

CREATING INDICATORS OF WETLAND STATUS (QUANTITY AND QUALITY)

FRESHWATER WETLAND MITIGATION IN NEW JERSEY



**NJ Department of Environmental Protection
Division of Science, Research, & Technology**

March 2002





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March 2002

Dear Reader:

Attached is a copy of the report of the research project entitled, "Creating Indicators of Wetland Status (Quantity and Quality): Freshwater Wetland Mitigation in New Jersey." The primary objectives of this study were to assess New Jersey's progress toward wetlands mitigation goals and develop indicators of progress toward these goals. The research was conducted by Amy S. Greene Environmental Consultants, Inc. (ASGECI), and co-managed by scientists from both the New Jersey Department of Environmental Protection's (NJDEP) Division of Science, Research and Technology (DSRT) and NJDEP's wetlands regulatory program (Land Use Regulation Program or LURP). This study was supported by NJDEP's Water Assessment and Environmental Indicators Research Programs. Relevant NJDEP managers were kept apprised of interim results and a peer review committee of leading state and national wetland scientists provided guidance throughout the duration of the study.

Background

Approximately 15% of New Jersey's land is freshwater wetlands, while 4% is tidal wetlands. Wetlands are critical natural resources because they perform a suite of important functions including: improvement of water quality through nutrient cycling; flood attenuation; groundwater recharge; prevention of shoreline erosion; critical habitat for a great diversity of plant and animal species; as well as providing aesthetic and recreational opportunities. It has been estimated that New Jersey lost 39% of its wetlands between the 1870s and 1970s and perhaps 20% between the 1950s and 1970s. The importance of tidal and freshwater wetlands was recognized when the New Jersey Legislature enacted the New Jersey Wetlands Act of 1970 and the New Jersey Freshwater Wetlands Protection Act of 1987 (considered to be one of the most stringent wetland laws in the United States). These state statutes provide additional protection beyond federal law by regulating more than dredge and fill activities, as well as providing protection in buffer areas for freshwater wetlands.

Yet, as the most densely populated state in the country, experiencing a population increase of approximately 1% annually over the last 10 years, New Jersey's wetland resources are subject to increasing stress. Recent data for New Jersey show a loss of approximately 1,755 acres of wetlands per year between 1986 and 1995, a period of time before the Freshwater Wetlands Protection Act had become fully operative. Even after that period, the implementation of the Act

has still allowed for the disturbance of approximately 150 acres of freshwater wetlands per year. Recognizing their importance, as well as these challenging trends, NJDEP has established a strategic planning goal for wetlands: *“improve quality and function and achieve a net increase by 2005. Explore innovative techniques for creation, enhancement and maintenance of New Jersey wetlands.”*

Techniques to mitigate the loss of wetlands from permitted activities include wetland creation, enhancement, restoration, preservation and banking. The attached report describes research that was specifically developed to measure progress toward the wetlands strategic planning goal with respect to mitigating wetland losses at freshwater sites. Freshwater sites were chosen as the study focus because these are the wetlands types with the most acreage in New Jersey, yet least studied in terms of mitigation. The research provides a standardized protocol to measure the quantity of wetlands constructed, compliance with approved plans and a means to evaluate the potential of the constructed wetland to evolve to a mature, functional system. In addition, a revised data management system was developed which enhanced NJDEP’s mitigation database with a Geographic Information System.

Results, Recommendations and On-going NJDEP Adaptive Management Measures

The results of the ninety-site study indicate that on average, for each acre of wetland impact that required mitigation, 0.78 acres of wetlands were actually constructed. On average, 48% of the study sites concurred with their design specifications; some sites achieved no wetlands while others achieved in excess of 100% proposed. Field indicators of relative wetland quality found an average score of 0.51 out of an index of 1, demonstrating that about one-half of the criteria were met to indicate sites have the potential to function as natural wetlands system over time.

The study also provided LURP with recommendations that could be implemented to strengthen the existing wetland mitigation program. In addition, while inspecting the sites, ASGECI staff took field notes, which included broad recommendations to improve success of each site. Hence, these results have not only helped to develop adaptive management measures within NJDEP, but also to reinforce the utility of recently revised wetland mitigation regulations (that had been under development concurrent with this study). These new regulations codify requirements for very detailed performance-based mitigation plans.

