

# Delaware Wetland Monitoring Strategy



Delaware Department of Natural Resources  
and Environmental Control  
Division of Watershed Stewardship  
Watershed Assessment Section  
820 Silver Lake Blvd., Ste 220  
Dover, DE 19904

Program Contact:  
Alison Rogerson  
(302) 739-9939

[Alison.Rogerson@state.de.us](mailto:Alison.Rogerson@state.de.us)

Last updated:  
March, 2011

## **Introduction**

The State of Delaware is committed to assessing its wetland resources to understand the current condition of the resource and how this condition is changing over time. Understanding the condition of wetlands will ultimately improve the condition of wetland resources in the state by allowing the State and other conservation partners to better direct resources aimed at restoration and protection efforts by avoiding further impacts to high quality wetlands and promote restoration of degraded wetlands. As wetlands are waters of the State, this wetland monitoring strategy is part of the State's overall Water Monitoring Strategy that directs the State's efforts to assess the condition of all waters.

Wetlands comprise approximately 30% of the State's land surface (Tiner 2001) and perform valuable functions including nutrient transformation, stormwater retention, carbon sequestration, sediment deposition, providing habitat for wildlife and maintaining the State's biodiversity. These wetland functions in turn provide valuable ecosystem services such as improving water quality, reducing flooding, providing recreational opportunities and enhancing aesthetics and viewscapes. Additionally, because of their prominence in the State they are an important cultural resource to the citizens of Delaware that have supported traditions and customs for centuries. Direct and indirect impacts to wetlands can reduce the condition and subsequently the functions and ecosystem services that wetlands provide.

***The vision of the Wetland Monitoring and Assessment Program (WMAP) in the Delaware Department of Natural Resources and Environmental Control (DNREC) is to achieve an annual net gain in wetland acreage and condition to be able to support the wealth of services that wetlands provide to the citizens and visitors of Delaware.***

### **The goals of the WMAP which will achieve our vision are:**

- Goal 1.** Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions
- Goal 2.** Inform the citizens and visitors of Delaware, other State programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource
- Goal 3.** Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting

Goal 1. is a direct product of the ongoing efforts to monitor and assess the condition, function, and services of wetlands in the state and integrating the latest research to understand the connection between the metrics and measures that are evaluated and actual processes and implications on services that wetlands provide. Goals 2 and 3 apply the information generated in Goal 1 to positively affect the decisions being made about



the management, restoration, and protection of wetlands (Figure 1.). This monitoring strategy will guide future efforts of the WMAP in each of these three goals.

