B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 2-3B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 2-4B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 2-5B	North Point	5/16/2007	6/22/2007	0	0	0	0					N
NP 3-1A	North Point	4/18/2007	5/16/2007	70	60	55	62	0-4	0-4	0-4	0-8	N
NP 3-2A	North Point	4/18/2007	5/16/2007	75	75	65	72	0-4	2-6	0-4	0-12	N
NP 3-3A	North Point	4/18/2007	5/16/2007	70	75	80	75	1-5	1-5	1-5	1-20	N
NP 3-4A	North Point	4/18/2007	5/16/2007	45	35	60	47	0-4	2-6	2-6	0-12	N
NP 3-5A	North Point	4/18/2007	5/16/2007	80	80	80	80	2-6	1-5	1-5	0-12	N
NP 4-1A	North Point	4/18/2007	5/16/2007	90	90	80	87	1-5	1-5	0-4	0-20	N
NP 4-2A	North Point	4/18/2007	5/16/2007	90	90	80	87	1-5	2-6	1-5	1-20	N
NP 4-3A	North Point	4/18/2007	5/16/2007	80	80	75	78	0-4	0-4	0-4	0-20	N
NP 4-4A	North Point	4/18/2007	5/16/2007	85	85	75	82	1-5	1-5	0-4	1-20	N
NP 4-5A	North Point	4/18/2007	5/16/2007	90	90	90	90	0-4	0-4	0-4	0-20	N
PP 1-1A	Patuxent Pres.	4/17/2007	5/21/2007	70	75	65	70	5-9	4-8	4-8	2-14	N
PP 1-2A	Patuxent Pres.	4/17/2007	5/21/2007	25	30	40	32	7-11	7-11	7-11	6-16	N
PP 1-3A	Patuxent Pres.	4/17/2007	5/21/2007	25	25	40	30	6-10	6-10	6-10	6-16	N
PP 1-4A	Patuxent Pres.	4/17/2007	5/21/2007	20	20	15	18	10-14	8-12	6-10	5-18	N
PP 1-5A	Patuxent Pres.	4/17/2007	5/21/2007	55	45	55	52	8-12	7-11	4-8	6-15	N

PP 2-1A	Patuxent Pres.	4/17/2007	5/21/2007	100	100	99	100	1-5	1-5	1-5	0-15	N
PP 2-2A	Patuxent Pres.	4/17/2007	5/21/2007	100	99	95	98	1-5	1-5	1-5	0-8	N
PP 2-3A	Patuxent Pres.	4/17/2007	5/21/2007	95	95	95	95	1-5	1-5	1-5	0-18	N
PP 2-4A	Patuxent Pres.	4/17/2007	5/21/2007	100	100	99	100	1-5	1-5	1-5	0-8	N
PP 2-5A	Patuxent Pres.	4/17/2007	5/21/2007	99	100	95	98	1-5	2-6	1-5	0-14	N
PT 1-1A	Port Tobacco 1	3/27/2007	4/25/2007	99	99	95	98	8-12	8-12	6-10	2-20	N
PT 1-2A	Port Tobacco 1	3/27/2007	4/25/2007	99	99	99	99	4-8	4-8	2-6	0-12	N
PT 1-3A	Port Tobacco 1	3/27/2007	4/25/2007	90	95	95	93	6-10	6-10	5-9	1-14	N
PT 1-4A	Port Tobacco 1	3/27/2007	4/25/2007	95	99	95	96	6-10	8-12	6-10	2-20	N
PT 1-5A	Port Tobacco 1	3/27/2007	4/25/2007	85	85	80	83	6-10	8-12	6-10	2-16	N
PT 2-1A	Port Tobacco 1	3/27/2007	4/25/2007	80	90	80	83	1-5	2-6	1-5	1-12	N
PT 2-2A	Port Tobacco 1	3/27/2007	4/25/2007	70	70	50	63	1-5	1-5	1-5	0-16	N
PT 2-3A	Port Tobacco 1	3/27/2007	4/25/2007	75	70	70	72	1-5	2-6	1-5	0-10	N
PT 2-4A	Port Tobacco 1	3/27/2007	4/25/2007	50	65	35	50	0-4	1-5	0-4	0-8	N
PT 2-5A	Port Tobacco 1	3/27/2007	4/25/2007	35	35	50	40	2-6	0-4	1-5	0-8	N
PT 3-1A	Port Tobacco 1	3/27/2007	4/25/2007	80	85	65	77	0-4	0-4	1-5	0-10	N
PT 3-2A	Port Tobacco 1	3/27/2007	4/25/2007	95	95	85	92	2-6	2-6	2-6	0-12	N
PT 3-3A	Port Tobacco 1	3/27/2007	4/25/2007	95	95	80	90	1-5	1-5	1-5	1-7	N
PT 3-4A	Port Tobacco 1	3/27/2007	4/25/2007	100	100	95	98	3-7	4-8	2-6	0-20	Y
PT 3-	Port Tobacco	3/27/2007	4/25/2007	85	85	70	80	1-5	1-5	1-5	0-17	N

