INTRODUCTORY NOTES

This monitoring manual shows how to quantitatively monitor a created/restored/enhanced wetland performance as a natural wetland, and how natural succession is progressing. It is important to remember that a created wetland will not even slightly resemble a natural wetland (in function) in a few years. What is most important during the 5 year monitoring period is that:

1. The wetland has adequate hydrology (but not so wet that few species survive),
2. The vegetation is naturally succeeding at an acceptable density and species competition, without an abundance of invasive exotic species, and
3. The wetland has nutrient rich organic material is accumulating in the soil.

During this time, hydrology may be slightly altered with drainage control pipes, invasive vegetation may be removed, and more desired vegetation may be planted.

Wetland creation is an art, not a science. This is why during the monitoring period quantitative data is important, but qualitative observations incorporate the bigger picture. Maybe over half of the planted vegetation died, but natural succession compensated for the loss with different non-exotic wetland plant species. Does that make the wetland a failure? No, the wetland is naturally revegetating and adapting to current conditions. This is what project managers and scientists want to occur.

The key to an effective monitoring program that will result in the most representative data is flexibility. If the monitoring is taken seriously with flexibility, monitoring can be extremely beneficial in following changes over time. The protocol, however, may need to be modified and customized to the site. This is more probable in years 4 and 5 of monitoring, when the vegetation may be too dense to monitor a transect line. The alternate sampling method could be the use of quadrats (See Chapter 4). While it would be nice to have protocol that applies to every situation and every site, it is not real life. Customization of protocol to certain sites is necessary to collect representative data. This must be incorporated into any monitoring program.

Wetland creations could be compared to organ transplants. While an organ may be transplanted into a recipient's body, it may not work exactly the same as the one removed. The goal is for it to function effectively and efficiently. Hopefully, the host's body will allow the organ to operate, (although it is new and different), and eventually accept the organ as a natural part of the body. The medical scientists may need to help the receiver's body accept the organ as wetland scientists may need to help the ecosystem accept the wetland. Both take time with close monitoring and possible alterations/modifications to be accepted as a natural part of the system. Just as the organ evolves into the bodily systems, so the wetland evolves into the natural ecological systems.

CHAPTER 1: INTRODUCTION

This manual is intended to provide guidance in the application of monitoring procedures for features of created, restored, and enhanced wetlands. This does not mean that the methodology described in this document is limited in use to only recently established wetlands. It has become increasingly important to measure the physical attributes of existing wetlands. Increased population pressure, urban sprawl, transportation infrastructures, and agricultural practices have caused scientist to look ever closer at the role wetlands play in preserving water quality and aquatic ecosystems. By monitoring the condition of natural and created wetlands over time we will better understand how wetland ecosystems function and what we can do to successfully restore them.

There has been and continues to be very little information available on the status of created wetlands (Kusler and Kentula, 1989). A review of the EPA National Directory of Volunteer Environmental Monitoring Programs shows that out of a handful of programs that monitor wetlands, only two programs in the United States are dedicated to using volunteers to monitor created wetlands. The information the Nontidal Wetlands and Waterways Division collects is important in establishing a basis for evaluating created wetlands. The support of citizen monitors is critical for the successful compilation of data contributing to the science and art of wetland creation.

Wetlands provide vital functions that contribute to the health of the environment we live in and thus have associated values to society. Disappearance of wetlands from the physical landscape is well documented. To address the problem of wetlands protection, a National Wetlands Policy Forum was held in 1988, the Forum issued a report that called for a policy of "no net loss" of wetlands. During President Bush's administration the findings from the National Wetlands Policy Forum were adopted in the form of an Implementation Plan. Federal and State wetland regulations can require compensation for impacts that result in wetland destruction or degradation.

Compensatory wetland mitigation is the requirement that wetland impacts be offset by creating new wetlands. Wetland mitigation is required of permittees whose construction projects that exceed regulatory thresholds for impacts to natural wetlands. Thresholds are established for size and the significance of the proposed impact to the natural wetland. Created wetlands are typically built to compensate for the loss of natural wetlands and are designed to meet certain performance standards that are meant to “jump start” the site in terms of succession. Long term monitoring of these sites is the only way we can judge if the performance standards established truly assist wetlands in maturing at faster rates, and if the created wetlands are maturing into self sustaining wetland ecosystems.

The importance of the information collected by this program can be emphasized by the general conclusions made by Jon Kusler and Mary Kentula in their book, Wetland Creation and

Restoration: The Status of the Science, 1989. One of the findings in their book was that, "Monitoring of wetland restoration and creation projects has been uncommon." There is a demonstrated need for long term monitoring of created wetlands in order to judge performance, identify problems, and contribute vital information supportive of restoration science.

A strong emphasis has been placed on reviving community participation in the monitoring of natural resources. With State and Federal budgets stretched to the limit, the practical alternative is to empower the citizenry to be actively involved in the management of our natural resources. Here is an opportunity to be involved in a unique program to monitor newly created wetlands. Citizen volunteers have demonstrated the ability to collect valuable data in support of State water quality monitoring programs. Volunteers have been used during the last 15 years to collect data and assist in reporting the health of our Nation's waters. Created wetlands offer a chance to learn about land restoration and the role wetlands play in helping protect water quality.

This manual is primarily designed to provide guidance in wetland mitigation monitoring procedures for use by volunteers. Methodologies and techniques for monitoring created wetlands performance are based on the Interagency Mitigation Task Force (IMTF) guidance document drafted August 1994. There are many methods of sampling and monitoring different aspects of the wetland biological community. Standardized sampling methods and site monitoring schedules were developed in this manual to provide uniformity in site monitoring reports. This manual is for wetland resource managers, consultants, and citizen volunteer monitors to use in gathering field information vital to the collective knowledge of wetland creation.

Scope of the Mitigation Monitoring Program

The Chesapeake Bay watershed is at risk to development and related causes of nonpoint source pollution. The problem is immense when consideration is given to the 64,000 square mile Bay watershed. The State of Maryland Nontidal Wetlands Protection Act was enacted in 1989 with a statutory goal of obtaining a “no net loss” of nontidal wetland acreage and function, and a requirement for the State to strive for a net resource gain. Full implementation of the Act commenced on January 1, 1991. “No net loss” was to be obtained through an evaluation of activities and whether or not wetland impacts could be avoided, or avoidance was not practicable, then minimization of impacts. Only impacts found to be unavoidable and necessary are authorized. Losses that are authorized are required to be mitigated for in terms of replacing lost acreage and function, either through requirements imposed on permittees, or for small impacts by the State in programmatic mitigation. Mitigation is usually in the form of creation, restoration, or enhancement of nontidal wetlands, or by other methods such as monetary compensation if the former methods are not feasible.

Regulatory programs rarely prohibit the loss of wetlands, and with increasing development within the Bay watershed, continued loss of some wetlands is unavoidable (Mitigation Technical Guidance of Chesapeake Bay Wetlands, 1994). Mitigation for wetland loss in the form of wetland creation has become the most common practice. Regulations pertaining to what is considered acceptable wetlands creation require yearly monitoring of the site. Wetland creation success is based on attaining 85% vegetative cover after 5 years for planted vegetation including naturally occurring vegetation that meets wetlands criteria and diversity requirements (COMAR 26.33.04) and having saturated, ponded, or flooded soils for a sufficient duration.

The Maryland Department of the Environment (MDE) Water Management Administration (WMA) has organized and implemented a citizen-based nontidal wetland mitigation monitoring program. This program includes the development of a monitoring manual and training seminars. Volunteers will be trained to collect baseline data on vegetation density and groundwater elevations on State developed programmatic wetland mitigation sites. Information gathered form this study will provide resource managers with quantitative site specific data for direct comparison with established performance standards. Sites will incorporate data gathered over a five year period based on established observation points to document wetland maturation. This project is proposed to cover two growing seasons April, 1995 through October, 1996 after which this program is to be a volunteer initiative.

This project proposes to provide data, collected by volunteers, which will describe the extent and condition of State created wetlands and relative degree of success as related to established performance standards for nine mitigation sites. Volunteers will gain important insight to the functions and associated values wetlands perform through on site monitoring of created wetlands. Development of a self sustained volunteer monitoring program that incorporates further education, research, membership recruitment, volunteer training, and developed quality assurance (QA) and quality control (QC) measures to be applied in the performance evaluation of created wetlands.

Objectives

The specific objectives of this project are to: 1) develop a nontidal wetland mitigation monitoring manual for volunteer training; 2) conduct training workshops on sampling protocol; 3) establish baselines, transects, and monitoring well locations for each monitoring site, of which should be included in the site descriptions; 4) coordinate scheduling of volunteer field crews and data collection; 5) develop data base and reporting format; 6) Produce an annual report.

Data Usage

Created wetland monitoring data will be used to:
1) Establish baseline conditions of created wetlands.
2) Monitor performance standards for five years.
3) Advise resource managers of remedial actions.
4) Aid in the review and revision of performance criteria and design guidelines for wetland mitigation projects.
5) Promote community stewardship of wetlands by training volunteers to monitor mitigation

sites.

6) Fulfill State monitoring requirement.

Manual Organization

There are nine chapters in this manual. Each chapter contributes to a well rounded understanding of the program goals. The first three chapters supply background information essential to the understanding of the physical elements that combine to make a wetland. Chapters four through seven discuss step by step monitoring procedures. The remaining chapters and appendices support the body of this manual and provide guidance in training volunteers.

Chapter 1: Introduction

Foreword to why volunteer monitoring is important to this program. This chapter discusses the objective and scope of this program and how the data is to be used.

Chapter 2: What is a Wetland?

This chapter introduces the concept of nontidal wetlands and the elements that contribute to their diversity. Descriptions of the different types of wetlands and the functions and values associated with them.

Chapter 3: What is Wetland Mitigation?

This chapter defines and describes the physical characteristics associated with created wetlands and construction techniques.

Chapters 4 through 7: Monitoring Vegetation Density; Monitoring Hydrology; Monitoring Soils; and Monitoring Other Conditions.

These chapters cover the monitoring procedures recommended by the Interagency Mitigation Task Force. Monitoring techniques and vegetation identification are discussed in detail. The monitoring portions of each chapter are presented in outline form.

Chapter 8: Training Volunteers

This chapter provides guidance for the training and instruction of volunteers in sampling methodologies.

Chapter 9: Performance Standards

Wetland mitigation performance standards developed by the Interagency Mitigation Task Force and the Nontidal Wetlands Act are outlined. Guidance for data interpretation is provided.

Appendices

Glossary of Terms

Biological community
Compensatory wetland mitigation
Created wetland
Functions
Interagency Mitigation Task Force (IMTF)
Landscape
Performance standards
Programmatic wetland mitigation
Quantitative
Restoration
Values
Water quality
Wetland mitigation

REFERENCES

COMAR. Code of Maryland Regulations. Title 26, Department of the Environment; Subtitle 33, Water Management Administration; Chapter 04, Nontidal Wetlands.

Kusler,J.A. and M.E. Kentula,eds. 1989a. Wetland Creation and Restoration: The Status of the Science. Volume I: Regional Reviews. U.S. Environmental Protection Agency, Environmental Research Laboratory, Corvallis, OR. 473 pp.

USEPA. 1993. Volunteer Estuary Monitoring: A Methods Manual. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. EPA 842-B-93-004.

USEPA. 1994. National Directory of Volunteer Environmental Monitoring Programs, Fourth Edition. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. EPA 841-B-94-001.

CHAPTER 2: WHAT IS A WETLAND?

What is a wetland? This question has not been an easy one to answer. Ralph Tiner of the U.S. Fish and Wildlife Service (USFWS) points out in the book Wetlands of Maryland, "That despite continued debate over what should constitute a wetland from the regulatory perspective, there is much agreement on what is a wetland among knowledgeable scientists." Wetlands are not a singular land form, there are many types of wetlands. The word wetland implies the association of water and land, which to a scientific degree has been explained as areas of land that are either flooded or have soils that are saturated near the surface of the land for varying periods of time during the growing season. The presence of water in these areas, often referred to as hydrology, helps create environmental conditions that influence the types of soils, plants, and animals living there.

A variety of wetlands exist, however two basic types of wetlands are commonly recognized: (1) tidal wetlands and (2) nontidal wetlands. Nontidal wetlands found in Maryland are most commonly inland freshwater areas not subject to tidal influence. They are typically areas where the water table is at or near the surface, or the land is covered by shallow water. Nontidal wetlands in Maryland can be classified into three common vegetative community types: (1) emergent wetlands, (2) scrub shrub wetlands, and (3) forested wetlands (Tiner 1987). The term "nontidal wetlands" encompasses a variety of environments such as marshes and swamps, bottomland hardwood forest, wet meadows, inland bogs and the shallow areas of lakes and ponds. Tidal wetlands are associated with daily fluctuations of water levels driven by the ocean tides. In Maryland tidal wetlands are typically found along the ocean coast, in the Chesapeake Bay estuary, and along the tidal reaches of streams and rivers flowing into the ocean and bay.

What are the physical characteristics of a wetland?

The physical elements that combine to make a wetland are: soil, water, and plants. Each one of these elements are influenced to some degree by their location in the landscape. One commonly referenced definition of how these elements combine to make a wetland is: Surface or ground water that resides long enough at a location to deplete the soil of oxygen during the growing season and thus supports plant communities dominated by vegetation adapted to saturated soil conditions. What does all this mean? Let us take a closer look at the three main elements of this definition and the role they play in forming a wetland.

We know from the vast amount of research supporting the definition of what a wetland is, that one definition many not support all assumptions. Among scientists it is pretty well acknowledged what elements contribute to making a wetland, however as you explore the world of wetlands you will find many definitions that have been developed to provide guidance for regulatory programs. We know that wetlands occur in the landscape many times as a buffer between uplands and some type of water body (i.e. river, lake, ocean). Figure 2.1 shows a tidal wetland, however, the tidal flooded zone can also resemble a nontidal wetland which receives water from a stream or river flooding. The amount of water an area receives determines the types of plants present. Somewhere between dry and wet environments begins the zone where water, soil, and plants combine to create wetlands.

In a wetland the surface soil can be either inundated (e.g., flooded, ponded) or saturated (like a sponge) for an extended period of time during the growing season. The circulation of water moving through land features, including soil, is known as hydrology. Hydrology is probably the most important determinant for the establishment and maintenance of specific types of wetlands and wetland processes (Mitsch and Gosselink, 1986). Water suppling a wetland can came from a combination of different sources: precipitation (rain or snow), surface runoff, flooding, and ground water. Precipitation will supply a wetland with water either directly or indirectly. We can easily picture rain falling into a wetland. The mystery is how does precipitation get to a wetland indirectly?

During a rainfall event some water is immediately absorbed into the soil surface and then begins to move through the soil particles pulled by gravity down to the water table. However, not all the rain falling to the ground can be readily absorbed by the soil, some of it will move across the soil surface as runoff (sheet flow). In both cases the movement of water on the surface or in the soil follows the path of least resistance and gravity. Surface and ground water flow in most cases mirrors the topography of the land moving from high to low land positions. Is it any wonder that wetlands are most often found in the low lying areas of the landscape: in shallow depressional areas like farm fields, or along river and stream corridors, as outcrops on slopes and at the toe of slopes, and as fringe to water bodies (e.g., pond, lake, ocean).

Flooding events in nontidal wetlands are most commonly associated with river, stream, and tributary systems. <u>Flooding</u> is the condition where the soil surface is covered temporarily by flowing water. It is important to note that in order for hydric soils to form, flooding must occur during the growing season. Many times people see stream <u>floodplains</u> with standing water during the late fall and winter months. They may think that because there is water present at a noticeable depth that it must be a wetland. The presence of water during winter months is common, as ground water is recharged and precipitation events increase. However, plants are dormant during this time of year and the water has little effect on the vegetations' ability to grow.

Ponding is a condition in which water stands in closed depressions. This can be seen in the forested wetland (Figure 2.4) the shallow divots fill with water during the water recharge time of year. Since it is a closed depression water can only be removed by percolation, evaporation, and transpiration. So ponding and flooding are not the same. In Maryland very few wetlands result primarily from overbank flooding; most nontidal wetlands are primarily ground-water induced systems.