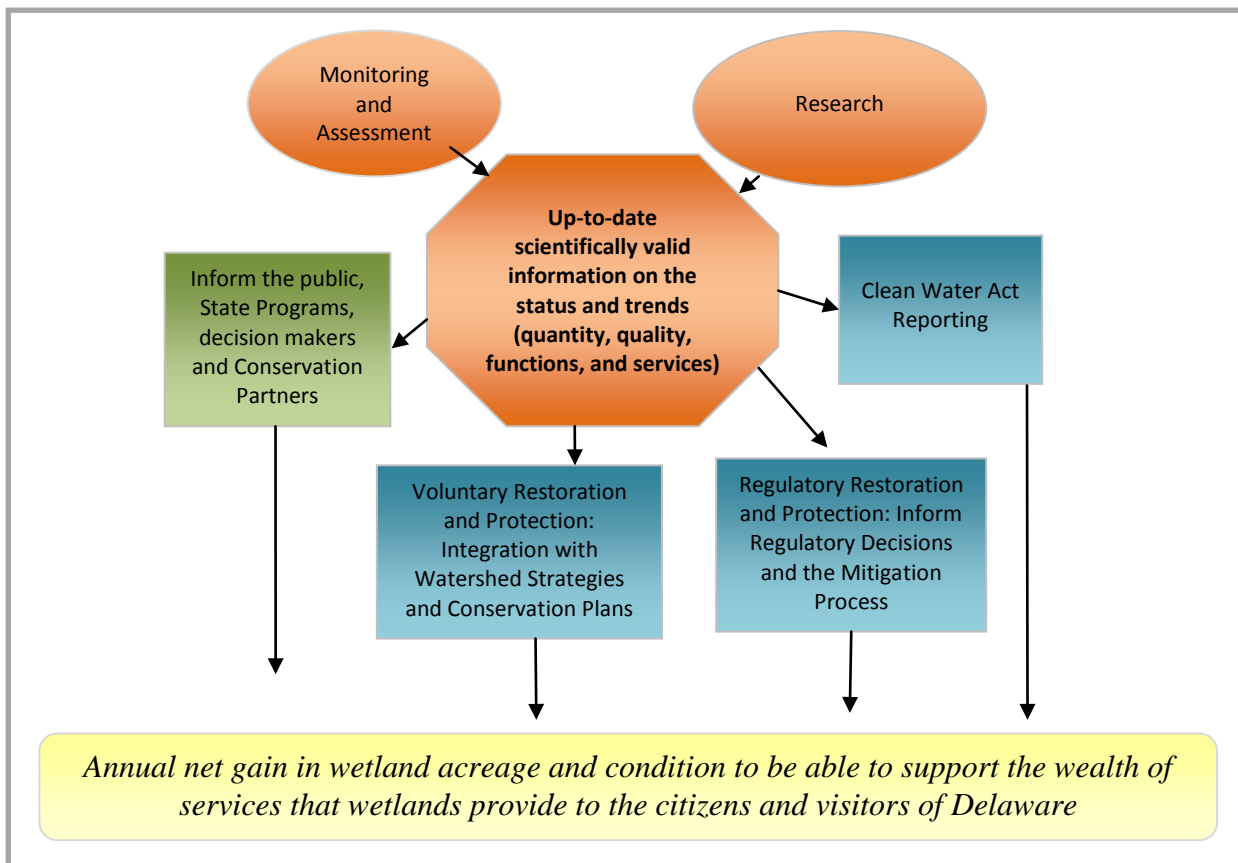


Figure 1. Components of the Delaware Wetland Monitoring and Assessment Program (WMAP). The three goals of the program (shown in orange, green, and blue) needed to achieve the vision of the WMAP in yellow.

### Supporting Document to the Delaware Wetland Conservation Strategy

The goals and objectives outlined in the Delaware Wetland Monitoring Strategy (Monitoring Strategy) support many of the goals of the Delaware Wetland Conservation Strategy

(<http://www.dnrec.delaware.gov/Admin/DelawareWetlands/Documents/Delaware%20Wetlands%20Conservation%20Strategy%2008.29.08.pdf>).

The Delaware Wetland Conservation Strategy (Conservation Strategy) was developed by representatives from every Division of the Department of Natural Resources and Environmental Control (DNREC) and the Division of Forestry within the Department of Agriculture and is signed by the Secretary of DNREC. The Conservation Strategy is the final product of a process through which current programs in the state were analyzed to identify gaps in protection, management and understanding of wetland resources. Concerns for current programs were expressed by wetland program managers and other professionals. The Conservation Strategy highlights successes, identifies gaps and areas of program overlap, and recommends approaches with measurable outcomes for enhancing and improving wetland protection on various fronts. *The Monitoring Strategy highlights the connection*

between these two documents by including the Conservation Strategy Goal and Action Item in parentheses following each Task in the Monitoring Strategy.

**GOAL 1. Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions**

Goal 1. Includes protocol development to have scientifically robust assessment methods for evaluating wetlands, monitoring and assessment implementation to guide the process with which wetlands in the state will be evaluated, and research to answer specific questions that arise to support better wetland protection, management, and restoration.

**Protocol Development**

The assessment of wetland condition requires methods appropriate for the diversity of wetland types in Delaware. The WMAP has been developing methods using a 4-tiered approach that includes levels of assessment methods: intensive assessment, comprehensive field assessment, rapid assessment, and landscape assessment. The four tiers of assessment vary in the detail of data that are collected and the resources that are needed to perform an assessment. The multi-tiered approach provides options depending on the specific goals and resources available for a project.

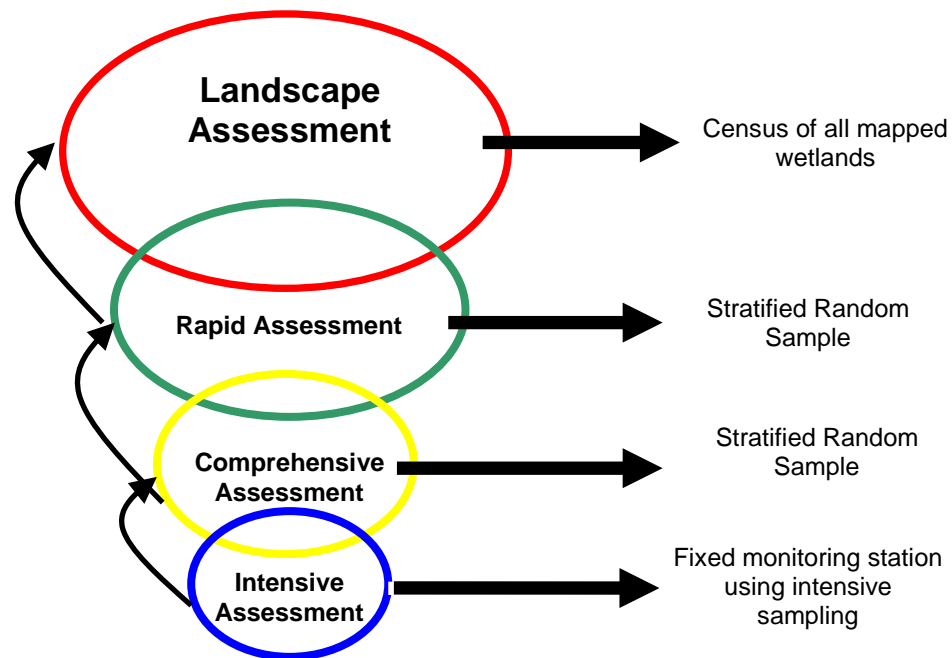


Figure 2. Four tiered approach to wetland assessment. The level of information and amount of effort increases from landscape assessment to intensive assessment.