The investigators did identify created freshwater wetland projects that met the goals for acreage and/or demonstrated relatively high field indicators of quality. Prior to undertaking this study, LURP recognized problems within their mitigation program and began implementation of many of the recommendations echoed in this report. Some of the changes currently being implemented include:

- Assignment of experienced staff to work exclusively on mitigation related issues for recent proposed mitigation projects
- Development of checklists for mitigation proposals and monitoring reports
- Requirement of a water budget for all constructed mitigation projects
- Requirement of on-site meetings with construction contractors prior to implementation of the project
- Requirement of a post grading, on-site meeting to evaluate compliance with construction plans
- Aggregation of small mitigation projects to a single large site
- Directing small mitigation projects to available mitigation banks

- Requirement for invasive and nuisance species vegetative control and herbivore management plans
- Requirements for letter of credit or other form of financial surety.

DSRT is continuing its collaboration with LURP scientists, as well as other wetland scientists, throughout New Jersey via other wetland research studies (some of which build specifically upon this study). We would like to thank our colleagues in NJDEP's Land Use Regulation Program, Amy S. Greene Environmental Consultants, NJDEP staff participants in the National Environmental Performance Partnership System (NEPPS) Land and Natural Resources Workgroup, and members of our Peer Review Committee for their assistance with this research. For additional copies or technical information regarding this study, please contact the New Jersey Department of Environmental Protection, Division of Science, Research, and Technology at (609) 984-6071, or visit our website at www.state.nj.us/dep/dsr.

Sincerely,

A handwritten signature in black ink, appearing to read "Martin Rosen". The signature is written in a cursive style with a large, sweeping initial "M".

Martin Rosen, Director
Division of Science, Research and Technology

Creating Indicators of Wetland Status (Quantity and Quality): Freshwater Wetland Mitigation in New Jersey

March 2002

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Executive Summary

This study included the development of three indicators to measure attainment of the New Jersey Department of Environmental Protection's (NJDEP) goals for wetland resources outlined in both its Strategic Plan and National Environmental Performance Partnership System (NEPPS) Agreement with the U.S. Environmental Protection Agency:

"Improve quality and function and achieve a net increase. Explore innovative techniques for creation, enhancement and maintenance of New Jersey wetlands."

Specifically, this study was initiated to determine the extent to which approved freshwater wetland mitigation sites had been constructed in terms of area achieved; concurrence with approved plans; and relative quality of constructed wetlands. In addition to these indicators of current conditions, this research developed a standard rapid assessment method that can be used to monitor New Jersey's wetland mitigation trends into the future. The study also enhanced NJDEP's Mitigation Database by establishing a geographic information system application. A peer review committee consisting of leading wetland scientists from academic institutions, government and non-governmental organizations, and the private sector provided guidance and oversight throughout the study.

Methods

Field evaluation was conducted for 90 freshwater wetland mitigation sites (out of 171 approved freshwater wetland mitigation projects in NJDEP's database at time of study commencement) that were distributed throughout 17 of New Jersey's 20 Watershed Management Areas (WMAs). Study sites included a total of 326 acres of proposed wetland mitigation area and ranged in size from 0.08 to 41.20 acres, with an average proposed size of 3.62 acres. Forested (PFO) and emergent (PEM) wetlands were the most common type of freshwater wetland proposed, accounting for 41% and 33% of total proposed freshwater wetland mitigation area, respectively. Sixty-four percent of the sites, representing 60% of the total area evaluated, were greater than 5 years old.

Wetland Area Achieved was determined for 85 mitigation sites and calculated based upon the results of a wetland delineation performed following the procedure in the *1989 Federal Manual for Identifying and Delineating Jurisdictional Wetlands*. Delineation methodology included observation of hydrology, soil, and vegetation characteristics of wetland and upland communities. Five sites were eliminated from this evaluation because mitigation site boundaries distinct from pre-existing wetlands could not be readily discerned in the field. A visual estimate of wetland community type (i.e. forested, scrub/shrub, emergent, State open water) was made during delineation and recorded as percent of total wetland area. Wetland Area Achieved was expressed in terms of total acreage achieved based on the area delineated in the field using a Global Positioning System (GPS) unit.