Water replaces oxygen in the pore spaces of the soil. Because this soil condition is prolonged (lasting for an extended period through the growing season), soil will actually mature and take on characteristics that many times visibly identify it as a hydric soil (wetland soil). The NRCS

Figure 2.4: Seasonally flooded palustrine forested wetland (Tiner and Burke, 1995)

1994 definition of a hydric soil is one that is formed under conditions of saturation, flooding, or ponding long enough during the growing season to develop anaerobic conditions in the upper part of the soil column. Because of the minimal amount of oxygen in hydric soils during the growing season, plants have to adapt to the lack of oxygen in their root zone. Plants that have adapted to anaerobic soil conditions are called hydrophytes (wetland plants). The wetland vegetative community is determined by climate and wetland hydrology. Wetland plant species are established based on their water regime requirements and on the natural hydroperiod (the seasonal occurrence of flooding and/or soil saturation) of the wetland (van der Valk, 1981).

What are the classifications of nontidal wetlands?

United States Fish and Wildlife Service Wetland Classification was developed by Cowardin et al., 1979 and is described as the following,

> This classification, to be used in a new inventory of wetlands and deep water habitats of the United States, is intended to describe ecological taxa, arrange them in a system useful to resource managers, furnish units for mapping, and provide uniformity of concepts and terms. Wetlands are defined by plants (hydrophytes), soils (hydric soils), and frequency

of flooding. Ecologically related areas of deep water, traditionally not considered wetlands, are included in the classification as deepwater habitats.

Four classes of various systems (marine, estuarine, riverine, lacustrine, and palustrine) are described as the following,

Forested Wetlands are the most abundant type of nontidal wetland in the State of Maryland, consisting of approximately 286,867 acres (Tiner, 1987). Forested wetlands include swamps dominated by trees over 20 feet in height and many wooded floodplains (see Figure 2.4). Common vegetation includes red maple, sweetgum, river birch and ashes. Forested wetlands provide excellent habitat values. Along streams, they help prevent nutrients and sediment from entering the water, and provide shade that helps maintain lower water temperatures critical to trout.

Scrub-Shrub Wetlands include true shrub swamps or wetlands dominated by small trees less than 20 feet in height (see Figure 2.5). True shrub wetlands are relatively uncommon. Some bogs are classified as scrub-shrub wetlands. Plants include alder, buttonbush, dogwood, sweetbay magnolia and spicebush. They provide excellent cover and browse for wildlife. Many shrub wetlands become forested wetlands over time.

Emergent Wetlands are marsh areas characterized by herbaceous vegetation. Common emergent vegetation includes cattails, sedges and rushes. Between the 1950's and 1970's the percentage of emergent wetlands decreased more than any other wetland type.

Aquatic Bed Wetlands are the least common type of vegetated nontidal wetland. They are found in some ponds and areas that are nearly always covered with water. Species may include

Figure 2.5: Emergent wetland (Tiner and Burke, 1995)

herbaceous plants such as spatterdock or pickerelweed. These wetlands are an important water source for plants and wildlife during drought. Waterfowl often use aquatic bed wetlands. (WRA Fact Sheet).

What benefits do nontidal wetlands provide?

The health of the Chesapeake Bay ecosystem is inextricably linked to the abundance and condition of the wetlands in the bay watershed. Nontidal wetlands possess many of the same physical and biological characteristics as tidal wetlands. They perform similar ecological functions which are of value to man. These include:

1) Fish and wildlife habitat (See Figure 2.5)
2) Habitat for rare, threatened and endangered species
3) Erosion control
4) Water quality improvement
5) Stormwater/flood control
6) Contribution of organic (plant) material to the bay food chain
7) Timber production (See Figure 2.6)
8) Education
9) Recreational opportunities and scenic beauty (See Figure 2.7)

Many species of wildlife, particularly waterfowl and other birds, use nontidal wetlands for breeding, wintering and migrating. Valuable fur bearers such as muskrats and beavers also inhabit nontidal wetlands.

Figure 2.5: Hen mallard leading her ducklings at North Point mitigation site (Photo Noble)

Some of the nation's endangered species make their homes in nontidal wetlands or are dependent upon them. The U.S. Fish and Wildlife Service estimates that wetlands provide habitat to 43% percent of all federally listed endangered plant and animal species (U.S. EPA Fact Sheet, 1993). Wetlands provide greenways or connections of undeveloped land along stream corridors that act as migratory paths for wildlife. When critical reproductive areas are filled for development or choked by pollution and excessive nutrients, the population of these bay species will decline. (See Appendix: List of Maryland Threatened / Endangered Species)

Wetland plants are very effective in reducing erosion of streambanks because they have extensive and complex root systems that hold soil in place and reduce sedimentation. Sedimentation decreases the penetration of sunlight needed by submerged aquatic plants and severely impacts reproduction and survival of aquatic life.

The aquatic food chain is dependent upon tidal and nontidal wetlands to provide nourishment for the many fish, shellfish and smaller organisms that spend periods of their lives in the wetland habitat. Organic material, or food (detritus), is produced in the water by the breakdown of wetland plant leaves and stems.

The special characteristics of nontidal wetlands make them particularly important to Marylanders for the following reasons:

Upland runoff water that passes through nontidal wetlands is filtered. This improvement in water quality comes from the nontidal wetland's ability (1) to intercept and retain excess nutrients such as nitrogen and phosphorus compounds and other pollutants, and (2) to trap sediment and reduce suspended solids in the overlying water.

Forested riparian (streamside) wetlands play an important role in reducing nutrient loading into water bodies such as the Chesapeake Bay. In one study, a riparian (streamside) forest in a predominantly agricultural watershed was shown to remove approximately 80% of the phosphorus and 89% of the nitrogen from the water before entering a tributary of the Chesapeake Bay (EPA Wetlands Fact Sheet, 1993).

Potentially damaging volumes of fast moving storm or flood water are temporarily stored in nontidal wetland areas. Saturated wetland soils can also hold large volumes of water like a giant sponge. A one-acre wetland can hold up to 330,000 gallons of water if flooded to a depth of one foot. If wetlands are removed or filled, down stream flood levels will rise and crest much faster (Wetland Protection Workbook, 1991). The gradual release of the water by the wetland minimizes erosion of agricultural fields and urban/suburban property loss.

There is evidence that nontidal wetlands may discharge water to adjacent streams when stream flow is low. Increased ground water base flows during periods of drought can help prevent stream flow levels from becoming too low to support aquatic life. The wetland itself is recharged when the stream level is higher than that of the wetland.

Nontidal wetlands also produce natural crops. The most valued commercial product is timber, an important industry on the Eastern Shore. Common species include Loblolly Pine, Oak and Red Maple. People also harvest crops of blueberries, cranberries and crayfish for individual consumption.

Nontidal wetlands have a natural beauty which has inspired painters and writers for centuries. They are now joined by enthusiasts with cameras and video and sound recorders. Battle Creek Cypress Swamp in Southern Calvert County contains the last remaining stand of bald cypress in central Maryland. These 100-foot tall trees are prized for their beauty.

There is also endless opportunity for recreation such as fishing and waterfowl hunting, as well as hiking, birdwatching, canoeing and other activities (See Figure 2.6). The financial benefit of these wetland-dependent activities to the economy is very significant, and is threatened with increasing nontidal wetland losses.

ECONOMIC IMPACTS OF WATCHABLE WILDLIFE IN MARYLAND

Total number of wildlife viewers in 1991:	2,062,000
Days of recreation:	
observing	87,380,000
photographing	2,132,000
Total wildlife viewing expenditures:	
	$239,041,000
Total trip expenditures in Maryland:	$92,042,000
State residents:	$40,562,000
Visitors:	$51,480,000
Total equipment expenditures in Maryland:	$146,999,000
Total estimated economic impact:	
	$457.9 million
Earning:	$138 million
Employment:	6,800 jobs
Tax Revenues:	
State sales tax	$10.3 million
State income tax	$5.2 million

Federal income tax $17.2 million

*Source: The Economic Benefits of Watchable Wildlife Recreation During 1991 in Maryland. Conducted by Southwick Associates (1996).

Threats to wetlands

Wetlands have been besieged since the first Colonial ships looked for anchorage on American shores. Communities developed next to water bodies that were their sources of transportation, commerce, and food, resulting in loss of nontidal wetlands along major rivers. Harbors were dredged, shorelines became docks, swamps were drained, and out of wilderness we created our cities and towns. According to U.S. Fish and Wildlife statistics over half (53%) of the wetlands in the conterminous United States were lost between the late-1700's and mid-1970's (Dahl, 1990). Today there remains approximately 103 million acres of wetlands (Dahl and Johnson, 1991).

Many threats to wetlands exist today as population pressure drives our land use decisions. Human activity has changed the landscape by clearing, draining, and filling wetlands for agriculture and development. Urbanization has introduced high levels of nutrients, toxics, and sediments into upland runoff. Even thought wetlands have been identified as a potential filter for pollutants, the long term effects of the introduction of substances to these ecosystems have not been determined (EPA Beyond the Estuary, 1990). The irony is that as we continue to learn more about natural systems like nontidal wetlands we recognize the importance of the functions they perform. Some of these functions are designed to be re-created through measures such as stormwater management facilities or wetland creation, restoration, or enhancement projects.

History of Maryland Wetland Regulations

Historically wetlands have been a diminishing natural resource in the American landscape. Estimates of the historical rate of loss for Maryland between 1955 and 1978, show that 24,000 acres of tidal and nontidal wetlands disappeared. Annual losses of these wetlands averaged about 1,000 acres. In Maryland almost two-thirds the natural wetlands that have been lost were related to stream channelization, ditching and agricultural projects (Tiner, 1987). Since the 1970s and 1980s, regulation of wetlands through Section 404 of the Clean Water Act (CWA) has dramatically slowed down the rate at which wetlands have been destroyed. Section 404 regulates placement of dredged or fill material in the “waters of the United States”, which includes wetlands.

The policy slogan of "No net loss of wetlands," was coined by President Bush, however, the Executive Order 11990 signed on May 24, 1977 by President Carter established wetlands protection as the official policy of all federal agencies. The Army Corps of Engineers (COE) administers the Section 404 permit program. Conditions have been drafted into the regulations that require compensation for impacts to wetlands.

The State of Maryland, along with the federal government, Pennsylvania, Virginia and the District of Columbia made a commitment to work with the federal government and each other to protect and preserve the area's nontidal wetlands, thereby adopting the Chesapeake Bay Agreement in 1987. As a result of Maryland's commitment to the bay agreement, a Nontidal Wetlands Task Force was assembled to evaluate options to protect nontidal wetlands in Maryland. The Water Resources Administration in the Department of Natural Resources (now Water Management Administration in the Department of the Environment) provided the principal staff support to the task force.

After six months of concentrated effort, a report was developed and released for further review. The report contained a section entitled "Elements for Possible Inclusion In A Nontidal Wetlands Statute". This document became the basis for the Nontidal Wetlands Protection Act which was passed by the Maryland Legislature in April 1989.

The Department of the Environment has been required by the Protection Act to establish a statewide program for the conservation, enhancement, regulation, creation, and monitoring of nontidal wetlands in Maryland. The stated goal is no overall net loss of nontidal wetlands acreage and function. Since January 1, 1991, all activities in nontidal wetlands require a nontidal wetlands permit or a letter of authorization, unless exempted by regulation. If impacts to nontidal wetlands exceed size limits set by State regulations (usually 5000 square feet) then wetland mitigation may be required of permittees.

Mitigation is the creation, restoration, or enhancement of, nontidal wetlands that were, or will be lost, due to regulated or agricultural activities. Creation is the establishment of nontidal wetlands on an upland site. Restoration is establishing nontidal wetlands on former nontidal wetlands sites. Enhancement is the additional protection of, or functional improvement of a nontidal wetland.

Glossary of Terms

Anaerobic
Bog
Bottomland hardwood forest
Buffer
Detritus
Ecosystem
Erosion
Endangered species
Flooding
Floodplains
Food chain
Forested wetlands
Ground water
Habitat
Herbaceous plant (herb)
Hydric soil
Hydrology
Hydroperiod
Hydrophyte
Mitigation
Nitrogen
Nontidal wetland
Nutrients
Phosphorus
Scrub-shrub
Sediment
Sedimentation
Tidal wetland
Water quality
Watershed
Water table

REFERENCES

Cowardin, L., M., V. Carterm F,C. Golet, and E.T. LaRoe, 1979, *Classificationof Wetlands and Deepwater Habitats of the United States*, U.S. Fish & Wildlife Service Pub. FWS/OBS-79/31, Washington, D.C., 103p.

Dahl,T.E. 1990. Wetlands losses in the United States 1780's to 1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 21 pp.

Dahl,T.E. and C.E. Johnson. 1991. Status and Trends of Wetlands in the Conterminous United States, Mid-1970's to Mid-1980's. U.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C. 28 pp.

Environmental Law Institute. 1992. Wetlands Protection Workbook. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. Washington, D.C. 162 pp.

Maryland Department of Natural Resources, Water Resource Administration. 1991. All About: The Values of Nontidal Wetlands. Fact sheet. Annapolis, MD.

Maryland Department of Natural Resources, Water Resource Administration. 1991. All About: The Nontidal Wetlands Protection Program. Fact sheet. Annapolis, MD.

Mitsch, W.T., and J.G. Gosselink. 1986. Wetlands. In: Natural Wetlands and Urban Stormwater: Potential impacts and Management. 1993, ed. U.S. Environmental Protection Agency, Office of Water, 843-R-001.

Tiner,R.W., JR. 1987. Mid-Atlantic Wetlands: A Disappearing Natural Treasure. U.S. Fish and Wildlife Service, Region 5, National Wetlands Inventory, Newton Corner, MA and U.S. Environmental Protection Agency, Region III, Philadelphia, PA. Cooperative publication. 28 pp.

Tiner, R.W., and D.G. Burke. 1995. Wetlands of Maryland. U.S. Fish and Wildlife Service, Ecological Services, Region 5, Hadley, MA and Maryland Department of Natural Resources, Annapolis, MD. Cooperative publication. 193pp. plus Appendices.

van der Valk,A.G. 1981. Succession in wetlands: A Gleasonian approach. Ecology 62(3): 688-696. In: Natural Wetlands and Urban Stormwater: Potential impacts and Management. 1993, ed. U.S. Environmental Protection Agency, Office of Water, 843-R-001.

USEPA. 1990. Beyond The Estuary: The Importance of Upstream Wetlands in Estuarine Processes. U.S. Environmental Protection Agency, Office of Water. 20W-5003.

USEPA. 1993. EPA Wetland Fact Sheets. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. EPA843-F-93-001e.

CHAPTER 3: WHAT IS WETLAND MITIGATION?

Wetland mitigation as defined by the State of Maryland is the creation, restoration or enhancement of nontidal wetlands that were, or will be lost, due to regulated or agricultural activities (COMAR 26.33.04). Creation is establishing a nontidal wetland on an upland site (land that does not exhibit wetland characteristics). Restoration is establishing nontidal wetlands on former nontidal wetlands sites (e.g., wetlands converted to farm land). Enhancement is providing additional protection to, or improving the functions of, a nontidal wetland (WRA Fact Sheet, 1991).

The Federal Mitigation Sequence

The federal government approaches the mitigation sequence somewhat differently. In the regulatory process, before a wetland is ever established or approved as mitigation for a specific impact, a proposed impact to an existing nontidal wetland must be approved. Even though most of us would prefer that the resource (naturally occurring nontidal wetlands) always be protected, the mitigation process was developed to allow projects that demonstrate socioeconomic benefits with no alternative location available to proceed forward. Existing laws protect nontidal wetlands so that a developer cannot fill a wetland without approval from the state and federal agencies that regulate wetlands. The mitigation process directs applicants with potential wetland impacts (i.e., developers, transportation systems, and industries) through guidelines first proposed by the Council of Environmental Quality (CEQ) in 1978. What is known as the mitigation sequence involves the following:

1) Avoiding the impact altogether by not taking a certain action or parts of an action.
2) Minimizing impacts by limiting the degree or magnitude of the action to its implementation.
3) Rectifying the impact by repairing, rehabilitating, or restoring the affected environment.
4) Reducing or eliminating the impacts over time by preservation and maintenance operations during the life of the action.
5) Compensating for the impact by replacing or providing substitute resources or environments (mitigation).

This sequential process is critical to achieve the no-net-loss of wetlands goal. The State of Maryland modified the sequence to allow consideration of mitigation proposals when the minimum acreage threshold (5000 square feet) is met. Evaluating the mitigation proposal early and independently of avoidance and mitigation helps ensure timely completion of mitigation. The principles of the mitigation process should apply in any proposed project which may result in adverse impacts to wetlands (U.S. EPA, Chesapeake Bay Restoration Program, 1994).

Types of Mitigation

In general there are three activities regarded by the Maryland Department of the Environment as compensatory mitigation for wetland losses (COMAR, 1996).