Landscape Assessment

Landscape assessment involves the prediction of wetland condition based on surrounding land use features that can be remotely detected. For example, if a

wetland is surrounded by suburban development, certain predictions can be made about how the wetland functions have been impacted based on studies that have documented the effects of various features associated with development such as increasing impervious surface, increased feral animals, increased noise, etc. The benefits of landscape level analysis are that access to private lands is not limiting, a complete census of all wetlands can be performed, and time and effort is greatly reduced because no field visits are required. The disadvantages to landscape level assessment are that predictions of wetland condition and function are based on documented relationships and may not always apply to specific wetlands. Also, detailed information is limited based on the type of indicators that can be assessed using remote information, and staffing with GIS capabilities are required.

Weller et al. (2007) developed a landscape level assessment method in the Nanticoke watershed to predict the condition of flat and riverine wetlands based on surrounding landscape attributes. This method is a validated assessment because the predictive models were developed based on comprehensive assessment data collected on the same sites. This method can be used to predict the condition of a group of wetlands in the same HGM subclass, but is not able to predict the condition of individual wetlands with a high level of confidence. This method could be useful for prioritizing watersheds based on their level of condition. However, this method will need to be tested in additional watersheds outside of the Nanticoke to determine its applicability to the rest of the state.

#### Rapid Field Assessment

The Delaware Rapid Assessment Procedure (DERAP) is a rapid assessment method for determining the condition of a wetland based on a short site visit. The DERAP was developed to meet the needs of users that require a rapid assessment of the general condition of a wetland that is based on current site conditions. The DERAP uses a 2-page checklist of stressors and other site features to produce an overall score of wetland condition.

The DERAP is calibrated to the Delaware Comprehensive Assessment Procedure (DECAP) Index of Wetland Condition (DECAP IWC) using step-wise multiple regression analysis to select the stressors that best define differences in sites, and then multiple linear regression (MLR) to assign weights to the stressors. Each wetland class is calibrated separately to produce weights for each wetland type. An overall score for a site is calculated by subtracting the sum of the weights for all the stressors that are present from the possible score if no stressors are present.

The advantages of the DERAP are that it requires less time and field staff to perform, produces an overall assessment of condition that is calibrated to the DECAP, and provides an assessment of the stressors that are impacting the site. The disadvantages to the DERAP are that it does not provide the detail of information to calculate functions and services, and may not provide the level of information needed to make some management decisions.

### Comprehensive Field Assessment

The Delaware Comprehensive Assessment Procedure (DECAP) is a comprehensive assessment method for determining the condition of a wetland site relative to reference condition. The DECAP and associated assessment models have been developed and refined by both regional and national wetland scientists following standard HGM development guidelines. Protocols for the DECAP can be obtained by contacting DNREC Watershed Assessment Section.

The DECAP is used to collect data on each reference site and encompasses a variety of parameters including vegetation, hydrology, soils, topography, structure, and surrounding landuses. The goal is to collect data on a wide variety of parameters to determine which ones distinguish sites based on disturbance. These data are then used to scale variables and functions for each wetland subclass. Variables (for example the density of trees per hectare) are scaled based on the reference sites. The highest score of 1.0 indicates that the variable is equivalent to a Reference Standard site (or minimally impacted) ranging down to a score of 0.1 for a highly degraded site where restoration is possible, or 0.0 for a site where restoration is no longer possible for that variable. Variables are then combined into mathematical equations that were developed by a group of wetland scientists to depict functions including maintenance of characteristic hydrology, wildlife habitat integrity, plant community integrity, biogeochemical cycling, and buffer integrity. The final function score is not an absolute value of performance of a function but rather an index of how much that function is departing from a reference standard or minimally altered site.

Field protocols and models are in different stages of development for the various wetland types in Delaware (Table 1). Once a method has been developed for a group of wetlands, it can be implemented for monitoring purposes.

### Intensive Assessment

Intensive assessment involves the direct measure of specific wetland functions, processes and ecosystem services. Intensive assessments are performed to validate landscape, rapid, and comprehensive assessments and to determine long term changes in wetlands. Currently, the WMAP is working to establish permanent monitoring stations in wetlands throughout the State to collect baseline data on healthy and impacted wetlands and to determine how they are responding to different stressors and changing overtime.

## **Monitoring and Assessment Implementation**

The WMAP uses the 4-tiered assessment protocols to determine the quality of Delaware's wetlands and assess the functions and ecological services that they are providing. However, to develop a comprehensive strategy from site selection to data analysis, various other factors must be considered. The following is an overview of the components of a wetland monitoring and assessment program as outlined in the EPA

document, “Application of Elements of a State Water and Monitoring and Assessment Program for Wetlands”.