Concurrence was determined for 88 mitigation sites and consisted of a field inspection to verify and measure the extent to which the constructed mitigation site conforms to and is consistent with NJDEP-approved mitigation plans. Concurrence evaluations could not be performed on two of the study sites due to insufficient plan information in the mitigation files. Scoring was based upon visual estimates of several variables that could be readily observed in the field: grading; hydrology; soil; vegetation cover; vegetation survival; and design. Raw scores for each variable were expressed as a percent from 0-100 representing the relative degree to which the constructed mitigation site was consistent with approved plans and specifications. A weighting factor was assigned to differentiate the relative importance of each variable to the final score. Observations were made to identify specific corrective action necessary to comply with approved plans and specifications, as well as improve status of the mitigation site.

Relative quality was determined using a Wetland Mitigation Quality Assessment (WMQA) tool developed through this research and determined for 74 mitigation sites. The WMQA was only applied to areas delineated as jurisdictional wetlands. A relative wetland quality value (rating scale of 0 to 3) was based on the presence or absence of readily observed field indicators of the following variables: hydrology; soils; wildlife suitability; vegetation; site characteristics; and landscape features. The variables were considered representative of the relative probability that the mitigation site would develop into a natural wetland system and provide desirable wetland

functions over time. A weighting factor was assigned to differentiate the relative importance of each variable to the final score.

All field data were collected using a Trimble Pathfinder Pro XRS[®] GPS unit. All field observations were recorded on standardized data forms. Photographs were taken at every site.

Results

The average percent freshwater wetland area achieved was 45%, indicating that approximately 0.45 acre of wetlands was achieved for each acre of mitigation proposed. The range of wetland area achieved was 0 to 140%; six sites achieved more than 100% of proposed acreage while 16 sites failed to achieve any wetlands. On average, 92% of proposed emergent wetland acreage was achieved, while 1% percent of proposed forested wetland acreage was achieved. Open water acreage was achieved almost three times in excess of that proposed.

The Concurrence Evaluation indicated that, on average, sites concur with 48% of the designs and specifications in permit plans. Concurrence Evaluation scores ranged from 0 to 100%. Corrective actions identified through the concurrence evaluation included: re-grading consistent with permit plans at 84% of the sites (partially accounting for low concurrence with permit plan hydrology); application of supplemental topsoil at 47% of the sites; and replanting at 84% of the sites to conform with permit plans.

Average WMQA index score was 0.51 out of a maximum possible score of 1, finding that freshwater wetland creation sites, on average, met half the criteria that would indicate they have the potential to function as natural wetlands over time. WMQA scores ranged from 0.25 to 0.83. Low scores for hydrology, the variable weighted highest in the WMQA based upon independent judgment of 15 wetland scientists in New Jersey surveyed for this research, were found to result from extremes in water conditions -- either too much or too little. In both cases, it appeared as if low hydrology scores resulted from inappropriate or inadequate sources of hydrology or established grades that were inconsistent with the hydrologic regime of the site. In areas where the mitigation site exhibited favorable hydrology and soil conditions, natural recruitment of desirable wetland vegetation was generally observed. Establishment of invasive species or

persistent grasses was evident on numerous sites and in some instances precluded the establishment of desirable wetland plants.

A compensation ratio (mitigation proposed/mitigation achieved to wetland losses in a single permit action) in excess of 1:1 is required to attain a net increase in wetland area. Examination of compensation ratios based on the 90 study sites revealed that for each acre of impact to wetlands approved by NJDEP, on average 1.80 acres of compensatory mitigation were required. The actual ratio of acres of mitigation wetlands achieved to those impacted for the 75 mitigation sites, for which sufficient information was available to determine ratios, was calculated to be 0.78:1. On average, for each acre of impact to wetlands approved by NJDEP, 0.78 acres were actually achieved through mitigation, a net loss of 22%.