Restoration is an effort to bring back lost wetland functions and values to a former wetland area that is degraded or has lost many of its functions and values. Former wetlands are most often areas that have been drained so that adequate hydrology is absent.

Creation is the building of a wetland in an upland or other nonwetland area, often by grading to make an area lower in elevation and closer to the groundwater table. The area thus becomes wetter. Creation, if successful, fulfills the goal of no net loss of wetlands by adding new wetlands and functions, but the science of wetlands creation is limited so far in successfully building a well-functioning wetland.

Enhancement means improving upon existing wetland functions and values by such measures as replanting native vegetation, removing exotic invader species, or adding protective buffers around a wetland to protect it from harmful adjacent impacts. Enhancement is similar to restoration but generally less comprehensive, costly, or time consuming. It also does not increase wetland acreage, though there is a gain in wetland function.

Finally, if an applicant finds that it is infeasible to preform wetland mitigation the Department of the Environment may accept monetary compensation. Monetary compensation may only be accepted if the size of the nontidal wetland loss is less that 1 acre, it is technically infeasible to create a similar replacement wetland, and the Department recommends the use of the Compensation Fund. The Nontidal Wetland Compensation Fund takes this money and uses it for creation, restoration, and enhancement of nontidal wetlands. The projects you will be monitoring have been created from the Nontidal Wetland Compensation Fund (COMAR., 26.33.04).

Mitigation requirements

Maryland has adopted the goal of achieving no net loss of its nontidal wetland resources. Thus, any loss of nontidal wetlands regulated under state law must be offset by mitigation. Nontidal wetland losses shall be replaced by creating, restoring or enhancing nontidal wetlands at the following ratios:

Note: Acreage replacement ratios are expressed as a relationship between two numbers. The first number specifies the acreage of nontidal wetlands to be mitigated (e.g., created or restored) and the second represents the acreage of nontidal wetlands lost.

1.5:1 Emergent nontidal wetlands
Farmed nontidal wetlands

3:1 Scrub-shrub and forested nontidal wetlands
Emergent nontidal wetlands of special state concern

4.5:1 Scrub-shrub and forested nontidal wetlands of special state concern

4.5:1 Mitigation banking requirement if no other options are found

Creating Wetlands

The physical components of creating wetlands like you will be monitoring revolve around the three characteristics associated with the definition of wetlands. The components of wetlands being: hydrology, soils, and vegetation. Hydrology can be considered the driving mechanism behind the changes that occur in wetland soils and plants (Gosselink and Turner, 1978).

The construction of a wetland appears simple in principle but we must be aware of the challenges in trying to recreate a natural ecosystem. The location of the wetland creation site is probably the most critical factor in the sites potential success. Location is a determinant for potential hydrological sources, either surface waters and or groundwater. Prior to the start of the Maryland program, site suitability was not always based on attributes favorable to successful mitigation. For example, some sites required extensive excavation, and resembled an artificial "bowl" in the landscape rather than a natural feature blending with the surrounding landscape. Land cost along with the lack of available mitigation sites can be constraints. In a perfect world a site would be selected based on physical location in the landscape, and the potential for connection with and contribution to a hydrologic system (surface and / or ground water).

Wetland ecosystems are closely coupled with terrestrial and aquatic systems (Nixon and Oviatt, 1973; Likens and Bormann, 1974; Mulholland and Kuenzler, 1979; Brinson et al., 1981; Odum et al., 1984). Transport mechanisms, such as water, animals, wind, and people control the flow of materials and energy across the ecosystem boundaries within a landscape (Froman and Godson, 1986). While much remains unknown about these linkages, integrating information derived from landscape-level analysis into regulatory programs is critical if the mitigation sequence is to have ecological meaning (U.S. EPA, Chesapeake Bay Restoration Program, 1994).

Construction

The typical scenario in the construction sequence for wetland mitigation sites starts long before any earth work (grading) is done. A potential mitigation site is identified by the criteria used in the previous section. Ground water monitoring wells are installed (See Figure 3.1) in order to track the elevation of seasonal fluctuations in the water table. If the site is surface water dependent, stream gages may be employed to determine periods of high water. Site design is based on the type of wetland to be created and the associated hydrology. The site grading (See Figure 3.2) will be based on the data collected from the ground water wells or surface water gauges and the site design requirements.

After grading, soils are typically amended (supplemented) with either topsoil, hydric soils from the impacted wetland, or some organic soil component. The final grade (surface elevation) of a site will allow the soils to be inundated or saturated during some portion of the growing season. Final surface elevations are surveyed and shown on plans (as-built plans) when the site is completed.

Figure 3.1: Groundwater monitoring well used before construction and also through monitoring after construction (photo Noble)

Plant stock selected for installation at the site is based on several factors. Plants are selected to complement the plant communities found in adjacent wetlands. A diversity of plant types may be supplemented and will reflect the type of wetland being created. Plant stock is supplied by nurseries that specialize in growing wetland plants, when plants are grown in a wet environment they are known as "wet cultured" plants. The plants are available in three different forms; bare root, containerized, and balled & burlapped. The bare root plants are just as they sound; just the plant without soil. The containerized plants come in a potting container which is removed before planting. The balled & burlapped plants are removed from the ground with the surrounding soil and the root base is covered in burlap to keep the soil with the roots. The planting pit size differs depending on how the plant is purchased; obviously a larger pit would be needed for the balled & burlapped than the bare root plants. Finally, the plants are installed usually during early spring or late fall (periods of low biological activity) in order to lessen shock or stress to the plants (survival ratios are usually higher).

A newly created wetland will appear many times to look like anything but a wetland (Keiler, 1991). Given time the site will slowly mature to reflect the hydrologic regime and plant types associated with it. While certain plants have been installed, there is no guarantee that these plants will be the dominate plants of the site. <u>Volunteer plants</u> or vegetation that was not planted often begin to propagate in mitigation sites, and will begin the slow process of natural revegetation. We plant sites to "jump start" them ecologically, by planting knowing full well that the dynamic properties associated with wetlands will develop with time a balance between the planted and volunteer vegetation.

Figure 3.2: Grading at Thompson Mitigation Site in Talbot County. (photo Beston)

Figure 3.3: Photo of the Robinson Tract wetland during planting

Glossary of Terms

Compensatory Mitigation
Creation
Enhancement
Preservation
Restoration
Mitigation

REFERENCES

Brinson,M.M. et. al, 1981. "Riparian Ecosystems: Their Ecology and Status." FWS/OBS-81/17. U.S. Fish and Wildlife Service, Kearneysville, WV. 154 pp.

Chesapeake Bay Wetlands Workgroup. 1994. Mitigation Technical Guidance for Chesapeake Bay Wetlands. Living Resources Subcommittee, Chesapeake Bay Restoration Program, U.S. Environmental Protection Agency. Annapolis, MD. 64 pp.

Environmental Law Institute. 1992. Wetlands Protection Workbook. U.S. Environmental Protection Agency, Office of Wetlands, Oceans, and Watersheds. Washington, D.C. 162 pp.

Forman, R.R.R. and M. Godson. 1986. Landscape Ecology. John Wiley and Sons, New York, NY. 619 pp.

Gosselink,J.G. and R.E.Turner. 1978. The role of hydrology in freshwater wetland ecosystems. In: Freshwater Wetlands - Ecological Processes and Management Potential (R.E. Good,D.F. Whigham, and R.L. Simpson, eds.). Academic Press, NY, NY. 378 pp. Adopted from: Mitigation Technical Guidance for Chesapeake Bay Wetlands. 64 pp.

Likens,G.E. and F.H. Borman. 1974. Linkages between terrestrial and aquatic ecosystems. In: BioScience. 24:447-456.

Mulholland,P.J. and E.J. Kuenzler. 1979. Organic carbon export from upland and forested wetland watersheds. In: Limnology and Oceanography. 24:960-966.

Nixon,S.W. and C.A. Oviatt. 1973. Ecology of a New England salt marsh. In: Ecological Monographs. 43:463-498.

Odum, W.E., et. al., 1984 The Ecology of Tidal Freshwater Marshes of the United States East Coast: A Community Profile. FWS/OBS-83/17. U.S. Fish and Wildlife Service, Washington, D.C. 177 pp.

Renner,J., 1994. Letter to the Editors. Society of Wetland Scientists Bulletin. Vol. 11, No. 5.

CHAPTER 4: VEGETATION MONITORING

An introduction to wetland plants and why we monitor them is appropriate at this time. The three physical indicators that are typically used in identifying wetlands are vegetation, soils, and hydrology. Of these three indicators for wetlands, plant dominance and vegetation density are used to evaluate mitigation vegetation performance. Studies have shown that mitigation sites without sufficient plant biomass (editors note, one measure of biomass is vegetation density) support low populations of fish and wildlife and provide insignificant water quality functions (i.e., nutrient removal, sediment deposition) (IMTF Guidance, 1994). The performance standard for created wetlands is to achieve 85% or greater wetland vegetative cover by the end of five years (COMAR, 1994).

What makes wetland plants so unique? We can start by looking at the definition of hydrophytic vegetation (wetland plants). Hydrophytic vegetation are plants adapted for life in water or periodically flooded or saturated soils (hydric soils) that are deficient in oxygen during some portion of the growing season (adapted from COE, EPA, and COMAR). Plants growing in wetlands may occur there either because they are adapted to the conditions of that habitat or because they are able to tolerate the wetland conditions (MD DNR Tidewater Administration, 1986). It will be important to remember that when monitoring vegetation, a tally must indicate which plants are considered "wetland" plants and which plants typically live under drier conditions. A successful mitigation site has, among other characteristics, a predominance of wetland vegetation verses upland vegetation.

Learning plant identification skills can be a fun and challenging endeavor. The types of plants we find most often in wetlands can sometimes be found in uplands. You might ask, how can that be? Plant (populations) over time adapt to the environmental conditions that affect them (through the process of natural selection), if the conditions are too harsh the plants will not survive. When the plant (population) has had time, perhaps generations to adapt to specific environmental conditions certain physical characteristics may also change. "Plant populations, when faced with an environmental change will be 'weeded out' if you will, the individual plants that have the mutation that enables them to survive in this new environment will, the plant population does not intuitively change to their environment, the environment selects the individuals that will survive" (Carroll, 1995). Some wetland plant species are known to adjust to wetland conditions by the following adaptations: morphological (a change in plant form or structure, e.g., once a plant is submerged, the stem will grow rapidly to expand aerobic surface area), physiological (physical and / or chemical adaptation of plant cells and tissue, e.g., development of pore space, which allows oxygen to diffuse to the wetter root systems), or reproductive adaptation (e.g., ability for seed germination under water) (COE Manual, 1987). However, not all species occurring in areas having anaerobic soil conditions exhibit these adaptations for such conditions.

There are many limiting factors that contribute to the location a plant occurs in. The most

important factor for the field person to be aware of in monitoring created wetlands is that the plants that occur there have adapted themselves to soil, that is inundated or saturated for extended periods of time during the growing season. The lack of hydrophytic vegetation can be an indication that the site is dryer then the anticipated design criteria. A list of the wetland plants used in each programmatic mitigation site can be found in Appendix E. The Coastal Plain encompasses approximately 54% of Maryland, with approximately 94% of Marylands' wetlands. The area covers the Southeastern part of the fall zone across Maryland. A list of the twenty most commonly used woody plants for wetlands creation in Marylands' Coastal Plain follows:
Note: Wetland indicator status was developed by the U.S. Fish and Wildlife Service to classify plants according to the relative affinity of a species for wetlands. Obligate (OBL) Always found in wetlands, greater than 99% of the time these plants occur in wetlands. Facultative Wetland (FACW) usually found in wetlands greater than 66-99% of the time. Facultative (FAC) sometimes found in wetlands 33-66% of the time. Facultative Upland (FACU) seldom found in wetlands less than 33% of the time.

Common Name	Scientific Name	Wetland Indicator
Black Willow	Salix nigra	OBL
Red Maple	Acer rubrum	FAC
Silver Maple	Acer saccharinum	FACW
River Birch	Betula nigra	FACW
Pin Oak	Quercus palustris	FACW
Willow Oak	Quercus phellos	FACW
Green Ash	Fraxinus pennsylvanica	FACW
Black Gum	Nyssa sylvatica	FAC
Water Tupelo	Nyssa biflora	OBL
Sycamore	Platanus occidentalis	FACW
Buttonbush	Cephalanthus occidentalis	OBL
Spicebush	Lindera benzoin	FACW
HB. Blueberry	Vaccinium corymbosum	FACW
N. Arrowwood	Viburnum dentatum	FAC
Sweet Pepperbush	Clenthra alnifolia	FAC
Smooth Alder	Alnus serrulata	OBL
Silky Dogwood	Cornus amomum	FACW
Winterberry	Ilex verticillata	FACW
Box Elder	Acer negundo	FAC
Possum Haw	Virburnum nudum	OBL

Monitoring Concepts

In learning methods to monitor vegetation there are three important concepts that must be recognized. 1) The methods selected for this manual are designed to be simple, 2) monitoring procedures are like a recipe and need to be followed, and 3) the data you collect will only be as accurate as your confidence level in the method you apply. There is no mystery to acquiring the skill to take meaningful measurements in the field if you keep perspective on these concepts.

Why do we monitor wetland mitigation vegetation?

Vegetation monitoring is used to establish plant density (quantity of plants per area) and dominant species (a plant species that exerts a controlling influence on the character of a community). In addition, techniques to measure vegetation are accomplished economically and require minimum training (IMTF Guidance, 1994). There are a number of methods used to determine vegetation density some examples are circular plot sampling, sample quadrats, and transect line surveys (See Figure 4.1). It is important for us to know the overall plant density of newly created wetlands in determining how well these sites mature and whether they are preforming to the standards established. (See section on mitigation performance standards)

Circular Plots	Quadrats	Transect
Identify, count, and measure vegetation inside circular plot.	Can be a circle or square of 1 sq. m. ID, count, measure	Count,measure,ID veg. that touches transect line

These will be discussed in further detail with diagrams later.

How do we monitor vegetation?

Three techniques for gathering field data are utilized by this program in determining vegetation type, density, and health; they are subjective analyses, the transect line method, and the six-foot radius circular plot method.

What is subjective analysis?

Subjective analysis is based on the field monitor's powers of observation; it is a visual assessment. Observations are based on recognizing and noting a fact or occurrence, that can be measured, but often is based on judgement (Webster, 1977). Time in the field greatly increases the observers ability to distinguish plant types and vegetation density patterns. Subjective analysis will be used in emergent sites to determine if plant stem density is equal to or greater than the performance standards. Other than the performance standards, the field monitor must observe the plant conditions (disease, water stress, etc.). This should be used in every monitoring site because there are always observations that are important to note but may not be on the data sheets. Developing skills in plant identification, the ability to recognize different plant communities, and a basic knowledge of the planting plan increase the accuracy of the field data gathered.

So what are transects and six-foot circular radius plots?

The sampling method the field monitors will be using on the wetland mitigation sites is known as the transect method. A transect is a line on the ground along which observations are made. There are two basic techniques we will be using to make observations with the transect line method and they are subjective observations and six-foot circular radius plots. As discussed above, subjective observations are based on experience in recognizing patterns and phenomena occurring in nature. The six-foot circular radius plot methodology relates occurrences of plants within a circular plot to vegetation density and plant dominance. These methods are designed to collect data that is statistically representative of a complete site without having to measure the entire site. For monitoring in emergent sites the subjective method will be used in determining if the plant stem density is equal to or greater than the performance standards. Six-foot circular radius plots located at predetermined intervals along transect lines will be used to monitor forested and scrub-shrub mitigation sites. The establishment of transect lines and the specific usage of sampling methodologies are discussed in detail in the following text.

The transect line

The transect line has been used extensively in the biological monitoring of vegetation. This form of gathering field information is known as systematic sampling by which items are selected at some regular interval along a traverse in a field study. This regular distribution of sample points may be used to produce a map along with statistical analysis (Gregory, 1979).

We have already defined what a transect is, now lets take a closer look at how they are used. In order to establish transect lines the site needs to be oriented lengthwise, then a longitudinal axis (baseline) running through the site and dividing it in half is established and staked in the field (Figure 4.1). The main purpose of the baseline is to give the foundation from which the transects are spaced. The length and orientation of the baseline is related to the shape and size of the mitigation site. Transect lines are then spaced parallel to each other and run perpendicular across the baseline through the monitoring site.