**Wetland Mapping**

The most recent wetland maps for the State are based on 2007 aerial photography. These maps updated prior NWI and State maps from 1981/2 and 1992, respectfully using existing Soil Surveys, land use data, statewide natural heritage data, and color-infrared photointerpretation. The Cowardin classification system and the LLWW system that identifies landscape position, landform, and hydrology modifiers was used to label each wetland polygon in addition to special state modifiers including exceptional ecological community types.

**Wetland Classification**

We are using an HGM-based system for classifying wetlands in Delaware that was developed for the mid-Atlantic by Brooks et al. (in press). Appendix A. provides a description of the subclasses including example communities, hydrology, NWI classification, and major sources of variation. The different wetland types can be differentiated using the wetland maps that have been improved with the HGM modifiers.

**Survey Design**

The wetland monitoring strategy for the State of Delaware involves two levels of survey design. The first is to prioritize the order in which watersheds in the state will be monitored and the second is to define how we will select sampling locations within a watershed.

Prioritization of watersheds

Prioritization of watershed monitoring efforts will be based largely on the TMDL implementation schedule. By following this schedule, comprehensive information about the surface waters and wetlands can be combined to develop the best restoration strategy for each watershed. Figure 3 depicts a tentative schedule for future wetland monitoring efforts. The actual dates that these watersheds will be sampled and how

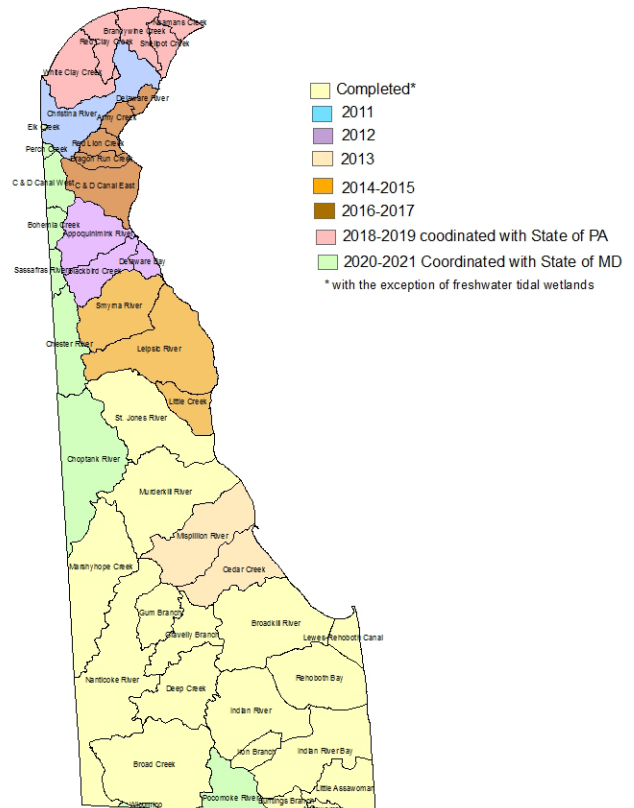


Figure 3. State of Delaware Wetland Monitoring Schedule

many rounds will be sampled in a year will depend on the availability of resources at the State level and development of appropriate methods. The intent of the State is to monitor these watersheds using a rotating basin approach once an initial assessment of the wetlands within each watershed has been performed.

Watershed sampling design - The approach used to select sampling locations within a watershed will be a probabilistic sampling design. We currently rely on technical support from EPA's Ecological Monitoring and Assessment Program (EMAP) to randomly select sampling sites within mapped wetlands in a watershed. DE DNREC supplies the base map and any additional criteria such as excluding manmade ponds or only including tidal or non-tidal wetlands. Currently EPA is working on developing a program that would allow states to perform this operation independently. The base map that will be used for all watersheds will be the most up-to-date wetland layer available.

### **Assessment Indicators and Methods**

The State of Delaware is developing multiple levels of assessment methods to evaluate wetland condition. These levels include a landscape level assessment, Rapid Field Assessment and Comprehensive Field Assessment (Figure 2) and are described in the Protocol section above. Because the DERAP has been calibrated to the DECAP and we are achieving high correlations between the 2 methods, we use a combination of rapid and comprehensive assessments to evaluate the condition of the random sites. We determined that the most efficient use of our resources to collect the most accurate data is to perform comprehensive assessments at approximately 20% of the sites and rapid assessments at the remainder of the sites. We also continue to perform rapid assessments along with the comprehensive protocol to continue to check the correlation of the two methods. Level 1 assessment may be used to provide additional information for prioritizing which watersheds to monitor in the future.

### **Field Data Collection**

Deployment of field crews will be based out of the DE DNREC/ Watershed Assessment Office in Dover, DE. This location will house workspace for field crews and computers in which to produce maps and store data. Field crews will depart from this location daily unless we are partnering with another organization to assess the watershed and there is a more suitable location for field crews to be housed.