5A	1											
PT 4-1A	Port Tobacco 1	3/27/2007	4/25/2007	20	10	15	15	11-15	10-14	6-10	11-15	N
PT 4-2A	Port Tobacco 1	3/27/2007	4/25/2007	20	15	30	22	7-11	8-12	6-10	7-11	N
PT 4-3A	Port Tobacco 1	3/27/2007	4/25/2007	40	35	50	42	2-6	2-6	1-5	1-6	N
PT 4-4A	Port Tobacco 1	3/27/2007	4/25/2007	15	15	20	17	0-4	0-4	1-5		N
PT 4-5A	Port Tobacco 1	3/27/2007	4/25/2007	5	5	5	5	6-10	8-12	4-8		N
PT 4-1B	Port Tobacco 1	4/25/2007	6/13/2007	35	10	55	33	16-20	6-10	12-16	16-20	Y
PT 4-2B	Port Tobacco 1	4/25/2007	6/13/2007	35	35	50	40	6-10	6-10	4-8	6-12	N
PT 4-3B	Port Tobacco 1	4/25/2007	6/13/2007	20	20	35	25	0-4	0-4	0-4	0-4	N
PT 4-4B	Port Tobacco 1	4/25/2007	6/13/2007	25	25	40	30	0-4	10-14	8-12	0-18	Y
PT 4-5B	Port Tobacco 1	4/25/2007	6/13/2007	45	50	75	57	4-8	4-8	4-8	2-12	N
PT 5-1A	Port Tobacco 1	3/27/2007	4/25/2007	85	80	75	80	3-7	3-7	2-6	0-10	N
PT 5-2A	Port Tobacco 1	3/27/2007	4/25/2007	30	30	25	28	1-5	1-5	1-5	1-8	N
PT 5-3A	Port Tobacco 1	3/27/2007	4/25/2007	65	65	70	67	3-7	2-6	2-6	1-10	N
PT 5-4A	Port Tobacco 1	3/27/2007	4/25/2007	40	35	40	38	1-5	1-5	1-5	1-8	N
PT 5-5A	Port Tobacco 1	3/27/2007	4/25/2007	85	80	75	80	2-6	2-6	2-6	1-12	N
RP 1-1A	Rum Pointe	4/10/2007	5/9/2007	1	2	2	2	8-12	8-12	6-10		N
RP 1-2A	Rum Pointe	4/10/2007	5/9/2007	0	0	3	1			8-12		N
RP 1-3A	Rum Pointe	4/10/2007	5/9/2007	0	0	2	1			8-12		N
RP 1-4A	Rum Pointe	4/10/2007	5/9/2007	0	0	3	1			6-10		N

RP 1-5A	Rum Pointe	4/10/2007	5/9/2007	0	0	10	3			8-12		N
RP 1-1B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 1-2B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 1-3B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 1-4B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 1-5B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 2-1A	Rum Pointe	4/10/2007	5/9/2007	0	0	0	0					N
RP 2-2A	Rum Pointe	4/10/2007	5/9/2007	0	0	0	0					N
RP 2-3A	Rum Pointe	4/10/2007	5/9/2007	0	0	0	0					N
RP 2-4A	Rum Pointe	4/10/2007	5/9/2007	0	0	0	0					N
RP 2-5A	Rum Pointe	4/10/2007	5/9/2007	0	0	0	0					N
RP 2-1B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 2-2B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 2-3B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 2-4B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
RP 2-5B	Rum Pointe	5/9/2007	6/5/2007	0	0	0	0					N
UB 1-1A	Union Bridge	4/11/2007	5/9/2007	65	60	60	62	0-4	0-4	0-4	0-7	N
UB 1-2A	Union Bridge	4/11/2007	5/9/2007	70	70	65	68	0-4	0-4	0-4	0-6	N
UB 1-3A	Union Bridge	4/11/2007	5/9/2007	60	60	65	62	0-4	0-4	0-4	0-4	N
UB 1-	Union Bridge	4/11/2007	5/9/2007	75	75	70	73	0-4	0-4	0-4	0-4	N