The type of plant community will determine the type of sampling method used (i.e., circular plot, subjective) along the transect line (Figure 4.1). Vegetation density is estimated by using a 12" ruler to compare the vegetation spacing along the transect in emergent zones. Proceeding along the transect line, the area is considered “vegetated” if vegetation spacing is 12" (Figure 4.1) or more dense, and the area is considered “open water” if vegetation spacing is more than 12". Trees and shrubs are actually counted using the six-foot radius circular plot method at predetermined intervals along the transect line.

The circular plot method

The circular plot method is used with trees and shrubs to give a quick method for calculating vegetation density (Figure 4.2). At intervals along the transect, six-foot radius circular plots are established. The presence or absence of vegetation achieving the specified height of **10" or taller** and growing within the circular plot is recorded. Plant identification, dominance and naturally succeeding vegetation are recorded. **Plants less than 10" should also be noted, but**

not counted as IMTF monitoring data. The amount of bare ground or limited vegetation should be noted as well. This is because the desired goal of a newly established wetland is for it to have natural succession occur to provide diversity and dense coverage between the planted or seeded vegetation, not bare ground.

Circular plot vegetation density is computed by an interval system of measurement where the occurrences of the phenomenon are counted and assigned weighted values. All tree and shrub counts are for living plants 10" or taller. Where there are no trees or shrubs the value is "0", if one living tree or shrub is within the plot the value is "1", and if two or more living trees or shrubs are within the plot the value is "2". These values are then used to calculate the vegetation density and cover types.

By recording observations made of plant type combined with measurements gathered from the transect line method, resource managers can determine if the created wetland meets anticipated performance standards.

Wetland plant sampling methods

Pre-site visit information

With all of the procedures we will be discussing, you will find that the initial steps are always the same. It is important to be familiar with the mitigation site. The files will have "as built" mitigation plans, project history, and a planting plan. The planting plan will show the types of plants, number and possibly a planting location. Depending on the size of the site and vegetation used, there may not be a planting plan that was written (See Figure 4.3 for an example of a planting plan). Field guides should be checked so that the monitors are familiar with the plants that will be present. An "as built" mitigation plan is the site plan with all the important features surveyed to verify actual location. This type of survey is done after construction to verify that the project was built as designed.

Location

In setting up a monitoring program with the State programmatic sites, contact MDE to obtain the history, contacts, plans etc. Also, a wavier should be filled out by all monitors that the State is not liable for any accident on site. Be sure you notify the site manager of your plans to be on location to monitor. It is always a good idea and a matter of courtesy to let people know when you will be out on site monitoring (for example the visitors center of a wildlife management area that a site is located). The location where you park and enter the site should be the same each time, and you should verify this with the site manager if it is not clear from the project file. Some of these sites are in sensitive areas and limiting our impact in reaching the site may be an issue.

Equipment

Equipment will need to be maintained. A little preventive maintenance will go a long way when it comes to the water and mud one finds in a wetland. It is proper protocol to wipe mud off a field tape with a rag at the end of the day. This will help prevent corrosion and prolong the life of the equipment. Keep all the equipment together in the field bag when not in use. Rulers, pens, clip boards are all subject to the natural order of the universe (chaos).

When to Monitor

Monitoring is to be done monthly during the growing season. Try to keep to a regular schedule spaced as close to one month apart as possible. Vegetation monitoring, however, should be done only once between May and September of the second, third and fifth growing seasons. We can monitor come rain or shine, however it is strongly recommended that you remain out of the monitoring site during periods of intense weather (that means lighting, tornado, or perfect weather for a trip to Ocean City). Remember that after storm events the water levels in our sites can be significantly higher. Be prepared.

Safety

Your personal safety always comes first. Wetlands can be full of hidden surprises from muskrat holes to ground hornets. Persons should be aware that wetlands can be tick-infested. When working in the field, light colored protective clothing should be worn to make ticks readily visible. Insect or tick repellents should be applied as recommended. In heavily tick-infested areas, pants legs should be tucked into the socks and the junction sealed with masking tape (Southeastern Cooperative Wildlife Disease Study). Protect yourself by wearing the appropriate clothing and be prepared and bring your own first aid kit.

I. Emergent vegetation method

Equipment: Tape measure, 12" ruler, compass, 6' stick, clip board, and plant guide.

The following steps explain how the transect line method is used in identifying two categories: "Vegetated" and "Open Water" in emergent mitigation sites.

1) In transect sampling the field monitor establishes a straight line (transect) across the area to be examined, perpendicular to the baseline. This step may have already been taken for you.

> A) Transect #1 starts 20 feet from one of the longitudinal ends of the wetland. The transects are spaced parallel to each other at 50-foot intervals; each transect crosses the entire width of the wetland and is given a sequential number for identification. Programmatic wetland mitigation sites will have baseline and transects staked in the field.

2) The field monitor walks the transect line looking for living stems in a minimum density of 12" x 12" spacing, which translates to 43,560 living stems per acre along each transect. In walking the transect lines, it should not be expected that there will be uniform spacing along the entire transect. Plants over time may appear to have uneven distribution, yet still have adequate 85% coverage of hydrophytic vegetation. It takes some practice to be able to visually perceive what a 12"x 12" plant stem spacing pattern looks like. Take a look at the following suggestion for determining plant densities.

The field monitor starts at one end of the transect line and proceeds across the emergent zone following the transect line to the other side of the wetland. With a 12" ruler in hand it is very easy to compare the spacing between plants along side the transect line. The stems of the emergent vegetation should be 12" or closer together in order to be considered "vegetated". As you are walking the transect line compare spacing of the plants with your ruler. When the spacing between plants becomes greater than the length of the ruler, stop and measure the distance along the transect you have walked. This is the area considered "vegetated" and that distance measured will be recorded to the nearest 0.5 foot on a data sheet and transferred to the site plan. Where the density of plants is spaced further apart then the length of the ruler (12" inches) this area is considered "open water". (See Data Sheet #1 in Appendix C and Example #1 in Appendix E)

3) The distance along the transect that meets the vegetation density requirements is recorded on the site visit information sheet (See Appendix C). This information will be plotted on the site plan (see figure).

II. Scrub-Shrub and Forested Vegetation

The following method for measuring the success of woody plant colonization should be conducted once between May and September for the five growing seasons following the completion of construction of the wetland.

Equipment: Tape measure, 12" ruler, compass, 6' measuring stick, clip board, and plant guide.

1) In transect sampling the field monitor establishes a straight line (transect) across the area to be examined, perpendicular to the baseline.

A) The first transect is located 20 feet from one of the ends of the baseline. There after the transects are spaced at intervals dependent on the sites' size.

1) If the site is greater than 0.5 acres and less than 5 acres, the transect lines will be spaced 50 feet apart.

2) If the site is greater than or equal to 5 acres, the transect lines will be spaced 75 feet apart.

2) Six-foot radius circular plots are spaced at 50-foot intervals along each transect (See Data Sheet #2 in Appendix C and Example #2 in Appendix E). The presence or absence of living wetland trees and shrubs, achieving the specified height standard (10" inches or greater) and growing within the circular plot is recorded.

Note: The first circular plot for the even-numbered transects is taken on the same side of the wetland (i.e., from the same cardinal direction). The first circular plot for the odd-numbered transects is taken on the opposite side of the wetland. For example: even numbers begin on south side of wetland site, therefore odd numbers begin on north side.

3) The numbered transects and circular plots are depicted on a map of the wetland mitigation site, scale is 1 inch = 100 feet. Circular plot data is recorded on standardized data sheets. The following interval values are used when recording observed woody stock in the circular plots:

"0" = no living tree or shrub over 10" in height is within the plot, however, make note of any.
"1" = one living tree or shrub over 10" in height is within the plot.
"2" = two or more living trees or shrubs over 10" in height are within the plot.

QUADRATS

Quadrats can be 1 meter by 1 meter PVC pipe square that is tossed into the site at random locations. The percent cover is measured as well as the vegetation identified. Quadrats could also be sections staked out in the wetland (5mX5m) that are measured each year by the percent cover and plant identification.

Glossary of Terms

biomass
monitor
plant density
plot center
transect
subjective analysis
Interagency Mitigation Task Force (IMTF)
Wetlands Delineation Manual

REFERENCES

Environmental Laboratory. 1987. "Corps of Engineers Wetlands Delineation Manual." Technical Report Y-87-1, U.S. Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Husch,B., Miller,C.I. and Beers,T.W. Forest Mensuration 2nd Edition, 1972. The Ronald Press Company, New York.

Interagency Mitigation Task Force. August 1994. Maryland Compensatory Mitigation Guidance. Baltimore, MD.

MacDonnell, William P. and Mawson, Joseph C. Basic Forest Measurements - A Laboratory Manual. circa 1972. Forestry Wildlife Management Department, University of Massachusetts.

Southeastern Cooperative Wildlife Disease Study. Ticks, Wildlife, and Lyme Disease in the Southeast. College of Veterinary Medicine. The University of Georgia. Athens, Georgia.

CHAPTER 5: MONITORING HYDROLOGY

A lot of time and effort has gone into establishing the hydrologic sources for a wetland creation site before a plan is ever drafted. Many sources are consulted during the planning process to assure adequate hydrologic input to the site.

Hydrology is the science dealing with the properties, distribution, and circulation of water on the surface of the land, in the soil and underlying rock, and in the atmosphere (Webster, 1977). We are interested in monitoring hydrology because it is considered the driving mechanism required for the formation and maintenance of wetlands (National Research Council, 1995). Fluctuations of water level and the duration of inundation or saturation determine, in part, the composition of plant communities (Erwin 1988). Establishing wetland hydrologic conditions is essential for successful wetlands plant growth and hydric soil development (IMTF 1994).

Inundation of water at the surface can be easily observed and recorded on a map. There are times throughout the year, however, when site visits will not coincide with surface inundation, and when soils are saturated below the surface. Therefore, several shallow wells are commonly installed within a wetland to measure water levels below the surface to depths of 0.5 to 2.0 m, depending on the expected movement of the local water table. Plastic (PVC) pipes with narrow, horizontal slots have been used successfully in numerous projects. These pipes can also be used to measure depths of surface water when standing water is present, or separate staff gauges can be installed (Horner and Raedeke 1989).

I. Hydrology / Groundwater

Equipment: 6' measuring staff, tape measure, clip board, data sheets (see Data Sheets 3,4 in Appendix C).

The way in which a site is created (i.e., graded to groundwater, impounded by diking or blocking drainage) will have a bearing on the type of hydrologic zones created. When we refer to hydrologic zones we mean an area in the created wetland that is capable of supporting specific types of vegetation. Since grading is typically not uniform in a mitigation site, a site may hav several different hydrologic zones in order to mimic natural variations in topography. In general shallow ponded areas are suited to emergent vegetation and saturated soil areas can accommodate scrub-shrub and forested wetland plants. What makes these specific areas wetter or dryer in most cases is the ground elevation they are located at in relation to the groundwater table and surface water elevation.

1. Placement of Groundwater Wells

Hydrologic zones distinguished by a 2-foot change in elevation should have a minimum of one groundwater monitoring well installed. In addition, a hydrologic zone should have a minimum of 1 groundwater well per 4 acres. If a given hydrologic zone occupied a total of 5 acres, at least 2 groundwater wells should be installed. One requirement for placement of groundwater wells applies to emergent zones where wells are to be located in the driest area of that zone.

Guidance for installation of groundwater monitoring wells, prepared by the National Resource Conservation Service (NRCS), is attached. (See Appendix D).

2. Collection of data

The collection of groundwater well data is initiated within 14 Days of the start of the growing season and continues for the first two (full) consecutive growing seasons subsequent to the completion of grading.

Groundwater well readings should be taken once every 14 days for the first two months (60 days) of the growing season, and every 30 days for the remainder of the growing season. Groundwater well readings are recorded to the nearest one inch on data sheets.

II. Hydrology / Surface water

If surface water is evident on the days the groundwater data is being collected, surface water measurements should be taken at the well. If no surface water is present, note that on the data sheet.

The collection of surface water data for the most part will be limited to emergent zones and early season high water in scrub-shrub and forested zones. The following procedures apply to emergent zones.

1. Surface Water Measurements

Water depth measurements are taken along the same transect lines that have been established to monitor vegetation.

Surface water depth measurements are taken at 25-foot intervals along each numbered transect, using a six-foot measuring pole that is marked in one inch increments. The bottom of the measuring pole is equipped with a flat one-foot diameter mesh or plastic disc support, to prevent the pole from sinking into the wetland substrate (mud). (Note: The first measurement for the even-numbered transects shall be taken on the same side of the wetland (i.e., the same cardinal direction). The first measurement for the odd-numbered transects is taken on the opposite side of the wetland. For example, even numbers begin on south side of wetland site, therefore odd numbers begin on north side.)

2. Collection of Data

Surface water depth measurements are recorded every 14 days throughout the first 2 months (60 days) of the growing season after the completion of grading and once every 30 days for the remainder of the growing season (See Data Sheet 4 in Appendix C). For emergent wetlands, the standing water should be a maximum depth of 2.0 feet (IMTF, 1994)(See Chapter 9 on Performance Standards). Therefore, if the depth is more than 2.0 feet, make note on the data sheet without measuring exact depth.

Growing Season

The growing season within Maryland has been calculated based on the soil temperature regime. The definition of growing season is the period of the year when soil temperature at 20 inches below the surface is above 20 F. The growing season can also be determined form climatological data given in most SCS county soil surveys as the period.

CHAPTER 6: MONITORING SOILS

In order for a mitigation site to support a viable plant community, the soil substrate must be suitable for plant growth. Documentation of wetland mitigation soil development indicates that the soil many times is poor in organic material. This can have a devastating effect on the revegetation of the site. The following recommendations provide several approaches for establishing a suitable soil substrate at wetland mitigation sites. If the soil at the mitigation site is left in place (i.e., farmed wetlands), plant the site or allow for natural revegetation to occur. Site plans that call for excavation to the subsoil, topsoil will have to be stockpiled, imported, or the subsoil will have to be amended with organic material.

I. Monitoring Soils

After the replacement of topsoil or the addition of organic compost material, or organic muck and within two (2) weeks of the completion of grading at the site, soils are randomly sampled.

A. Three (3) holes per acre are excavated to a depth of 15 inches to determine the depth of topsoil, muck, and organic compost. the results of the sampling, including a map depicting sampling locations are submitted in the first year monitoring report, and are not required thereafter (See Data Sheet #5 in Appendix C). It is recommended that a few holes as described above be dug to observe amount of organic material accumulation through the monitoring years.

CHAPTER 7: MONITORING OTHER CONDITIONS

This section should be included because it allows for general observations to be made at the site in a narrative format. A procedure for photographic documentation is outlined. The two additional types of subjective information recommended to be included in the monitoring report are descriptions of existing conditions and any problems observed within the mitigation site.

A. The description of existing conditions need only address the general observations upon entering the site. The monitor should be aware of the condition of adjoining buffers and hydrologic connections (i.e., wetlands).

1. Photographic documentation
    a. Establish photographic plots
        i. Locate best view of site
        ii. Establish photo plots
    b. Photos taken once a year (May - August)
        i. Pictures should be taken during the same time of year when possible.
    c. Photos can complement narrative

B. Description of problems observed within the mitigation site:

1. excessive inundation
2. insufficient hydrology
3. seasonal drought condition
4. invasion by undesirable plant/animal species
5. disease conditions for plants
6. adverse water quality impacts (i.e., excessive sediment loading, water pollution)
7. slope failures
8. erosion problems
9. differences in adjoining land use i.e., was a field now a sand and gravel pit.
10. illegal activity: filling, draining, etc.

C. Consultants and Resource Managers upon confirmation of existing site problems will need to prepare a description of proposed remedial measures to correct the problems identified.

1. Reports should include:
    a. Identification of problem(s)
    b. Remedial actions to be taken
    c. Construction schedule
2. Remedial reports are subject to review and approval by the regulatory and resource agencies.

CHAPTER 8: TRAINING VOLUNTEERS

The Environmental Protection Agency (EPA) has actively monitored the growth of Volunteer programs since the first edition of the National Directory of Volunteer Environmental Monitoring Programs, was published in 1988. The first edition of the Directory included 44 programs. The acceptance of volunteer programs has continued to grow to where the 1994 fourth edition included 517 groups in 45 states. Volunteer programs continue the tradition of providing volunteers the opportunity to learn more about our natural environment. As monitoring programs have developed higher standards and quality controls, the information collected has become useful for federal and state programs.