Based on our experience, we believe that it is essential to have a fulltime coordinator who is responsible for implementing the monitoring in a watershed. This person should be dedicated full time to this task to be able to effectively manage the large amount of information and oversee the multitude of tasks needed to be accomplished to assess the wetlands within a watershed. This person will work directly under the Project Manager who is a DNREC employee.



Access to private property will be essential to the success of this program. We will only sample sites on private property in which we have received permission from the landowner. We have found that, in general, private landowners in Delaware are very receptive to having field crews collect data on their property that will be used to improve the resources in their watershed. As part of every monitoring effort in a watershed, we will continue to include a public outreach component aimed at distributing information on the goals of the program as well as summaries of the data that we collect.

### **Quality Assurance Program and Project Plans**

The WMAP collects and manages all data under an EPA approved Quality Assurance Project Plan (QAPP). These plans are updated before data are collected in each watershed. The QAPP covers project/ task organization, training, data generation and acquisition, sampling design, sampling methods, quality control, equipment testing, data management, assessment and oversight, and data review verification and validation. A copy of the QAPP can be obtained from DE DNREC/ Watershed Assessment Section.

### **Data Management Procedures**

Training - All persons involved in the data collection process will be required to complete training to properly use the assessment protocols. One to two day training sessions will be offered by DNREC and will consist of lectures on how to properly use the protocols, high quality data collection practices, and field training to demonstrate the techniques. Field crew leaders will be required to have additional training consisting of participating on a field crew to collect data until the program manager is confident that they are proficient with the techniques. While collecting data, the current QAPP will be followed to ensure the highest quality of data.

Data Collection – All data collection will be performed using the standardized DE Comprehensive Assessment datasheets and DE Rapid Assessment datasheets. DERAP may also be recorded using a palm computer which has the current version of the DERAP datasheets. Current versions of both methods are available from the DE DNREC/ Division of Watershed Stewardship/ Watershed Assessment Section.

Data Storage – All data will be entered into an Access computer database that has been developed to consistently store wetland assessment data. Additionally, if STORET becomes compatible with entering this type of information we will consider its use for including all or parts of the data collected.

### **Project Reporting Venues**

A final report for documenting the condition of wetlands on the watershed scale and the wetland watershed profile will be produced. The condition of wetlands on the watershed scale will be included in Delaware's 305(b) report for the State.

Other information will be produced as needed from the data collected including information to assist with prioritizing restoration and protection efforts.

### **Program Evaluation**

A team of scientists and managers will be assembled to review our wetland monitoring strategy every 5 years. This team will consist of individuals with knowledge of sampling methods and techniques, survey design, as well as individuals that will be users of this information including planners and managers. After the team performs a review, the comments will be incorporated into Delaware's wetland monitoring strategy.

### **Research**

Research is an integral component of the WMAP to ensure that we are using appropriate methods to assess wetlands as well as obtain a more in-depth understanding between our assessment methods and the functions and processes that they predict. Research provides information on the effects of land use decisions and management actions to inform our efforts to protect and restore wetlands. Research is also needed to respond to unexpected events that affect wetlands.

### **Goal 1. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time-line for tasks is outlined in Appendix B.**

- 1 Develop scientifically valid assessment methods for wetlands that evaluate the condition of the resource relative to reference condition
  - Task A Develop regional flat HGM model using reference data from Delaware, Maryland, and Virginia (B-1)
  - Task B Update Riverine flat HGM model to incorporate beaver impoundments (B-1)
  - Task C Adapt DECAP and DERAP to evaluate freshwater tidal forested wetlands (B-1)
- 2 Assess the ambient condition of wetlands by watershed in Delaware and identify major stressors that are impacting wetlands
  - Task D Assess wetlands in specified watersheds based on monitoring schedule (Figure 3; B-1)
  - Task E Participate in National Wetland Condition Assessment in 2011 (B-1)
- 3 Maintain long-term monitoring sites in every HGM subclass
  - Task F Establish long-term monitoring sites in riverine and flat wetlands (B-1)

- Task G Evaluate the use of long-term data to improve assessment methods (DECAP and DERAP; B-1)
- 4 Perform research to improve our understanding of wetland functions, the impact of stressors, and ecosystem services
  - Task H Evaluate the relationship between wetland condition and the services that they provide (B-1, E-10)
  - Task I Determine the relationship between NWI functions based on LLWW codes and functional scores from site assessment using DECAP
  - Task J Evaluate if tidal wetlands in Delaware are keeping pace with sea level rise (A-4)
  - Task K Evaluate the use of beneficial dredge material as a method of restoring tidal wetlands

**GOAL 2. Inform the citizens and visitors of Delaware, other State programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource.**

Outreach and education is a critical link between obtaining information on the status of wetlands in Delaware and improving the condition of wetlands on the ground. Outreach and education efforts will focus on relaying information from the monitoring, assessment, and research efforts as well as the overall value and services of wetlands.