Compensation ratios can be examined by wetland type to determine replacement of ecological value lost from permitted disturbances. When analyzed by type of wetland compensation, emergent wetlands (n = 14 sites) were the only types where mitigation exceeded impacts (average compensation ratio of 1.29:1); this was still below the approved compensation ratio of 1.85:1. Forested wetlands achieved an average compensation ratio of 0.01:1 (n = 31 sites). These results suggest that for the two most commonly permitted freshwater mitigation wetlands (forested and emergent), New Jersey has achieved a net increase of emergent wetlands but not forested wetlands.

Several other analytical applications of the data were explored: analysis by New Jersey Watershed Management Area (WMA); site size; site age; and source of hydrology. Site age did not correlate with the study indicators. Other analyses suggested possible relationships with study indicators (watershed-based local conditions and site size); however, small sample sizes limit the ability to confirm these possibilities and further research would be needed to explore these hypotheses. More sites greater than one acre in size would be needed to further examine the influence of site size on mitigation outcome.

The data were analyzed to determine effect of hydrologic source on project indicators. Although Wetland Area Achieved remained relatively constant among sources of hydrology, stream

diversion resulted in the highest average score of 61%, well above the mean value of 45% when all sites are combined. Stormwater-driven wetlands scored substantially lower for the WMQA Index values than wetlands with other hydrologic sources. Stormwater-driven mitigation wetlands were also found to be more likely to have in excess of 50% cover of nuisance and invasive vegetation than mitigation wetlands driven by other sources of hydrology.

Recommendations

NJDEP could facilitate NEPPS goals for wetland resources and improve future mitigation projects through several mechanisms. Continued focus should be on avoiding impacts to wetlands and minimizing the effects of permitted activities on wetlands. Refinement and standardization of permitting, mitigation planning, monitoring and maintenance, and compliance inspections/enforcement of mitigation sites should continue. Some of these issues have been addressed in the recently adopted revisions to the New Jersey Freshwater Wetland Protection Act Rules that specifically outline the performance and pre-construction requirements for wetland mitigation proposal submissions. Increased resources should be devoted to implementation, oversight and tracking of mitigation projects once they have been approved by NJDEP. Tracking of approved mitigation projects should include an up-to-date, well-maintained data management system for filing and retaining monitoring reports and other administrative documents. Research on New Jersey's wetlands resources should continue and the results provided to regulatory staff.

Conclusions

Based on a subset of 90 New Jersey freshwater wetland mitigation sites, NJDEP has not yet met its goal to improve wetland quality and function and achieve a net increase. Emergent and open water wetland projects were more likely to succeed than forested wetland projects. Some high quality wetlands of all proposed mitigation types, however, were observed during the course of this study. These successful projects provide evidence that wetland creation is possible for all community types given the level of knowledge currently available.

1. INTRODUCTION

The New Jersey Department of Environmental Protection (NJDEP) is committed to providing a high quality of life for the residents of New Jersey. Central to that vision is maintaining a sustainable environment. Protecting healthy, functioning wetland systems is a vital element of a sustainable environment.

A wetland is defined in the New Jersey Freshwater Wetlands Protection Act rules (N.J.A.C. 7:7A-1.4) as “an area that is inundated or saturated by surface water or groundwater 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 known as hydrophytic vegetation...”. The term “wetland” can refer to many diverse areas such as swamps, marshes, fens, and wet meadows, but they are all generally characterized by the frequent or prolonged presence of water at or near the soil surface, by soils that form under flooded or saturated conditions, and by plants that are adapted to life in these types of water levels and soils.

Wetlands are a critical natural resource because they perform a suite of functions which includes improvement of water quality through nutrient cycling and sediment trapping; protection from flooding by attenuation of peak flows in streams and rivers; recharge of groundwater supplies; protection of shorelines from excessive erosion; aesthetic and recreational opportunities; and habitat for a great diversity of plants and animals including some of New Jersey’s most rare, endangered and commercially valuable species. However, through agriculture, urban and suburban development, mosquito control, and other draining and filling activities that have benefited our society, we have lost much of the wetland resources in New Jersey and with them many of the important functions that wetlands provide.