Working with volunteers can be rewarding for everyone involved especially when the efforts of one person are multiplied by many. Volunteers come from a variety of backgrounds (interest, education, and profession) but usually have something in common, for some people it is the chance to learn a new subject, for others it is an opportunity to work closely with the resources that they are interested in, whatever the reason the era of the volunteer is here. Natural resource managers have long recognized the ability of volunteers to assist in accomplishing management goals. Groups like the Sierra Club and the Audubon Society have traditionally supplied volunteer effort for a variety of management protects from flora and fauna species inventories to trail maintenance.

Now after years of hearing how the environment is suffering, people are rolling up their sleeves and getting their hands dirty helping to make this a better place for us all to live. The following steps are provided with permission from the EPA Office of Water to help in facilitating the implementation of your volunteer monitoring program.

Before establishing a monitoring program, a coordinator must be chosen. This is someone who will serve as an administrator, recruiter, trainer and will also collect, analyze the data, administer quality assurance activities, and produce reports. The general goals of a monitoring program are to 1.) supplement state professional staff data, 2.) educate the public, and 3.) build stewardship of the site. These goals and any additional ones must be established before developing a monitoring program. The uses and users of the data should also be determined. Therefore, someone can analyze the data and determine problems and trends. A quality assurance plan is important to a monitoring plan and must be established. This is addressed later in this chapter.

Sources of volunteers may vary. Depending on the site location, sources can be schools of different levels, park volunteers, existing monitoring groups, or local residents. The school level will depend on what exactly the program will be designed to monitor. In depth studies may be better suited for college level. In this level you have the advantages of knowledgeable professors and a continuous source of new volunteers with fresh interest. The local residents are also useful because they may have grown up in the area and have an innate interest in stewardship of the area. Choose your volunteers with an overall direction in mind.

The coordinator must also research before starting a program to determine costs involved (travel, training, quality assurance/quality control, analysis materials etc) It is also useful to know the history of the area, this will help with the bigger picture of the system. For example, find out what was planted on the site if it is a created wetland.

Training

Training provides the common ground from which well-designed and scientifically valid data collection can take place. At the beginning of all programs time needs to be allocated to conduct volunteer training.

The program will realize the benefits of such training in short order. Citizens often commit themselves to a volunteer endeavor not only because of their conviction in the merits of the cause, but also because they will personally benefit from the experience. Training provides the volunteer with the critical information necessary to do the job right.

Introductory training ensures that all volunteers learn to sample in consistent manner. This initial training will also introduce new volunteers to the program and its objectives and create a positive social climate for the volunteers. Such a climate enhances the exchange of information among participants and between the participants and the program leaders. Continuing education and retraining sessions in which the leaders reintroduce standard methodologies and present new information, equipment, data results, or informative seminars are also extremely useful. Such sessions:

*Reinforce proper procedures;

*Correct sloppy or imprecise techniques;

*Permit resolution of equipment or logistics problems;

*Allow volunteers to ask questions after familiarizing themselves with the field techniques;

*Encourage a "team effort" outlook;

*Give volunteers a reason to stay with the program;

*Make experienced volunteers feel integral to the program by encouraging them to supply valuable feedback to the instructors; and

*Provide educational opportunities to the participants.

Volunteer monitoring training can be divided into three broad categories. Each category has a different purpose, but together the categories should complement one another and make the training program well-rounded.

The categories are:

1. Introductory training to describe the program, teach standard methods, and motivate the volunteers;

2. Quality assurance and quality control training to ensure consistency and reliability of data collection and to emphasize the importance of accuracy; and

3. Motivational sessions that encourage information exchange, identify problems, and provide a social atmosphere for participants.

Although different sessions will vary in content, the training process necessary to present the material is fairly constant. Volunteer training may be broken down into five separate steps.

Step 1: Creating a Task description

Step 2: Planning the Training

Step 3: Presenting the Training

Step 4: Evaluating the Training

Step 5: Coaching/Providing Motivation and Feedback

Creating a Task Description

Prior to volunteer involvement, the program manager must develop a detailed blueprint of each volunteer monitoring task. This task description spells out, in sufficient detail, every step a volunteer must complete to collect data for each parameter.

A well-conceived task description standardizes the data collection process and ensures that each volunteer samples in a consistent and acceptable manner. Consistency allows comparisons of site performance over time. Additionally, when the sampling methods are consistent, managers can more easily identify data outside the norm and evaluate whether they result form unusual conditions or faulty collection techniques.

A standardized approach allow the program manager to develop performance criteria which evaluate how well the volunteers are handling the tasks. Once the volunteers master the techniques, the manager can also assess the time and cost requirements of gathering the data.

There are four critical steps in creating a roster of tasks:

Developing the list of parameters;

Determining the required level of quality for each parameter sampled;

Defining the steps for each sampling task; and

Creating a written protocol to be used by the volunteers for each parameter.

Many of the sampling protocols summarized in the previous chapters are suitable as basic task descriptions. The project coordinator can adjust descriptions to represent certain unique characteristics of a site. A separate protocol should be drafted for each major parameter.

The written description provides each volunteer with a readily available reference sheet that clearly describes how to sample while serving as a reminder of the correct methodology. Additionally, such a sheet helps to minimize the number of times the program leaders have to answer the same questions.

Writing the monitoring tasks provides program leaders with the opportunity to evaluate fully the job at hand and improve potentially troublesome areas. Once the program is outlined, the leaders and a few volunteers should test and refine the protocols under field conditions.

Planning the Training

With completed task descriptions for each of the parameters, the planning committee can then design training sessions. Usually, programs will find that group sessions are the most cost-effective means of training the volunteers. In some situations, however, individual instruction may be the only feasible option.

Group sessions are preferred for both the introductory training and the advanced classes, because thy are generally inexpensive, efficient, encourage interaction among the volunteers, and foster enthusiasm for the program.

Group field trips, either for advanced training or special educational sessions, are an ideal means of motivating volunteers while teaching them additional skills. Field trips could be to an natural wetland to compare the differences between a created and natural wetland. The volunteers can also see first hand what the mitigated wetland will hopefully resemble. They could also monitor the natural wetland once and quantitatively compare the two. Most volunteers are quite enthusiastic about getting to preform a monitoring activity at the mitigation site. Volunteers often approach their sampling with renewed enthusiasm after participating in a field trip.

In addition, accompanying individuals to the monitoring site allows instructional field demonstrations. Training volunteers for field sampling ideally takes place in the field. Problems that might not arise under training conditions in a classroom may well emerge under less predictable field conditions.

Group sessions can cover any of the following topics:

Goals and objectives

Role of the volunteer

Fundamental ecology of wetlands

Management and conservation of wetland plants and animals

Basic sampling techniques

Advanced sampling techniques

Proper use of monitoring equipment

Operating problems encountered by volunteers

Proposed use of the monitoring data

Results of data analysis

Special seminars of interest presented by a local expert.

Usually, the task description can serve as the basic outline for the initial training session. A mini-lesson may revolve around the task design for each major parameter. If each volunteer is expected to monitor many parameters, however, the instructor may need to schedule more than one session. Too much information presented at a single session my quickly overwhelm and discourage the volunteers.

Presenting the Training

A well-conceived plan for instruction along with simple handouts is key to an effective training presentation. The instructors should make the most effective use of the participants' time. Volunteers, like most students, will appreciate a well-organized and smoothly placed class. Four major steps constitute an effective and lively training session: preparation; presentation; demonstration; and review.

Preparation

As any teacher can attest, thorough preparation for class is critical. The sampling protocols provide a basic framework for the initial training session; subsequent sessions may require research, preparation of additional task descriptions, and class planning.

With the basic information in hand, the instructor must then tailor the lesson to the audience. The instructor should try to anticipate those portions of the lesson that may cause confusion and be prepared to clarify these areas. Volunteers should be invited to ask questions throughout the session.

Volunteers with no background in science may require additional explanation of assistance so that they understand the importance of high quality data collection methods and the use of scientific equipment. Although separate sessions for experienced and untrained volunteers are preferable, some instructors may elect to have a single session with experienced volunteers helping those who are new to the program.

When planning the session, the instructor should allot a set amount of time for each task. Lectures, activities, and discussions should be kept on a timetable. If the pace drags because one or two volunteers are slow to understand the material, the rest of the volunteers may quickly become annoyed and bored. Slower students may require individualized attention at a later date.

Instructors should make appropriate use of audiovisual materials to enhance the presentation. All equipment should be in the room at the start of the session, in working condition, and ready for use. Slides of the wetland and of volunteers sampling in the field are good teaching devices and tend to hold people's attention. Transparencies and videos are also effective teaching tools.

The instructor may want to rehearse a training session for other members of the monitoring program to catch potential problems prior to the first presentation.

Presentation

Knowing the material thoroughly and having the information well organized are critical to an effective presentation. Instructors may want to experiment with several styles of presentation to see which seems most effective and comfortable. The general tips that follow help ensure a successful session:

Be enthusiastic about the subject - enthusiasm inspires dedication.

Establish good rapport with the audience.

Get the audience involved in the talk and keep the presentation lively.

Utilize visual aids.

Talk sufficiently loudly and enunciate clearly.

Make use of humor.

Use eye contact.

Encourage questions and comments.

Use anecdotes throughout the presentation.

Maintain good posture and positive body language.

Demonstration

Two types of demonstrations are effective training tools: one in which the instructor demonstrates the techniques to the volunteers and another in which the students practice the outlined procedures under the watchful eye of the instructor. An effective teacher can incorporate both into a training session.

If time permits, the instructor can demonstrate the sampling protocols. Viewing the execution of a procedure is more meaningful than simply reading the instructions.

Once the volunteers are familiar with the techniques, they can then repeat the procedures under the tutelage of the instructor. These practice sessions can take place in the field or classroom and give volunteers the confidence to transfer these newly learned skills to their own monitoring site. Such hands on training is invaluable and should be treated equally or more importantly than standard instructor/student presentations; in training sessions for volunteers.

Review

Like any good learning session, the instructor should end the session with a review of the material. Summarizing reinforces the salient points and assists the volunteers in retaining the information. The volunteers should be invited to ask questions during the review. At the close of the session, the instructor can inform participants about upcoming events and future training opportunities and reiterate the importance of citizen monitoring and data collection.

Evaluating the Training

High quality data reflects successful volunteer training. To ensure that the sessions are effective and successful, the planning committee should make written evaluations and integral part of the training process. While an instructor may feel that the sessions are adequate, only the volunteers can let the planning committee know how much they learned and retained.

Evaluation of the training should include an assessment of:

Training techniques and style;

Information presented;

Classroom atmosphere; and

Use of handouts and audiovisual aids.

Volunteers may provide feedback at the end of the sessions. The true test of an effective session, however, is how well the volunteers perform in the field. A follow-up evaluation form, sent to participants after a few weeks or sampling, may pinpoint any weaknesses in the presentation.

Members of the monitoring program may also want to accompany volunteers into the field and examine their sampling techniques as they work unassisted. Such spot checks can identify areas in which the volunteers are encountering difficulties.

If large numbers of volunteers are experiencing problems in carrying out the sampling protocols, the planning committee may what to revise the format of the sessions or have a new instructor take over. The evaluation process should be ongoing to ensure that all the sessions consistently meet a high standard.

Coaching / Providing Motivation and Feedback

While the initial training sessions are designed to give volunteers all the basic skills to successfully complete their sampling, training does not stop here. Follow-up coaching, either through advanced training sessions or one-on-one interaction, is imperative to keep volunteers enthusiastic, motivated, and collecting good data.

Previous sections described the advantages of advanced training sessions. Individualized coaching, though less time-efficient, has many other benefits. It:

Permits the volunteer to ask questions particular to a site;

Allows the instructor to solve specific problems in the field;

Indicates to the volunteer that his/her data are important;

Gives the instructor feedback on training effectiveness;

Enhances communication between the program leader and the volunteer;
Motivates the volunteer; and

Provides a forum of introducing new methods.

In addition to going into the field with specific volunteers, the program leaders should also consider phoning other volunteers who may not require one-on-one contact. A phone call lets volunteers know that the leaders are interested in their progress and give the volunteer an opportunity to ask questions. Informal gatherings for volunteers, such as a potluck dinners and slide shows also give the leaders an opportunity to check on the progress of the participants and answer questions.

The success of the program is highly dependent on maintaining volunteer motivation and enthusiasm. A apathetic volunteer will likely not collect good data and may drop out of the program. Volunteer Water Monitoring: A Guide for State Managers (1990), summarizes several other means of fostering volunteer interest. These techniques include:

Sending volunteers regular data reports;

Keeping volunteers informed of the uses of their data;

Preparing and distributing a regular newsletter;

Ensuring that program leaders are readily available for questions and requests;

Providing volunteers with educational opportunities;

Keeping the local media abreast of the goals and findings of the citizen monitoring effort;

Recognizing the volunteers' efforts through awards or some other type of distinction; and

Accommodating the needs of volunteers by providing them with advanced training, learning opportunities, and more demanding or changing responsibilities.

Training citizen volunteers to conduct wetland mitigation monitoring is time consuming and demanding. Nevertheless, successful training sessions are key to a long-term and effective monitoring program. It is well worth the effort to devote this time to the volunteers.

Quality Assurance/ Quality Control

While volunteers are a valuable resource for wetland monitoring, they are not always extensively trained in wetland ecology. Therefore, a quality assurance program is important. This will ensure consistency and reliability as well as emphasizing accuracy during the monitoring. At least once a season, the program managers should monitor the site along the transects immediately before the volunteers. The data can be compared and large discrepancies evaluated.

This will also show if there is a particular area that many volunteers are having trouble understanding. More time and training can then be arranged. Care must be taken, however as to not insult the volunteers. If the project manager observes the volunteers while they are sampling, the reasons for discrepancies may be determined. See Appendix J for more detailed information.

References

Cook, J.S., 1989, The Elements of Speech Writing and Public Speaking. MacMillan Publishing Company, New York, 242 pp.

Ellett, Kl, 1993, Introduction to Water Quality Monitoring Using Volunteers, 2nd ed., Alliance for the Chesapeake Bay, Baltimore, MD. 26 pp.

Smith, T.C., 1984, Making Successful Presentations: A Self-Teaching Guide. John Wiley & Sons, Inc., New York. 182 pp.

U.S. Environmental Protection Agency, 1990, Volunteer Water Monitoring: A Guide for State Managers, EPA 440/4-90-010, Office of Water, Washington, DC. 78 pp.

CHAPTER 9: PERFORMANCE STANDARDS

To borrow an old expression, the success of a mitigation project sometimes appears to be in the eyes of the beholder. As people gain experience in monitoring and observing mitigation sites, they will learn to look beyond what they see as the current condition of the mitigation site. It is very common for mitigation sites to appear unnatural, with their often uniform spacing of plants and little other vegetation. Sites also may initially appear as an overgrown field as colonizing plants appear. It is important to realize that sites will often "improve" in terms of sustaining coverage of desirable plant species, and that what you are looking for is a site that has the conditions in place to become a certain type of wetland in time - most often, a forested wetland. It is unrealistic to expect that a site designed to replace acreage and function of a wetland with 30-year old trees will mimic the precise functions in much less than another 30 years. The numerical standards presented should be considered with a common sense view on how the site is progressing to a certain stage (e.g., a forested wetland with large trees).

Certain attributes designed in a wetland mitigation project may provide advantages or disadvantages to different species or functions. If you are the species enjoying the advantage, then to you the project is a success. As you can see, the term success in wetland mitigation appears to be relative and subjective.

What the restoration specialist tries to do is create a favorable environment in which natural systems can achieve there maximum potential. The goal is a balanced ecosystem with species diversity and vegetative community types that reflect what would naturally occur in that area. In order to measure the performance of the project, how well it does over time, we have had to agree to a set of performance standards.

The Interagency Mitigation Task Force (IMTF) has developed performance standards to measure wetlands mitigation success. The following guidance provides the performance standards used to measure success. This chapter is divided into three major sections: vegetation, hydrology, and soils. The vegetation section is divided by nontidal wetland types. Each of the three major sections discuss the performance standards.

These performance standards are the minimum required standards for wetland restoration or creation. These standards provide clear goals for vegetation diversity and density, depth of soil, as well as duration and range of acceptable elevations of surface water and depths to groundwater. The standards established can be modified to reflect site specific conditions and best professional judgement.

Developing standards for wetland restoration and creation are important. However, the overall importance of mitigation site selection cannot be over emphasized. This is the single most important decision a mitigator has to make in determining the successful outcome of a wetland restoration or creation project.

The following criteria refers to the Maryland growing season and will be referenced throughout the body of the performance standards chapter. Growing seasons within Maryland vary by physiographic province and are defined as regional averages. The growing season may be shorter or longer depending upon the mitigation sites location.