4A												
UB 1-5A	Union Bridge	4/11/2007	5/9/2007	80	85	80	82	0-4	0-4	0-4	0-10	N
UB 2-1A	Union Bridge	4/11/2007	5/9/2007	85	85	75	82	0-4	0-4	0-4	0-14	N
UB 2-2A	Union Bridge	4/11/2007	5/9/2007	85	85	95	88	0-4	0-4	0-4	0-18	N
UB 2-3A	Union Bridge	4/11/2007	5/9/2007	80	80	80	80	0-4	0-4	0-4	0-16	N
UB 2-4A	Union Bridge	4/11/2007	5/9/2007	60	65	45	57	0-4	0-4	0-4	0-8	N
UB 2-5A	Union Bridge	4/11/2007	5/9/2007	75	70	70	72	0-4	0-4	0-4	0-16	N
UB 3-1A	Union Bridge	4/11/2007	5/9/2007	85	85	90	87	0-4	0-4	0-4	0-8	N
UB 3-2A	Union Bridge	4/11/2007	5/9/2007	98	95	95	96	0-4	0-4	0-4	0-20	N
UB 3-3A	Union Bridge	4/11/2007	5/9/2007	90	90	95	92	0-4	0-4	0-4	0-20	N
UB 3-4A	Union Bridge	4/11/2007	5/9/2007	99	95	95	96	0-4	0-4	0-4	0-8	N
UB 3-5A	Union Bridge	4/11/2007	5/9/2007	95	95	95	95	0-4	0-4	0-4	0-16	N
UB 4-1A	Union Bridge	4/11/2007	5/9/2007	40	40	45	42	0-4	0-4	0-4	0-6	N
UB 4-2A	Union Bridge	4/11/2007	5/9/2007	15	15	20	17	0-4	0-4	0-4		N
UB 4-3A	Union Bridge	4/11/2007	5/9/2007	30	25	30	28	1-5	0-4	1-5	1-5	N
UB 4-4A	Union Bridge	4/11/2007	5/9/2007	40	40	40	40	0-4	0-4	0-4	0-4	N
UB 4-5A	Union Bridge	4/11/2007	5/9/2007	45	35	45	42	0-4	0-4	0-4	0-4	N
WI 1-1A	Wye Island	4/5/2007	5/7/2007	35	30	40	35	2-6	2-6	2-6	2-12	Y
WI 1-2A	Wye Island	4/5/2007	5/7/2007	15	20	20	18	2-6	2-6	1-5	0-8	N
WI 1-3A	Wye Island	4/5/2007	5/7/2007	35	25	40	33	0-4	0-4	1-5	0-10	N

WI 1-4A	Wye Island	4/5/2007	5/7/2007	30	25	35	30	2-6	4-8	1-5	0-10	N
WI 1-5A	Wye Island	4/5/2007	5/7/2007	35	25	50	37	1-5	0-4	2-6	0-8	N
WI 2-1A	Wye Island	4/5/2007	5/7/2007	50	70	50	57	2-6	1-5	1-5	1-13	N
WI 2-2A	Wye Island	4/5/2007	5/7/2007	30	40	35	35	2-6	3-7	1-5	2-13	N
WI 2-3A	Wye Island	4/5/2007	5/7/2007	65	75	55	65	4-8	0-4	1-5	0-13	N
WI 2-4A	Wye Island	4/5/2007	5/7/2007	45	45	35	42	2-6	2-6	2-6	0-14	N
WI 2-5A	Wye Island	4/5/2007	5/7/2007	75	80	60	72	2-6	2-6	1-5	1-10	N