The condition of wetlands including the identification of major stressors that are impacting wetlands as determined through the monitoring program will be valuable for wetland education efforts. The goal is to share wetland condition information and the identified stressors with conservation partners, decision makers and the public to gain their support in reducing wetland stressors through restoration, management and protection. Literature and online resources are being designed to share with the public in order to educate them in ways that they can work with their local land use decision makers to protect wetlands from encroaching development. The website also serves the public by instructing homeowners on steps to minimize their footprint on their local watershed. A wetland restoration guidebook has been published and distributed to inform private landowners of programs, funding and options available to restore wetland areas.

The information collected through the monitoring and assessment program will be shared with the public and other conservation partners through a Delaware Wetlands Website, Delaware Wetlands literature, and a biennial Wetlands Conference. Wetland Workshops

will be held and presentations will be conducted focusing on public participation in wetland restoration and protection.

**Goal 2. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time line for tasks is outlined in Appendix B.**

- 1 Use wetland monitoring data to educate State programs, decision makers, conservation partners, and the general public to improve efforts to protect and restore wetlands.

Task L Post wetland assessment results via technical reports and wetland report cards as each watershed assessment is completed on the Delaware Wetlands Website (A-5, A-7, B-4)

Task M Make the most recent versions of the assessment methods and protocols available on the Delaware Wetlands Website (A-5, A-7)

Task N Host a biennial Wetlands Conference to encourage communication amongst biologists, managers, educators, and decision makers in 2012 and 2014 (D-2)

Task O Create Data Portal to allow access to all wetland related information in the state (A-6, A-7, A-8)

- 2 Distribute information about the value of wetlands and the services they provide to the public and decision makers through the Delaware Wetlands Website and brochures.

Task P Maintain the Delaware Wetlands Website with up-to-date information (A-5, A-7)

Task Q Expand Delaware Wetlands message through the use of social media

Task R Create literature for non-technical audiences on the status, condition and the monetary and biophysical values of wetland functions to use during presentation and outreach opportunities (D-1, E-9)

Task S Create literature on the monetary and biophysical values of wetlands for natural resource professionals and managers, the public, and decision makers (E-10)

- 3 Provide training for wetland professionals, the public, and decision makers.

Task T Host training workshops for wetland scientists, educators, and volunteer participants to disseminate updates on monitoring protocols, data collection methods, and quality assurance techniques (B-3)

- Task U Host workshops for local decision makers in Kent and Sussex County about the benefits of wetlands while providing them with tools available for wetland protection (E-7)
- Task V Provide technical training on the use of the DECAP, DERAP, and MidTRAM to wetland professionals (B-3)

**GOAL 3. Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting**

The results generated from monitoring efforts will be used to enhance regulatory and voluntary wetland restoration, management, and protection programs in the state. Data will also be compiled and included in the State's 305(b) report as part of the Clean Water Act requirements. The data obtained during monitoring efforts will serve to inform State restoration partners of the type of wetlands most in need of restoration and protection, which will be shared in summaries generated by the WMAP.

The assessment results will be used to enhance existing regulatory programs and evaluate the need for additional regulations. Based on the recommendations from the wetland monitoring reports for assessed watersheds, regulations that would address dominant stressors impacting wetlands will be evaluated to determine how to make them more effective. Additionally, mitigation provides an opportunity to incorporate the assessment methods (DERAP, DECAP, and MidTRAM) to improve restoration practices and focus future sites in areas identified as priorities in the watershed restoration plans.

Voluntary restoration will be promoted through the development of watershed restoration plans. Based on assessment results, restoration can be focused on the dominant stressors that are impacting different wetland types. Watershed level restoration plans in watersheds with completed wetland assessments will be developed using the wetland data as well as other relevant science-based information that is available (i.e. rare species and communities, soils, hydrology, land use). These plans will provide direction and detail for restoration and protection project planning. Once the plan is completed, outreach will be performed to landowners in priority areas to initiate restoration in these areas.

The National Water Quality Inventory Report to Congress (305(b) report) is the primary vehicle for informing Congress and the public about general water quality conditions in the United States. This document characterizes our water quality, identifies widespread water quality problems of national significance, and describes various programs implemented to restore and protect our waters. The condition of wetlands on the watershed scale was included in Delaware's 305(b) report for the State beginning in 2008 for the Nanticoke Watershed.