1. East of Washington County -- 1 April through 31 October (214 days)

2. West of and including Washington County -- 30 April through 30 September (154 days)

I. Vegetation

Vegetation diversity and density has been chosen as a primary performance standard because sites without sufficient plant biomass support low populations of fish and wildlife and provide insignificant water quality functions. In addition, techniques to measure vegetation are accomplished economically and require minimum training and equipment.

Performance Standards

Although success is measured at time increments prescribed by the performance standards, the mitigation site should be monitored throughout each growing season for the 5-year monitoring period.

A. Nontidal Emergent Wetlands

Sampling methodologies help us determine the amount of vegetation coverage present on the site. In order to calculate the percent vegetated coverage of emergent areas we refer to the distance measurements of "Vegetated" and "Open Water" categories plotted on the 1 inch = 100 feet scale map of the wetland mitigation site. Each distance measurement taken along a given transect for either category is denoted as a single point on each transect. A line is drawn crossing the transects to connect the points for emergent vegetative cover. Connecting the points will serve to delineate the area(s) of the wetland which are "Vegetated" as opposed to the wetland area of "Open Water" (See Figure 4.1). The area(s) classified as "Vegetated" should be planimetered to calculate the square footage of the wetland site occupied by emergent vegetation. This achieves the specified standard, and when the area is divided into the total area, the percent coverage is determined.

1. Second Growing Season -- Achieve 45% coverage of the emergent zone with emergent wetland species at a minimum density of 43,560 living stems per acre(12"x 12"spacing), consisting of a minimum of three (3) wetland species.

2. Third Growing Season -- Achieve 70% coverage of the emergent zone with emergent wetland species at a minimum density of 43,560 living stems per acre (12"x 12" spacing), consisting of a minimum of three (3) wetland species.

3. Fifth Growing Season -- Achieve 85% coverage of the emergent zone with emergent wetland species at a minimum density of 43,560 living stems per acre (12"x 12" spacing), consisting of a minimum of three (3) wetland species.

B. Nontidal Scrub-Shrub Wetlands

1. Establish a minimum of two (2) species of wetland shrubs with an indicator status of Obligate, Facultative Wet, or Facultative. No more than 50% shall be Facultative.

2. Second Growing Season -- In the scrub-shrub zone, achieve a minimum density of approximately 435 living wetland shrubs, at a minimum height of 10 inches, per acre.

3. Third Growing Season -- In the scrub-shrub zone, achieve a minimum density of approximately 538 living wetland shrubs, at a minimum height of 10 inches, per acre.

4. Fifth Growing Season -- In the scrub-shrub zone achieve a minimum density of approximately 600 living wetland shrubs at a minimum height of 10 inches, per acre.

C. Nontidal Forested Wetlands

1. Establish a minimum of two (2) species of wetland trees and two (2) species of wetland shrubs with an indicator status of Obligate, Facultative Wet, or Facultative. No more than 50% shall be Facultative.

2. Second Growing Season -- In the forested zone, achieve a minimum density of approximately 538 living wetland trees and shrubs, at a minimum height of 10 inches, per acre.

3. Third growing season -- In the forested zone, achieve a minimum density of approximately 538 living wetland trees and shrubs, at a minimum height of 10 inches, per acre.

4. Fifth Growing Season -- In the forested zone, achieve a minimum density of approximately 600 living wetland trees and shrubs, at a minimum height of 10 inches, per acre.

II. Hydrology

Establishing wetland hydrologic conditions is essential for successful wetlands plant growth and hydric soil development. Considerations in establishing hydrology for nontidal wetland types are discussed below.

Performance Standards

A. Nontidal Wetlands

Collect groundwater elevation data for two growing seasons once the wetland restoration or creation work has been completed. This will verify if the hydrology performance standards listed below have been met.

1. **Emergent** -- the soil is saturated to the surface or there is water on the surface or a combination of surface water and saturated soils for at least 21 consecutive days of the growing season to a maximum depth of 2.0 feet of standing water.

2. **Forested and scrub-shrub** -- the soil is saturated to the surface and the ground water table is within 10 inches of the surface for at least 21 consecutive days of the growing season.

III. Soils and Soil Amendments

For a mitigation site to support a viable plant community, the soil substrate must be suitable for plant growth. The following recommendations provide several approaches for establishing a suitable soil substrate at wetland mitigation sites. If the soil at the mitigation site is left in place (i.e., farmed wetlands), plant the site or allow for natural revegetation to occur. If site plans call for excavation to the subsoil, top soil will have to be stockpiled, imported, or the subsoil will have to be amended with organic material. Design plans will show whether or not there was soil amendments. There are not any performance standards for long term soil monitoring since it is only monitored within 2 weeks of grading completion.

Performance Standards in Construction/Design

A. Emergent Wetlands

1. Stockpiled or imported topsoil or organic muck -- spread evenly over the site to a minimum depth of six inches.

2. Organic material -- incorporated a minimum of 25 tons per acre of organic matter or commercially available mulches evenly throughout the subsoil to a depth of 10 inches.

B. Scrub-Shrub and Forested Wetlands

1. Stockpiled or imported topsoil or organic muck -- spread evenly over the site to a minimum depth of eight inches.

2. Organic material -- incorporate a minimum of 40 tons per acre of organic matter or commercially available mulches evenly distributed throughout the subsoil to a depth of 10 inches.

Appendix A
Glossary of Terms

Anaerobic
A situation in which molecular oxygen is absent from the environment.

Biological community
A unified body of organisms living in a particular area. The plant and animal life of a region or environment.

Biomass
The total mass or amount of living organisms in a particular area (Delaware Adopt a Wetland, 1994)

Bog
A peatland dominated by ericaceous shrubs (e.g., labrador tea, bog laurel, cranberries), sedges, and sphagnum moss and usually having a saturated water regime or a forested peatland dominated by evergreen trees (usually spruces, hemlocks, or firs) and/or Larch.

Bottomland hardwood forest
Deciduous forested wetlands, located along rivers and streams generally in broad floodplains.

Compensatory wetland mitigation
Wetland creation, restoration, and/or enhancement required under mitigation guidelines for impact(s) to existing wetlands.

Created wetland
A type of mitigation which involves the establishment of a wetland where one did not formerly exist. Creation generally takes place in upland environments (adapted form Mitigation Technical Guidance for Chesapeake Bay Wetlands. 1994).

Detritus
Minute fragments of plant parts found on the soil surface.

Ecosystem
A functional system which includes the organisms of a natural community together with their environment.

Emergent
Wetlands dominated by erect, rooted, herbaceous (non-woody) plants, excluding mosses and lichens.

Endangered species

Wetlands provide habitat for about 45 percent of the nation's federally listed endangered animal and plant species.

Enhancement
Actions performed in existing, or severely degraded wetlands to increase one or more wetland functions. Enhancement differs from restoration activities in that the former occurs in existing wetlands (IMTF, 1994)

Erosion
The active abrasive forces found in nature usually but not limited to the movement of water, wind, and debris over the earths surface.

Flooding
Inundated conditions resulting from overland flow, streambank overflow, or groundwater discharge.

Floodplain
Area on either side of a stream which receives overbank flow.

Food chain
An arrangement of the organisms of an ecological community according to the order of predation in which each uses the next, usually a lower member as a food source.

Forested wetlands
Nontidal wetland dominated by woody vegetation greater than 20 feet in height.

Functions
The role nontidal wetlands serve through: a) Reduction of pollutant loadings, including excess nutrients, sediment, and toxins; b) Attenuation of floodwaters and stormwaters; c) Shoreline stabilization and erosion control; d) Breeding grounds and habitat for may species of plants and wildlife, including threatened and endangered species; e) Food chain support; and f) Timber production (adapted from the Maryland Code of Regulations).

Ground water
That portion of the water below the ground surface that is under greater pressure than atmospheric pressure.

Habitat
The environment occupied by individuals of a particular species, population, or community.

Herbaceous plant (herb)
A nonwoody plant species with soft stems.

Hydric soil
Soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions.

Hydrology
The science dealing with the properties, distribution, and circulation of water.

Hydroperiod
The seasonal occurrence of flooding and/or soil saturation; the depth, frequency, duration, and seasonal pattern of inundation/flooding in a riparian zone (areas bordering streams, lakes, rivers, watercourses) or wetland.

Hydrophyte
Plants typically found in wet habitats.

Interagency Mitigation Task Force (IMTF)
Mitigation guidance counsel made up of members from federal and state resource management agencies.

Landscape
A spatial mosaic of ecosystems which interact functionally and are large in scale. Examples are watersheds, physiographic provinces or ecoregions (adapted from Gosselink et al. 1990). The land forms of a region in the aggregate (Webster's new collegiate dictionary. 1977).

Maryland Nontidal Wetland Compensation Fund
The nontidal wetlands regulation for the State of Maryland allows the Department of Natural Resources to accept monetary compensation in lieu of mitigation, if it is determined mitigation is not a feasible alternative. Monetary compensation may be accepted if it meets certain criteria (adapted from IMTF, 1994).

Mitigation
Compensating for the impact to wetland(s) by replacing or providing substitute resources or environments.

Natural regeneration
The colonization of a site by volunteer plant species.

Nitrogen
A nutrient plants can take up in various forms. The nitrogen cycle in wetlands can include several nitrogen sinks with nitrogen being lost as a gas, absorbed to soil particles, and incorporated into organic material.

Nontidal wetland
An area that is inundated or saturated by surface water or ground water at a frequency and duration sufficient to support, and that under normal circumstances does support, a prevalence of vegetation typically adapted for life in saturated soil conditions, commonly know as hydrophytic vegetation. Not influenced by ocean driven tides.

Nutrients
Something that promotes the growth and repairs the natural wastage of organic life.

Organic Material
Related to soil composition, consisting of any of the following: 1) composted organic matter which may include: manure, wood chips, plant clippings, or straw. 2) commercially available mulches (e.g., "Compro") and 3) lime, if the site is acidic and the vegetation requires alkaline conditions (IMTF, 1994).

Performance standards
Achievement goals established for wetland mitigation sites, e.g., percent vegetation coverage after five years, plant diversity, percentage of plants adapted for life in hydric soils.

Phosphorus
A nonmetallic element that occurs widely and is essential to the growth of aquatic organisms as well as all forms of life. In aquatic environments, phosphorus is often the nutrient that limits the growth that a body of water can support. Additions of phosphorus to wetlands can cause increased vegetative growth and modifications to community composition.

Preservation
The protection of lands for the purpose of increasing the functional value of wetlands, which will result in an overall benefit to the ecosystem mosaic. Such lands include wetlands and adjacent areas, and may receive credit as compensatory mitigation. Fee simple acquisition, conservation easement, or other legal mechanisms that provide for perpetual protection will be required (IMTF, 1994).

Programmatic wetland mitigation
Wetland mitigation projects which have been implemented by the State.

Quantitative
Relating to or involving the measurement of quantity or amount.

Restoration
A type of mitigation which involves reestablishment of a wetland through hydrological modification in an area where the wetland previously existed.

Scrub-shrub
A wetland class consisting of woody vegetation less than 20 feet in height. True scrub-shrub is characterized as low (dwarf) multi-stemmed woody plant species.

Sediment
Fragmented material that originates from weathering and erosion of rocks or unconsolidated deposits (soil) and is transported by, suspended in, or deposited by water.

Sedimentation
The action or process of depositing particles of waterborne or windborne soil, rock, or other materials; the depositing or formation of sediment.

Tidal wetland
Wetlands influenced by ocean driven tides.

Topsoil
A presumed fertile soil or soil material, or one that responds to fertilization, ordinarily rich in organic matter, used to topdress lawns and gardens (IMTF, 1994).

Values
The associated socioeconomic worth of a wetland function as a commodity or resource.

Volunteer plants
Vegetation that is not planted at a planting site, but is part of the natural revegetation process.

Water quality
The degree to which the physical, chemical, and biological properties of aquatic systems deviate from untouched natural systems.

Watershed
A region or area bounded peripherally by a body of water parting and draining ultimately to a particular watercourse or body of water.

Water table
The upper limit of the portion of the ground wholly saturated with water.

Wetland mitigation
The creation, restoration, or enhancement of nontidal wetlands, that were or will be lost due to regulated activities.

Wetlands
Those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation

typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (IMTF, 1994).

Wetlands mitigation monitoring volunteer
A person who is hopelessly addicted to the pursuit of knowledge pertaining to the creation of wetland ecosystems (Keiler, 1995).

Appendix B

Data collection time line

Subsequent grading soil analysis:	2 weeks after final grading and soil amendments
Vegetation density monitoring:	
Emergent:	Once during May through September of year 2,3,5
Forested/scrub-shrub:	Once during May through September of year 2,3,5
Hydrology:	First sample within 14 days of growing season (May); then every 14 days for the first 60 days of the growing season. Monitoring is conducted through the first two growing seasons.

Appendix C

Data Sheets

Appendix D

NRCS Groundwater Well Installation Procedures

Taken from IMTF, 1994

Appendix E

Sampling Methods

Appendix F

Plants in Distress

Figure F.1: Red maple with water stress- hanging leaves (photo Noble 8/97)

Figure F.2: Stressed herbaceous plant (photo Noble 8/97)

Figure F.3: Drought conditions lead to sparse vegetation (photo Noble 8/97)

Nutrient stressed tree (photo Noble 8/97)

Figure F.5: Stressed shrub (photo Noble 8/97)

Appendix G

Case Histories of Citizen Monitored Sites

CLOVERFIELDS MITIGATION PROJECT

Directions:
East on Rt 50, across the Bay Bridge, take first exit (Rt 8 north- Stevensenville), cross over Rt 50, turn right at convenience store (Main St, or Rt 18), follow about five blocks, left on State St, right on Church St, mitigation site is on the left. The site is bordered on the south side by Church Lane, on the west by private homes, on the north by a fallow farm field, and on the east by the elementary school driveway and parking areas.

This wetland mitigation project is part of a cooperative effort by Queen Anne's County and Maryland Department of Natural Resources to replace nontidal wetlands which were impacted by road construction and the installation of sewers in a nearby existing subdivison named "Cloverfields". DNR's Mitigation and Technical Assistance Section prepared the design, engineering and planting plans and the County Roads Department performed the actual construction. Over 700 trees and shrubs were planted in Spring of 1993 by the ecology club of Stevensenville Middle School and a group of second and fourth graders from Bayside Elementary School. This area will serve as a study area for students who are interested in the ecology of wetlands, amphibians, plants, hydrology, water quality monitoring, and passive recreation activities like birdwatching. This area will also provide educational opportunities for teachers and students at other nearby schools.

A total of 2.92 acres of palustrine forested wetlands were created and planted in the Spring of 1993 and 1994. Before the creation, the site was a fallow level field of prior converted cropland located in the Cox Creek watershed. The vegetation for the site was typical fallow cropland weeds such as ragweed, sunflower tickseed and annual grasses. The soil for the site is Mattapex silt loam and Othello silt loam which was drained in the past by farming activities and road ditching. This entire site is owned by the Queen Anne's County Commissioners.

The mitigation construction process took place as follows. The Department of Environment Erosion and Sediment Control Inspector was notified two weeks prior to construction. The sediment controls were then installed. The rock lined outlet structure was installed according to plan grade. Topsoil was removed and temporarily stockpiled in the field across Church Lane. The site was graded according to the site plan to various elevations between 10 and 12 feet. Preliminary grading 0.5 feet lower than the final grade to allow for the addition of topsoil. Stockpiled topsoil was spread on the site as needed to match final grade. The slopes were graded to 3/1 or flatter and excess soil was removed to an upland area. The site was stabilized with annual rye at the rate of three bushels per acre. The site was permanently stabilized in the spring of 1993 and 1994. Since this mitigation was constructed with in kind services, there were no outstanding costs.

The site was planted with, shrubs such as; Sweet Pepperbush, Black Willow, Red Chokeberry, Sweetbay Magnolia, Silky Dogwood, Red Osier Dogwood, Red-panicled Dogwood, trees such as: Pin Oak, Green Ash, Sycamore, Red Maple, Sweet Gum, Black Willow, and emergent vegetation such as: Soft Rush, Wool Grass, Soft-stemmed Bulrush, Smartweed.

The monitoring to this date has been limited. Maryland Department of the Environment is monitoring the site. The site is divided into nine transects. In 1995, stem density was calculated to be 284.5 per acre, and 291 in 1997. The MDE project manager is George Beston.