By the 1980’s as much as 50% of the original wetland resources in the United States had been lost and were disappearing at a rate of approximately 300,000 to 400,000 acres per year (Dahl, 1990; Tiner, 1984). Dahl (1990) estimated that New Jersey lost 39% of its wetlands between the 1870s and 1970s. Tiner (1985) estimated that New Jersey may have lost at least 20% of its

wetlands resources since the mid-1900s. Within New Jersey, the Department of Environmental Protection (NJDEP) has developed an aerial-photo based data set that shows changes in land-use between 1986 and 1995. During this time, New Jersey lost 15,798 acres of wetlands, or an equivalent loss of 1,755 acres of wetlands per year (Thornton et al., 2001).

The Federal Clean Water Act of 1972 33 U.S.C. 1344 et seq. (and amended in 1977) was enacted to restore and maintain the chemical, physical and biological integrity of the Nation's waters. The Clean Water Act regulates the discharge of dredged or fill material into navigable waters of the United States, including wetlands. In March 1994, the State of New Jersey officially assumed Clean Water Act Section 404 authority from the U.S. Army Corps of Engineers through implementation of the State's freshwater wetlands protection program, joining Michigan as the only states so far to have assumed authority. The State program, administered through the *1987 Freshwater Wetlands Protection Act*, was modeled after the Section 404 program, but it regulates activities not covered under 404, such as the regulation of upland buffers or transition areas. New Jersey also regulates activities in mapped coastal wetlands under the NJ Wetlands Act of 1970. As such, the New Jersey State Legislature has taken additional steps beyond those of the federal law to protect wetlands through the regulation of nearly all activities within tidal and freshwater wetlands, respectively. In doing so, they recognized that wetlands serve important functions that provide great value and benefit to New Jersey. Protection of wetland resources is an important part of sustaining a high quality of life, protecting public health and property, and maintaining economic vitality for all New Jersey residents. The US Environmental Protection Agency (USEPA) oversees the State program through the review of selected permit applications ("major discharges") based on such factors as acreage of impacts and Endangered Species Act concerns as well as by programmatic yearly reviews of the State program.

Under the provisions of New Jersey's *Freshwater Wetland Protection Act*, which is considered to be one of the most stringent wetlands laws in the nation (Torok et al., 1996), the alteration, disturbance, or erection of structures in and around freshwater wetland areas and the discharge of dredged or fill material into State open waters are subject to review and authorization by NJDEP. Because the statutory authority regulating activities in and around wetlands also includes the

regulation of placement of dredged or fill material in State open waters, we have treated open water as a wetland resource for purposes of this study.

The NJDEP, through its land use regulation programs, is responsible for instituting a systematic review of land development activities to ensure that wetlands and State open waters are protected from undesirable and unnecessary loss, alteration or disturbance. One management tool the NJDEP uses to compensate for wetland/open water losses resulting from land development and management activities is compensatory wetland mitigation. When required, mitigation is intended to replace values and functions of wetlands/open waters impacted as a result of development activities. Compensatory wetland mitigation helps NJDEP make progress toward its goal of sustaining economic development without compromising the integrity of our natural resources.

In the context of environmental regulation, the term “mitigation” refers to the broad range of actions that might be taken to avoid, reduce, or compensate for the effects of environmental damage. Compensatory mitigation refers to the practice by which unavoidable impacts to wetlands are permitted with the condition that they be replaced. The NJDEP recognizes and authorizes various forms of mitigation depending on the circumstances of the disturbance (N.J.A.C. 7:7A-1.5). Creation, enhancement, restoration, upland preservation, mitigation banking, land donation and monetary contributions to the Wetlands Mitigation Fund can all be acceptable methods of mitigation.

Generally the NJDEP requires in-kind mitigation unless because of certain circumstances, out-of-kind mitigation would be more likely to provide equal functions and values. In-kind mitigation means mitigation that provides similar functions and values as the area disturbed including similar wildlife habitat, similar vegetative species coverage and density and equivalency of other relevant values and functions. However, the NJDEP can provide some flexibility in the type of wetland mitigation proposed if the design of the mitigation site provides a clear demonstration that replacement of ecological value can be achieved. For example, a mitigation site that includes a variety of wetland community types, including elements of open

water, to compensate for impacts to degraded wetlands, may provide increased ecological benefit relative to in-kind replacement.