**Goal 3. Actions and Future Tasks (associated tasks from the Delaware Wetlands Conservation Strategy are listed in parentheses). A time line for tasks is outlined in Appendix B.**

- 1 Enhance existing regulations and evaluate the need for additional regulations based on the assessment results
  - Task W Adapt DERAP and test the use of the assessment method for use in making CWA Sec. 401 decisions (F-3)
  - Task X Evaluate the performance of wetland restoration and other compensatory wetland mitigation in replacing wetland acreage and function (FF-1, F-2, F-3, F-6)
  - Task Y Work with Army Corps and other organizations to incorporate assessment methods (DECAP, DERAP, MidTRAM) and reference data into the mitigation process to improve site performance
  - Task Z Work with the Army Corps to use completed restoration plans to locate future mitigation sites (C-1)
  - Task AA Facilitate discussions with legislators and decision makers on the status and value of wetlands (E-7)
- 2 Improve voluntary restoration and protection based on the assessment results
  - Task BB Integrate monitoring and assessment data into watershed restoration plans and other conservation strategies (C-1)
  - Task CC Assess pre- and post conditions at restoration sites to determine habitat, water quality, and flood storage changes (C-5)
  - Task DD Disseminate information on programs that are available to landowners to perform voluntary restoration (B-5)
- 3 Include assessment results in state's Clean Water Act Reporting
  - Task EE Report on the condition of wetlands in compliance with the Clean Water Act

<b>HYDROGEOMORPHIC CLASS<sup>1</sup></b> Subclass	<b>Dominant water sources of class and flow dynamics</b>	<b>Major source of variation within subclass</b>	<b>NWI vegetation classes<sup>2</sup></b>	<b>Regional example</b>	<b>Protocol Development</b>
<b>FLAT</b>	Precipitation; Vertical fluctuation				
<b>Mineral soil</b>		Hydroperiod and fire frequency	FO, SS, EM	Wet flatwoods/ Broad areas with poor drainage on mineral soils	Completed combined protocol for organic and mineral flats in the Coastal Plain
<b>Organic soil</b>		Peat depths (from histic epipedons to histosols)	FO, SS, EM	Great Cypress Swamp/ Broad areas with poor drainage that accrete organic matter	
<b>SLOPE</b>	Groundwater discharge and interflow; Unidirectional & horizontal				
<b>Mineral soil</b>		None available	FO, SS, EM	Spring seep	In development by UDE
<b>Organic soil</b>		None available	FO, SS, EM	Forested fen	
<b>Sea-level fen</b>	Groundwater seepage, oligotrophic, acidic freshwater		EM	Sea-level fens	Low priority because there are only a few in the State and Heritage monitors them
<b>DEPRESSION</b>	Precipitation or groundwater; vertical fluctuation				
<b>Inland</b>	With or without inlet and outlets	Hydrology	FO, SS, EM,	Coastal plain ponds, forested depressions	Completed for Coastal Plain
<b>Interdunal Swale</b>	Groundwater driven	Groundwater withdrawal causing intrusion of salt water, ditching, dune crossings, OMWM, invasive species	PEM	Along Atlantic coastal strand and barrier islands, shallow depressions behind primary dune ridges	Not developed
<b>Human impounded or excavated</b>		Size of catchment	SS, EM, AB	Borrow pits; some farm ponds;	Not developed

<sup>1</sup>Upper case in bold are HGM classes; lower case in bold are regional subclasses, except for deepwater environments.

<sup>2</sup> NWI vegetation classes: forested (FO), scrub-shrub (SS), emergent (EM), aquatic bed (AB), unconsolidated shore (US), unconsolidated bottom (UB), riverine (R), Lacustrine (L), estuarine (E), marine (M).

<b>RIVERINE – non-tidal</b>	Overbank flow from channel and groundwater discharge; Unidirectional				
<b>Intermittent-Upper perennial</b>	Non-tidal	Range of hydroperiods within riparian zone (usually < third order), gradient high, water velocities fast.	FO, SS, EM, AB	Riparian forest	Completed combined model for Riverine wetlands on Coastal Plain
<b>Lower Perennial</b>	Non-tidal	Range of hydroperiods within 100-y floodplain, including in-stream terraces and bars (usually > third order) Gradient is typically low; water velocities slow.	FO, SS, EM, AB	Bottomland or floodplain forest	
<b>Beaver-impounded</b>		Dam more temporary than human-impounded; usually < third order	FO, SS, EM, AB	Beaver pond	In development
<b>Human-impounded<sup>4</sup></b>		Range of water residence times based on impoundment volume and discharge	FO, SS, EM, AB	Mill ponds; large farm ponds created in stream	Not developed
<b>ESTUARINE TIDAL FRINGE</b>	Mixture of sea and fresh water; bi-directional and horizontal				
<b>Estuarine lunar intertidal</b>					
	Freshwater tidal (ETF)		FO, EM, AB	Freshwater tidal swamps	Not Developed
	Brackish tidal (ETB)	Meso-polyhaline (>5 ppt)	EM, AB	<i>Spartina alterniflora</i> -dominated zone	Meso-polyhaline model in development
		Oligohaline (.5 – 5ppt)		<i>Nuphar advena, Zizania aquatica</i> dominated	Not developed
<b>Estuarine subtidal</b>		Low energy regime allows SAV establishment (Salinity ranges - 0 to >30ppt)	FO	Mud and sand flats; SAV beds; Oyster reefs	Not developed
<b>Estuarine impounded</b>		Flow is blocked by dike, gate, or dam; water source precipitation except for controlled delivery of estuarine water of varying salinity	FO, EM, AB	Waterfowl impoundments?	Not developed
<b>MARINE TIDAL FRINGE</b>	Marine source; bi-directional and horizontal	<i>March 2011</i>		<i>Page 16</i>	
<b>Marine intertidal</b>		N/A	US	High energy beach	Not developed