1995 CLOVERFIELDS MONITORING RESULTS

Data Collection Date: 09/08/95 | Samplers: M. Keiler, J. Bonsack

Site size: 2.92 ac

Mitigation Type: PFO

Date Planted: Spring 1993 and Spring 1994

Growing season: 02

IMTF Performance Standard: 435 stems per acre by year 2

Number of Transects: 09

Number of circular plots: 42

Total number of stems counted: 31

Stem Density per acre at site: 284.5 stems per acre
*see density calculations

Site conditions:
The site was visited during the 27th day of a drought in the Stevensville, Maryland region of the eastern shore. Moisture was detected in the upper soil solum. Vegetation exhibited signs of drought stress in the form of wilt and burnout. Standing water was not observed in designed emergent zones.

Site stem density computations:

43560 (sq feet/acre)	113 (size of plot sq ft)
x 2.92	x 42
127,195.2 sq ft	4,746 sq ft

127,195.2 / 4,746 = 26.8 (number of times the total sq feet of the sample plots goes into the total site size

stem count for all the sample plots = 31

23.0 x 31= 830.8 stems on site
830.8 / 2.92 ac = <u>284.5 stems per acre</u>

1997 CLOVERFIELDS MONITORING RESULTS

Data Collection Date: 07/02/97 Samplers: MCC

Site size: 2.92 ac

Mitigation Type: PFO

Date Planted: Spring 1993 and Spring 1994

Growing season: 4

IMTF Performance Standard: 538-600 stems per acre (by year 3,5 respectively)

Number of Transects: 09

Number of circular plots: 49

Total number of stems counted: 37

Stem Density per acre at site: 291
*see density calculations

Site conditions: Dry summer!! 8/97 conditions were extremely dry with little to no standing water in emergent zones; also many dead plants

---

Site stem density computations:

43560 (sq feet/acre)	113 (size of plot sq ft)
x 2.92	x 49
127,195.2 sq ft	5,537 sq ft

127,195.2 / 5,537 = 23.0 (number of times the total sq feet of the sample plots goes into the total site size

stem count for all the sample plots = 37

23.0 x 37= 851 stems on site

851 / 2.92 ac = 291 stems per acre

HASHAWHA ENVIRONMENTAL CENTER WETLAND MITIGATION

Location: Carroll County, Westminster, Md
As you enter the Environmental Center, at the bottom of the first hill, by the lake, is the mitigation site.

A freshwater wetland existed on the site about 300 years ago. Since then farmers have filled the wetland for agriculture many years ago. Therefore, the site can be considered a wetland restoration as well as a wetland creation. Prior to the project, the site was an open, grassy floodplain with Mount Airy soil (upland). This site lies near an unnamed tributary of Bear Branch River, in the Middle Potomac River Area. It is also located next to existing wetlands and a pond.

An important part of the mitigation process was that the site was constructed by Hashawha staff. This cut the prices substantially. The dirt from the site was stored by the HEC for future grading or fill use. Additionally, a boardwalk was constructed to allow handicap access. This unfinished wood boardwalk connected to the boardwalk in the adjacent wetland area. Planting was done by a student corps, led by Mr. Bob Foorhogue of South Carroll High School. There was a phase I and II to this creation/restoration, costing $38,000 and $4455 respectively.

In phase I, 0.125 acre of scrub-shrub and 1.875 acres of palustrine forested wetland was created in the summer of 1992 and planted in the spring of 1993. This totals 2 acres. The site was treated for invasive cattail in June, 1995. In phase II, 0.75 acre of forested wetland was created in the fall of 1994, with planting in the spring of 1995. PVC piping from a nearby pond, as well as directed runoff provided the water for the wetland.

The mitigated wetland provides: educational opportunities for students and visitors to the Hashawha Environmental Center, enhanced habitat for wildlife, improved water quality of runoff that drains into Bear Branch, a demonstration site to show farmers and other land owners how wetlands can be restored or created on their land. There is not any official monitoring program to date and no plans for the future due to the deep ponding. Project manager is Kevin Smith, at the Department of Natural Resources. In June 1997, the site was dominated with cattail and arrow arum. The plants were healthy, with ponded water over much of the area.

LITTLE PATUXENT RIDGE MITIGATION SITE

This mitigation site lies in the Little Patuxent River watershed sub-basin in Howard County. The site consists of 2.75 acres of created wetlands (2.25 acres of forested and 0.5 acres of emergent). The owner, Mr. Paul Miller is the developer of the Grey Rock residential community in Howard County and was responsible for 0.25 acres of wetland mitigation. Therefore, Mr. Miller created the wetland on his property in the floodplain of the Little Patuxent

River. Wetlands were created on the remainder of the floodplain to aid the 0.25 acre hydrology and successfulness.

The goals of the mitigation project are to increase flood storage, water quality and wildlife habitat and allow for educational opportunities in a watershed with high wetland losses.

The site was previously agricultural land, however, before construction, the site had been abandoned for quite some time. The design consisted of three depressional cells linked by channels. Two gravity sewer right-of-ways traverse the site, which prevented any extensive excavation. The right-of-ways line beneath the linking channels, which are not as deep as the depressional areas. The construction was completed in January, 1994 and the site was planted in fall of 1994. This site was used for research of a masters thesis, and the original planting plan was altered. The site was divided into four sections based on the three cells; 1, 2A, 2B, 3. Cells 1 and 2B were planted according to the plan. The plants that were used included; Red Maple, River Birch, White Ash, Green Ash, Red Cedar, Sweetgum, Tulip Poplar, Blackgum, Sycamore, Pin Oak, Winterberry, Smooth Alder, and Black Willow. Cell 2A was allowed to colonize naturally, and cell 3 used a high diversity self organized seed approach. In this cell, the area was seeded with a total of 132 plant species in two seed sprayings (early spring 1994 and late fall 1994). The four areas had different hydrologic regimes, which made any significant results invalid. The project was funded by the Maryland Nontidal Wetland Compensation Fund, and totaled approximately $81,000. Contacts are Kevin Kelly at ESA, Denise Clearwater at MDE and Kevin Smith at DNR. The site was monitored in 1994 and 1995 and average percent cover increased from approximately fifty percent to seventy percent. Cells one and three had average percent covers of 80 and 91 respectively. Cell 2 had the lower percent cover to lower the mean.

MERKLE WILDLIFE SANCTUARY MITIGATION SITE

Merkle Wildlife Sanctuary is located in Prince George's County. The site was used as agricultural land, consisting primarily of mowed grass, and wildlife food plots. There is a catfish pond to the west of the site. Merkle's Critical Area Driving Tour road borders this area to the east.

The site required minor excavation to achieve adequate hydrology. The soil, which was excavated from the wetlands site was used to elevate the roadway about one foot. Grading, however, was limited to the existing plow layer (Ap soil horizon). Sediment was cleaned out of the pond, and a handicapped accessible pathway was built from the road to the site. The pond and the two culverts under the road were adjusted to increase the amount of water in the site. Accumulated sediment in the pond was removed. Two geoweb road crossings were installed to replace two culverts and to set a control elevation for maximum water levels within the project area. Construction was completed during the summer of 1993 and the site was planted in the spring of 1994. These plants included Sweet Gum, Pin Oak, Swamp White Oak, American Sycamore, Black Willow, Northern Spicebush, Chokecherry, Sweetbay Magnolia, Highbush Blueberry, Elderberry, and various sedges, grasses, and wildflowers. For each acre, approximately 562 stems were planted. The planting was done by students and inmates, who were overseen by Department of Natural Resources employees. The total cost of the project was

$74,000.

Approximately nine acres of palustrine forested, scrub-shrub, and emergent wetlands were created. The old catfish pond was deepened, making it suitable for fishing. A wheelchair accessible path encircles the pond and leads to the road. The hydrology of the site comes from precipitation, overland flow from fields, springs, and groundwater. The mitigated site is connected to adjacent wetlands on three sides and an unnamed freshwater tributary. The Patuxent river flows nearby, to the east of the area. Since the area is in a public wildlife sanctuary, the site has public access.

The project manager is George Beston from MDE, and the area is monitored with transects (15 designated).

1995 MERKLE MONITORING RESULTS

Data collection date: 08/22/95 Samplers: M. Keiler
M. Carrol

Site size: 9.00 ac

Mitigation type: PFO

Date planted: Spring 1994

Growing season: 02

IMTF Performance Standard: 535 stems per acre by growing season 02

Number of Transects: 15

Number of circular plots:
33 (inclusive of all forested areas)
49 (inclusive of all areas within the study area including areas functioning as emergent zones)

Total number of stems counted: 60

Stem density per acre on site: 701 stems per acre
*see density computations

Site conditions:
The site was visited during the 10th day of a drought in Croom, Maryland (Merkle Wildlife Sanctuary) on the western shore. Moisture was detected in different areas (pockets) of the site in the upper soil solum. However, visually the North side of the site had an area (less than 0.5 acre) where the vegetation exhibited signs of drought stress in the form of wilt and burnout. Standing water was observed in the Catfish pond and in the drainage from the Pond that passes through the south portion of the site.

Site stem density computations:

43560 sq ft/acre	113 (size of plot in sq ft)
x 9	x33
392,040 sq ft	3,729 sq ft

392,040 / 3,729 = 105.13 (number of times the total sq ft of the sample plot goes into the total site size)

stem count for all the sample plots: 60

105.13 x 60 = 6307.8 stems on site
6307.8 / 9.0 ac = 700.86 stems per acre

2.) Calculations for 49 circular plots

392,040 sq ft	113 (size of plot sq ft)
	x49
	5,537 sq ft

392,040 / 5,537 = 70.80 (number of times the total sq ft of the sample plot goes into the total site size)

The stem count for all sample plots = 60

70.80 x 60 = 4,248 (stems on site, in this case including the areas designed to be forested but now support emergent veg.)

4,248 / 9.0 ac = 472 stems per acre

NORTH POINT MITIGATION PROJECT

This wetland mitigation project was constructed to compensate for wetland losses in Baltimore County and to help achieve the goal of "no net loss of wetlands". The site was originally DNR farmland with the following soils: Barclay silt loam with hydric inclusions, Mattapex silt loam with Othello inclusions, Othello silt loam (hydric), and Lenoir silt loam (hydric). This project is a combination of a wetland restoration and creation that will increase water quality in Shallow Creek, increase habitat and provide educational opportunities. The site is owned by the state of Maryland (Agricultural lease- Mr. Robert Iman).

Twelve inches of topsoil was excavated and used to create a sediment control dike, which was temporarily seeded with ryegrass. Specific areas were then excavated 10-36 inches to provide sediment traps. A rock outlet was installed and all disturbed areas were seeded with ryegrass. Construction was completed by the summer of 1994 and the site was planted by volunteers in the spring of 1995. The plants used on this site included: Buttonbush, Smooth Alder, Black Willow, Possom Haw, Arrowood, Highbush Blueberry, Sweet Pepperbush, Spicebush, Swamp White Oak, Pin Oak, Overcup Oak, Black Gum, Silky Dogwood, Green Ash, Sycamore, Red Maple, Tussock Sedge, Lurid Sedge, Smartweed, Rice Cutgrass, and Manna Grass. The cost of this project totaled $142,000 and the funding was provided by Maryland Nontidal Wetlands Compensation Fund.

The site, which encompasses 8.5 acres, was planted with different types of wetland vegetation to create emergent (0.4 acres), scrub-shrub (3.0 acres), and palustrine forested wetland (5.1 acres) areas. The site is publicly accessible. Sources of hydrology include groundwater inundation and surface runoff.

The monitoring program is currently being developed with Dundalk Community College. The project manager is Kevin Smith with the Department of Natural Resources.

WYE ISLAND MITIGATION PROJECT

Location: Queen Anne's County
Proceed on Wye Island Road, right before Granary Creek picnic area, on the other side of the road, behind the field, is the mitigation site. It is split between a hedgerow.

This wetland mitigation project is being used to reach the goal of "no net loss of wetlands". Six acres of prior converted cropland was restored to forested wetland at Wye Island Natural Resource Management Area. The area was removed from agricultural production, (corn and soybeans), in the spring of 1991. The area is believed to have been a wetland at one time because the original soil is Elkton silt loam, a hydric soil. Also, the site drains into Granary Creek, a tributary of the Wye East River, in the Chester River sub-basin.

Approval for the project was granted by Maryland Historical Trust and the Critical Area Commission. The six acres is in the critical area, but not in the 100 foot buffer. Because it is believed that there was previously a wetland on this site, the most effective way to convert it back to a wetland is to understand the current hydrologic processes and work with what is already present. This area was a wet field that did not have the high agricultural productivity of other drier areas. Therefore, the area should reconvert without excessive grading. Before creation, the site had a large amount of microtopography. This is beneficial to wildlife habitat and diversity of plants and animals. It must also be understood that the site is naturally separated into two sections by the hedgerow. These two sections (North and South) were designed differently due to the difference in existing processes.

The North section was graded differently than the south section and was not planted. After grading, the North section was seeded with ***red top*** and allowed to revegetate without planting. The South section, containing more microtopography was graded around the depressions slightly to enhance them. The existing ditch in the South section, that was originally constructed to drain the site for agriculture, was altered so that it would not drain the site. In addition to the depressions being enhanced, they were hydrologically separated into hydrologically connected clusters. Because of the microtopography, this did not consist of much grading. The South section was designed to avoid water collection in one depression, thereby concentrating the species. As the water level decreases after the wet part of the growing season, the water displaces into the groups of depressions, then into each depression and becomes drier.

A timber weir was also constructed to ensure prolonged inundation. Construction of the site was finished in August, 1994 and the site was planted in the fall of 1994. After grading, the entire site was seeded with redtop and the berm was seeded with fescue in August/September, 1994. The purpose of the seeding is to stabilize the soil before planting. The site was not planted until the Spring of 1995. There was also a buffer, which was planted around the wetland bordered by the agricultural field. The buffer was planted in order to prevent agricultural residue (fertilizers, pesticides etc.) from entering the site. As stated before, only the South section was planted and only some trees and shrubs were planted. The site had already begun establishing from seeds from the adjacent PFO. The planting was done by local high school students, however, the plants were not all planted at the correct depth and were also not watered and there was not a rain storm for a few weeks after the planting. Therefore, many of the trees died. Also, the trees and shrubs were only planted in the higher areas, because the depressional areas revegetated on their own. Some of the plants included; Red Chokeberry, Sweet Pepperbush, Common Winterberry, Virginia Sweet-spires, Buttonbush, Highbush Blueberry, Possum Haw, Swamp Chestnut Oak, Swamp White Oak, Pin Oak, Green Ash, and Water Tupelo. The costs of the mitigation totaled $38,000, which was funded by Maryland Nontidal Wetlands Compensation Fund. The DNR project manager is Kevin Smith

This site is being monitored by the Maryland Conservation Corps (MCC) and Mitch Keiler. The site is divided into six transects. The MCC were trained by Mitch and the monitoring is performed twice per year in the summer and fall.