Questions about the advisability and success of compensatory wetland mitigation projects surfaced over a decade ago (Race and Christie, 1982) and many subsequent studies suggest that there is room for improvement in compensatory mitigation techniques. Previous studies conducted in Virginia (Maguire, 1985), Florida (Erwin, 1991; Redmond, 1992; Lewis, 1992), Louisiana, Alabama, and Mississippi (Sifneos et al., 1992), Oregon and Washington (Kentula et al., 1992), and California (Holland and Kentula, 1992), have found success and/or compliance rates ranging from 4.6% to 50%. A recent study conducted by the National Research Council (NRC, 2001) has found that the regulatory objectives of offsetting wetland losses through compensatory wetland mitigation are not being achieved. A previous study conducted in New Jersey also indicated poor success of wetland mitigation (USFWS, 1994). From 1985 to 1992, as much as 40% of approved mitigation sites were found to be inconsistent with approved plans and permit conditions. Although these studies suggest a low success rate for compensatory wetland mitigation and are cause for concern, comparison among studies or use of these studies as a basis of regulatory decision making are problematic due to varying methodologies used for assigning rates of success and/or compliance. In response, NJDEP wanted to develop a systematic approach to evaluate, quantify and monitor the effectiveness of wetland mitigation in compensating for unavoidable wetland losses, that could be readily implemented in the field.

Since 1995, NJDEP has been an active participant in the National Environmental Performance Partnership System (NEPPS). NEPPS is a performance-based management system that relies on the use of environmental indicators to measure attainment of goals and upon which future allocation of resources can be based (Kaplan and McGeorge, 2001). As a participant in NEPPS, NJDEP will be better prepared to address future challenges toward achieving a sustainable environment.

Through the NEPPS process, NJDEP has developed the following goal for its wetland resources:

“Improve quality and function and achieve a net increase. Explore innovative techniques for creation, enhancement and maintenance of New Jersey wetlands.”

However, it was unknown to what extent freshwater wetland mitigation sites approved by NJDEP had been constructed, whether they had been constructed in substantial conformance with approved plans, or whether the mitigation project was successful in achieving desired wetland quantity and quality. This study was designed to determine to what extent compensatory wetland mitigation is consistent with NJDEP’s NEPPS goals for wetlands.

The purpose of this study was to:

- Provide an indicator of performance in attaining NEPPS wetlands goals.
- Develop standard methods for monitoring progress.
- Establish a vehicle whereby future performance can be measured.

This study includes the development of three indicators (described in section 2.3 of this report) to measure attainment with NJDEP’s NEPPS goals for wetlands and monitoring wetland mitigation performance in New Jersey. This method is intended to generate an efficient and reliable source of data regarding NJDEP’s mitigation program. This study also includes the development of a GIS-enabled wetland mitigation database, which allows for both spatial and site-specific analyses. This study is intended to provide a basic template for tracking and measuring the status of compensatory freshwater mitigation projects in New Jersey. Finally, this study provides performance-based recommendations based upon best professional judgment as to the steps that can be taken on a site-specific basis to optimize attainment of wetland goals.

The primary focus of the study is freshwater wetland creation (see Section 2.2 of this report for a discussion of how study sites were chosen). As such, it does not represent an inventory of all authorized wetland impacts and required mitigation. NJDEP maintains a database of mitigation sites including general information on the location, size, type and status of individual mitigation

sites approved by the department. As of the spring of 1999, the NJDEP mitigation database included data on 223 mitigation proposals, accounting for approximately 1,249 acres of wetland mitigation. Of this total, 177 sites (562 acres) were designed as non-tidal, freshwater wetland systems. The remaining sites primarily consisted of tidal wetland systems and mitigation sites that had not yet been constructed and were not included in this study.

This study is intended to provide an indicator of wetland mitigation status in relation to permitted wetland activities within the jurisdiction of NJDEP. Therefore, a subset of 90 freshwater wetland mitigation sites (Appendix A) was selected for which sufficient information was available to allow an independent reviewer to conduct a thorough and consistent evaluation.

The study design and methods were a collaborative effort among the staff at Amy S. Greene Environmental Consultants, Inc. and an internal NJDEP project team composed of scientists from multiple program areas. A peer review committee consisting of leading wetland scientists from academic institutions, government and non-governmental organizations, and the private sector provided guidance and oversight throughout the study.