## Appendix B. 5-Year Schedule for Completing Tasks Associated with each Goal.

**Goal 1. Obtain up-to-date scientifically valid information on the status and trends (quantity, quality, functions and services) of wetlands to make wise management decisions**

Task	2011	2012	2013	2014	2015
<b>A. Develop regional flat HGM model using reference data from Delaware, Maryland, and Virginia</b>	<b>X</b>	<b>X</b>			
<b>B. Update Riverine flat HGM model to incorporate beaver impoundments</b>		<b>X</b>			
<b>C. Adapt DECAP and DERAP to evaluate freshwater tidal forested wetlands</b>			<b>X</b>		
<b>D. Assess wetlands in specified watersheds based on monitoring schedule</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>E. Participate in National Wetland Condition Assessment in 2011</b>	<b>X</b>	<b>X</b>			
<b>F. Establish long-term monitoring sites in riverine and flat wetlands</b>		<b>X</b>	<b>X</b>		
<b>G. Evaluate the use of long-term data to improve assessment methods</b>		<b>X</b>	<b>X</b>		
<b>H. Evaluate the relationship between wetland condition and the services that they provide</b>		<b>X</b>	<b>X</b>		
<b>I. Determine the relationship between NWI functions based on LLWW codes and functional scores from site assessment using DECAP</b>				<b>X</b>	<b>X</b>
<b>J. Evaluate if tidal wetlands in Delaware are keeping pace with sea level rise</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>K. Evaluate the use of beneficial dredge material as a method of restoring tidal wetlands</b>		<b>X</b>	<b>X</b>	<b>X</b>	

**Goal 2. Inform the citizens and visitors of Delaware, other state programs, decision makers and conservation partners about the functions and services of wetlands so they can make decisions that will improve the resource**

<b>Task</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
<b>L. Post wetland assessment results via technical reports and wetland report cards as each watershed assessment is completed on the Delaware Wetlands Website</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>M. Make the most recent versions of the assessment methods and protocols available on the Delaware Wetlands Website</b>		<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>N. Host a biennial Wetlands Conference to encourage communication amongst biologists, managers, educators, and decision makers in 2012 and 2014</b>		<b>X</b>		<b>X</b>	
<b>O. Create Data Portal to allow access to all wetland related information in the state</b>	<b>X</b>				
<b>P. Maintain the Delaware Wetlands Website with up to date information</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>Q. Expand Delaware Wetlands message through the use of social media</b>	<b>X</b>	<b>X</b>			
<b>R. Create literature for non-technical audiences on the status, condition and the monetary and biophysical values of wetland functions to use during presentation and outreach opportunities</b>	<b>X</b>	<b>X</b>			
<b>S. Create literature on the monetary and biophysical values of wetlands for natural resource professionals and managers, the public, and decision makers</b>	<b>X</b>	<b>X</b>			
<b>T. Host training workshops for wetland scientists, educators, and volunteer participants to disseminate updates on monitoring protocols, data collection methods, and quality assurance techniques</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>
<b>U. Host workshops for local decision makers in Kent and Sussex County about the benefits of wetlands while providing them with tools available for wetland protection</b>		<b>X</b>	<b>X</b>		
<b>V. Provide technical training on the use of the DECAP, DERAP, and MidTRAM to wetland professionals</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>	<b>X</b>



**GOAL 3. Protect and restore wetlands through a variety of tools including regulatory and voluntary programs including integration with watershed strategies and conservation plans, informing regulatory decisions and the mitigation process, and Clean Water Act reporting**

<b>Task</b>	<b>2011</b>	<b>2012</b>	<b>2013</b>	<b>2014</b>	<b>2015</b>
<b>W. Adapt DERAP and test the use of the assessment method for use in making CWA Sec. 401 decisions</b>	X	X			
<b>X. Evaluate the performance of wetland restoration and other compensatory wetland mitigation in replacing wetland acreage and function</b>			X	X	X
<b>Y. Work with Army Corps and other organizations to incorporate assessment methods (DECAP, DERAP, MidTRAM) and reference data into the mitigation process to improve site performance</b>	X	X	X		
<b>Z. Work with the Army Corps to use completed restoration plans to locate future mitigation sites</b>	X	X	X		
<b>AA. Facilitate discussions with legislators and decision makers on the status and value of wetlands</b>	X	X	X		
<b>BB. Integrate monitoring and assessment data into watershed restoration plans and other conservation strategies</b>	X	X	X	X	X
<b>CC. Assess pre- and post conditions at restoration sites to determine habitat, water quality, and flood storage changes</b>	X	X	X		
<b>DD. Disseminate information on programs that are available to landowners to perform voluntary restoration</b>	X	X			
<b>EE. Report on the condition of wetlands in compliance with the Clean Water Act</b>		X		X	