1996 WYE ISLAND MONITORING RESULTS

Data collection date: 6/96 Samplers: MCC

Site size: 6 ac

Mitigation Type: PFO

Date planted: Fall 1994

Growing season: 02

IMTF Performances Standard: 435 stems per acre by growing season 02

Number of Transects: 06

Number of circular plots: 51

Total number of stems counted: 77

Stem Density per acre at site: 582 stems per acre
* see density computations

Site conditions:

Site stem density computations:

43560 (sq ft/acre)	113 (size of plot sq ft)
<u>x 6</u>	<u>x51</u>
261,360	5763

261,360 / 5763= 45.4 (number of times the total sq ft of the sample plot goes into the total site size

stem count for all the sample plots: 77

45.4 x 77 = 3496 stems on site

3496 / 6 = <u>582 stems per acre</u>

1997 WYE ISLAND MONITORING RESULTS

Data collection date: 07/02/97 Samplers: MCC

Site size: 6 ac

Mitigation Type: PFO

Date planted: Fall 1994

Growing season: 03

IMTF Performances Standard: 538 stems per acre by growing season 03

Number of Transects: 06

Number of circular plots: 34

Total number of stems counted: 47

Stem Density per acre at site: 533 stems per acre
* see density computations

Site conditions: dry, hot, with some ponded emergent areas

Site stem density computations:

43560 (sq ft/acre)	113 (size of plot sq ft)
x 6	x 34
261,360	3842

261,360 / 3,842 = 68.0 (number of times the total sq ft of the sample plot goes into the total site size

stem count for all the sample plots: 47

47 x 68.0 = 3197 stems on site

3197 / 6 = 533 stems per acre

CLOVERFIELDS

Figure G.1: Cloverfields; showing adjacent buildings and ponding

Figure G.2: Cloverfields; showing planted trees growing (Photo Noble 8/97)

Figure G.3: Cloverfields; stress from drought conditions (photo Noble 8/97)

Figure G.4: Cloverfields, view from adjacent school (photo Noble 8/97)

Figure G.5: Cloverfields; ditch flowing out of wetland (view towards site)
(Photo Noble 8/97)

Figure G.6: Cloverfields; ponded emergent area (photo Noble 8/97)

HASHAWHA

Figure G.7:Hashawha; looking in from road (photo Noble 6/97)

Figure G.8: Hashawha; emergent area surrounding pond (photo Noble 6/97)

Figure G.9: Hashawha; emergent area (photo Noble 6/97)

Figure G.10: Hashawha; close up of arrowhead (*Sagittaria latifolia*), prominent at the site (photo Noble 6/97)

Figure G.11:Merkle; aerial photo after grading, before planting (photo 10/94)

Figure G.12: Merkle; ponding, not much herbaceous vegetation (photo Noble 6/97)

Figure G.13: Merkle; planted trees growing well, but not much herbaceous vegetation (photo Noble 6/97)

Figure G.14: Merkle; herbaceous vegetation bordering emergent area (photo Noble 6/97)

NORTH POINT

FigureG.15: North Point; view from parking lot (photo Noble 6/97)

Figure G.16: North Point; trees growing without much herbaceous vegetation (photo Noble 6/97)

Figure G.17: North Point; trees growing well (photo Noble 6/97)

Figure G.18: North Point; drought stressed tree (photo Noble 6/97)

Figure G.19: North Point; emergent area and trail behind area (photo Noble 6/97)

Figure G.20: North Point: back corner of site; some *Phragmites austrailis* and trees (photo Noble 6/97)

Figure G.21: Wye Island; north side, view facing the adjacent forest and hedgerow; trees are growing extremely well (photo Noble 8/97)

Figure G.22: Wye Island; emergent area and bird box; view away from hedgerow north side (photo Noble 6/97)

Figure G.23: Wye Island; north side; close up of emergent area with surrounding trees (photo Noble 8/97)

Figure G.24: Wye Island; north side looking into south side, behind the hedgerow with the adjacent forest to the right (photo Noble 8/97)

Figure G.25: Wye Island; north side, view facing the road; dense, diverse vegetation (photo Noble 8/97)

Figure G.26: Timber weir along hedgerow to control drainage (photo Noble 1/98)

Appendix H

Equipment Supply Houses

Equipment Type

<u>Compass, Measuring tapes,
Soil Probes and Bucket Augers</u>

Ben Meadows Company
3589 Broad Street
Atlanta, GA 30341
Phone: 1-(800)-241-6401
Fax: 1-(800)-628-2068

Forestry Suppliers, Inc.
P.O. Box 8397
Jackson, MS 39284-8397
Phone: 1-(800)-647-5368
Fax: 1-(800)-543-4203

<u>Measuring Tapes</u>

K & E
9017-F Menden Hall Court
Columbia, MD 21045
Phone: (410)-621-6000

A & E
10940 Beaver Dam Road
Hunt Valley, MD 21030
Phone: (410)-666-3800

<u>Munsell Soil Color Charts</u>

Munsell Color Company
2441 North Calvert Street
Baltimore, MD 21218
Phone: (410)-243-2171

<u>Hand Lens and Other Supplies</u>

American Biological (AMBI)
1330 Dillon Heights Avenue
Baltimore, MD 21228
Phone: (410)-747-1797

Wards Natural Science Establishment, Inc.
5100 West Henrietta Road
P.O. Box 92912
Rochester, New York 14692-9012
Phone: 1-(800)-962-2660

***Note: This is a list of some available suppliers; it does not imply endorsement of any supplier**.

Appendix I

Ticks and Lyme Disease

Lyme disease is caused by a spiral-shaped bacterium (spirochete). Infection is transmitted by the bite of an infected tick. The disease affects humans and some domestic animals including dogs, cats, horses, and cattle. Illness in humans often begins with a slowly expanding rash and may progress to involve the joints, the nervous system, and the heart. The rash, however, is not always present, and sometimes only flu-like symptoms are present.

The Lyme disease organism and the fact that Lyme disease is transmitted by ticks are recent medical discoveries. Although a Swedish dermatologist described the skin lesions associated with Lyme disease in 1909, the mystery did not begin to unfold until 1975 when a cluster of cases in children from Old Lyme, Connecticut, prompted an investigation. Hence the name...Lyme Disease. The causative agent of Lyme Disease was not discovered until 1981 when Dr. Willy Burgdorfer from the Rocky Mountain Laboratories in Hamilton, Montana, found a new spirochete associated with the midget tissues of the incriminated tick vector, Ixodes dammini. The spirochete, now known as Borrelia burgdorferi, was subsequently isolated from ticks and patients in this country as well as abroad.

Lyme disease Cycle In Nature

Ticks that are known to transmit lyme disease in the United States are the "deer" tick (Ixodes dammini) in the Northeast and Midwest and the western black-legged tick (Ixodes pacificus) in the West. In those regions, the Lyme disease organism is maintained in nature by wild animals, notably small rodents. Such animals, particulary the white-footed mouse, can harbor the bacteria without becoming sick and may remain infected for long periods, possibly for life. The Lyme disease organism is spread from an infected animal to an uninfected animal by ticks. The maintenance of Lyme disease spirochetes in nature is enhanced by the ability of the spirochete to multiply in both the tick and the small mammal hosts.

The multi-staged life cycle of the tick vectors is an important feature in transmission of Lyme disease organisms. After hatching from an egg, the tick progresses through three stages...larva, nymph, and adult. In each stage the tick obtains a blood meal from the host, drops to the ground, sheds its skin, and develops to the next stage. Thus, species of ticks known to spread lyme disease feed upon three animals during their life span. after mating and feeding on a host, adult female ticks drop to the ground, lay their eggs, and die. Immature larval and nymphal ticks prefer small mammals as hosts but also are found on birds, reptiles, and larger mammals.

Appendix J

QUALITY ASSURANCE PROJECT PLAN

CITIZEN MONITORING OF STATE PROGRAMMATIC MITIGATION SITES

Project Officer:

Supervisor: George Beston
Chief, Mitigation Section
Nontidal Wetlands and Waterways Division
Maryland Department of the Environment

Original fund source: U.S. Environmental Protection Agency
State Wetland Program Development Grant
CD 993010-01-0

TABLE OF CONTENTS

PROJECT DESCRIPTION

The Maryland Nontidal Wetlands Protection Act has been implemented since 1991, first by the Department of Natural Resources and presently by the Department of the Environment (MDE). The Act and Regulations require that Maryland achieve a "no net loss" of wetland acreage and function and to strive for a net resource gain. "No net loss" is primarily met through compensatory mitigation required of permittees whose authorized losses exceed a certain threshold (generally 5000 square feet). MDE is responsible for mitigating for small losses, and has established a number of wetlands on public and private land. These sites are referred to as "programmatic mitigation" sites.

MDE monitors its programmatic sites and takes remedial action as necessary to ensure that the sites sustain themselves as wetlands. Due to staff limitations, ongoing monitoring will progressively become more difficult as more sites are established and other responsibilities increase. In order to best manage staff resources and provide opportunities for the public to become actively involved in the state's mitigation efforts, a citizen monitoring program has been established to monitor programmatic sites on public land.

Initial tasks for this effort included preparation of new and adaptation of existing procedures for monitoring. Many procedures were adapted from the document Maryland Compensatory Mitigation Guidance, developed in 1994 by various State and federal agencies. Monitoring groups were also formed, through local educational institutions, individual research projects, the Maryland Conservation Corps, and volunteers organized through the park or public land managing agency on which the mitigation site is located. The following sites have been monitored by volunteers:

Hashawha Environmental Center
Merkle Wildlife Management Area
Little Patuxent Ridge
Wye Island Natural Resources Management Area
North Point State Park
Cloverfields

PROJECT ORGANIZATION AND RESPONSIBILITY

The Nontidal Wetlands and Waterways Division, Maryland Department of the Environment, is responsible for program implementation. The address is:

2500 Broening Highway
Baltimore, Md. 21224
(410) 631-8094

QUALITY ASSURANCE OBJECTIVES

The major objective is to evaluate the sites for evidence of the three required characteristics that make an area a wetland: water (hydrology), hydric soils, and a predominance of hydrophytic vegetation. The characteristics require less refined sampling and handling methods than are typically necessary for water quality monitoring.

I. Hydrology

1. Precision

Hydrology is measured by visual observation and notation of presence of surface water, or depth to ground water during the growing season between March through June. There are no formal laboratory measurements necessary to calculate the amount of certain substances. Monitoring location will be fixed by monitoring wells placed by MDE. Seasonal variation is natural and expected.

2. Accuracy

Volunteers will be trained using the same instructional materials. Equipment does not require strict calibration, and consists mainly of measuring tapes to measure depth to ground water. Instructions on use of equipment will be part of training sessions and training materials.

3. Representativeness

Monitoring wells will be placed by MDE in locations that will best reflect ground water patterns.

4. Completeness

Measurements are ideally taken twice per month from March through June, and monthly from July through September. However, fewer measurements have been taken in the past for monitoring both pre- and post-construction conditions. At a minimum, sampling should occur monthly from March through June. This time period reflects periods of normally high water levels in naturally occurring wetlands, particularly those that are seasonally wet. Most wetlands that will be monitored were created, restored or enhanced to be seasonally or temporarily flooded wetlands.

E. Comparability

There is only one other created wetland monitoring program for volunteers.

II. Hydric soils

1. Precision

Soil samples will be taken at different parts of the site, and variation is expected. Volunteers will have been trained in identification of hydric soil characteristics to ensure that appropriate characteristics are noted. No formal calculations are taken, though depth at which hydric soil indicators appear will be recorded. Results are based on visual observation.

2. Accuracy

No equipment requires calibration that would otherwise alter results. There is no standard for comparison in measuring when new hydric soil characteristics will occur. Volunteers will be provided with a description of soil conditions that existed upon completion of construction of the wetland, so that changes in soil characteristics may be noted over time. If necessary, MDE will visit the site to examine questionable soil characteristics.

3. Representativeness

MDE will specify general areas in which soil samples should be examined.

4. Completeness

Soil characteristics do vary as much as water levels. Water levels may be used to indicate hydric soil function.

5. Comparability

There is no standard for comparison in measuring new hydric soil features in mitigated wetlands. Procedures here are used in evaluating individual mitigation sites required of permittees under the Maryland Nontidal Wetlands Act and Regulations.

III. Plant composition

1. Precision

Precision will be largely achieved by use of standard transects. MDE will establish transect lines and sampling areas. Volunteers will also be trained to determine when other sampling locations may be added.

2. Accuracy

No equipment requiring calibration will be needed. Measuring tapes may be provided. The greatest difficulty may be in plant identification. Volunteers will be provided a list and location of species that were planted, so that these can be identified using field guides. Common plants that naturally become established in mitigated sites will also be identified for volunteers. If a species cannot be identified in the field, volunteers will be trained in techniques for collecting and preserving specimens for future identification by MDE or other designated personnel.

3. Representativeness

Procedures for establishing transects and sampling grids will ensure that the site is adequately sampled for representativeness.

4. Completeness

Dominant plant species may be best observed at different times. Sampling should take place at a minimum of two times during the growing season at intervals of at least two months. During times of drought, sites should be visited to determine survival. Indicators of stress will also be taught to volunteers.

5. Comparability

Plant sampling techniques mirror those that are well established in forest mensuration manuals.

SAMPLING PROCEDURES

See attached.

SAMPLE CUSTODY

Data sheets may be mailed to a designated contact at MDE. The only physical samples that may be transferred are plants. As some handling may occur without damage to the specimen, chain-of-custody protocols are more flexible than are necessary for water quality samples. No laboratory analyses will be required. A time may be arranged for the volunteer and staff person to meet and for MDE or a designee to receive the sample. MDE or a designee may also meet in the field to evaluate the unknown plant without gathering a specimen.

Plants shall be gathered according to standard sampling manuals. An example is included here from guidance developed by the Interagency Wetland Training Committee for U.S. Environmental Protection Agency Region III.

CALIBRATION PROCEDURES AND FREQUENCY

Equipment typically does not need calibration. Protocols for maintaining monitoring wells will be followed as attached.

ANALYTICAL PROCEDURES

Analytical methods to be used are to measure areal coverage of plant species, which is an important performance standard to be monitored. The calculations of stems/acre and areal coverage are principal measures for comparison to a performance standard. Equations for calculating stems per acre and an areal extent of 85% coverage by plant species acceptable to MDE are shown in the following examples, using the attached data sheets.

In the attached example of a 1-acre forested wetland, it is shown that there are ten sample plots with 6 foot radii. There are 43,560 square feet in 1 acre. The plots have an area of 113 square feet each, and total 1,113 square feet, or 2.6% of the site. The plots contain a total of 11 living trees > 10" in height. To calculate stems per acre, use:

(Area of site in sq.ft./acre)/[(Number of plots)x(area of plots in)]x(number of stems) = stems/acre.

DATA REDUCTION, VALIDATION, AND REPORTING

Data sheets shall be mailed to the appropriate contact at MDE, as identified during training sessions. MDE will screen the data sheets for completeness of information. Volunteers will be contacted as necessary to discuss data gaps.

At present, MDE will not be entering data into a computer system, though volunteer groups may do so. Software must be compatible with MDE operating systems.

MDE or the volunteer group will prepare reports on status of the mitigation site and monitoring effort. If a volunteer group prepares a report, MDE will respond to the volunteer contact on the acceptability of the report. MDE will provide copies of reports it prepares to the volunteer contact and include a discussion on what remedial action will be taken, if any, to improve success of the mitigation site.

Reports shall contain the following:

1. Project history and site location, with maps
2. Project design
3. Past monitoring results and contacts
4. Dates of current year monitoring efforts
5. Names of monitors and contacts
6. Results
7. Recommendations
8. Description of remedial actions to correct problems.

INTERNAL QUALITY CONTROL CHECKS

Internal quality control will be managed by the Mitigation Section Chief in the Nontidal Wetlands and Waterways Division. Reports for the different sites monitored by volunteers, as well as sites monitored by MDE, will be compared to ensure consistency. Variations to standard protocols will be acceptable if unique characteristics of a particular site require a deviation from the protocols.

Meetings will be held to ensure that all internal staff follow same protocols and understand when it will be appropriate for procedures to vary.

PREVENTIVE MAINTENANCE

There is much more flexibility in the amount of data that can be gathered to adequately monitor a mitigation site than there is for water quality monitoring. The reason is that mitigation monitoring focuses more on long term trends at the site, and a single occurrence such as a precipitation event have less importance. It is possible to monitor sites several times over the growing season and still have adequate data to determine whether the site appears to be successful or not. Therefore, it will usually not be critical if a monitoring period is missed on its scheduled date.

The spacing of visits to gather data should be sufficient to evaluate whether or not there the required hydrology is present for the site to be considered a wetland, and whether or not the desirable plant species will survive. This can be done with visits at the beginning and end of the growing season, and will show duration and fluctuations of water levels, and how plants may tolerate extreme wet or drought conditions.

MDE will address scheduling and monitoring times by agreeing on general time periods for sampling. The contact should notify MDE if sampling cannot be done and why, or MDE will call and verify that sampling was done. MDE may elect to do the sampling for that general time period or schedule a new time for the volunteers to monitor.

MDE will have extra measuring tapes and supplies. Supplies may be entrusted to the contact for the season or MDE may lend them to the monitors according to a regular schedule.

CORRECTIVE ACTIONS

Measurements taken for monitoring mitigation sites is much less precise than for water quality sampling, and thus there are much broader, more general limits on acceptable data. MDE staff will use best professional judgment in determining when the data is suspect. This approach is essential since wetland mitigation remains as much an art as a science, and success standards are likely to change over time.

The most common error will probably be in plant identification. An incorrectly identified species, particularly if it is a dominant species, can result in an inaccurate finding on whether or not the site has the proper species composition to be considered a wetland. MDE will visit the sites early in the growing season to assess conditions and plant species composition. A change from the initial conditions will trigger another visit from MDE to determine if there was a misidentification of a plant. If so, the appropriate monitors will be shown how to properly identify the plant.

QUALITY ASSURANCE REPORTS

An annual report will be produced describing data accuracy for each site, completeness, results of quality control reviews, and recommended changes to the overall monitoring program.