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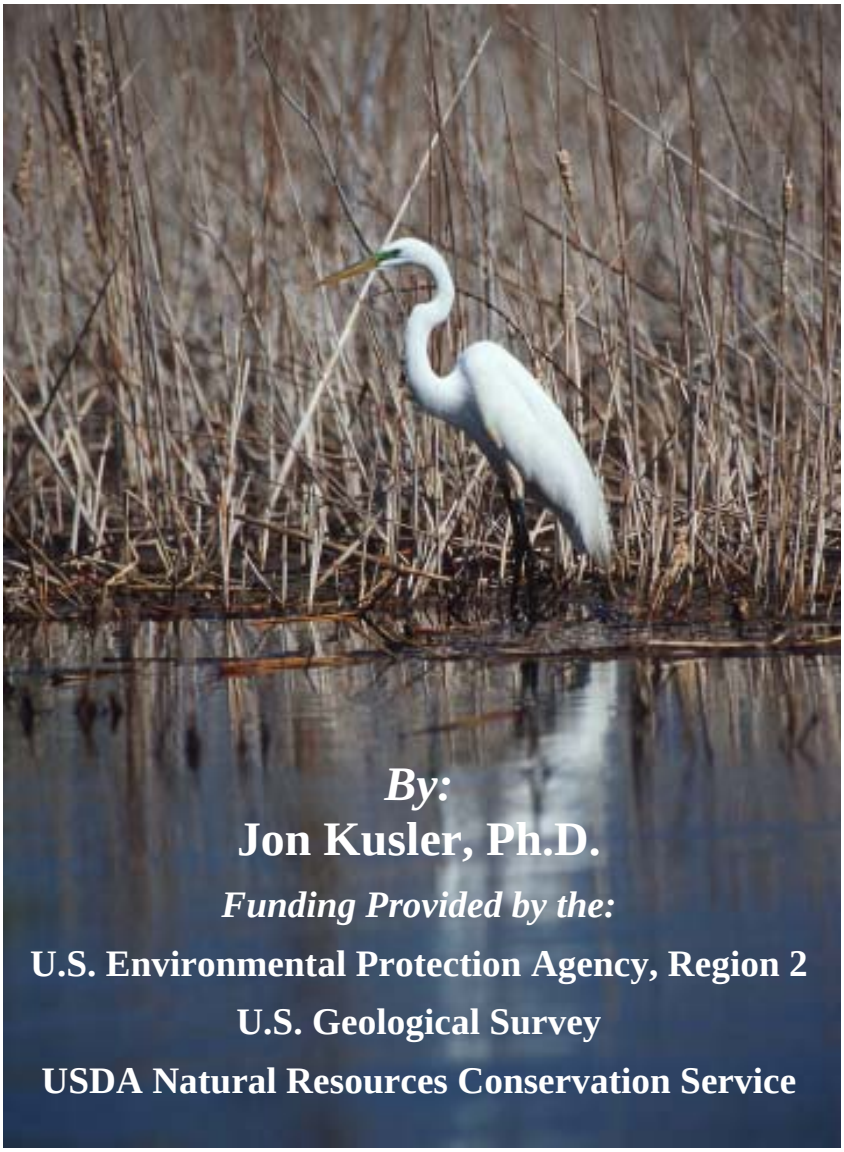
RECOMMENDATIONS FOR RECONCILING WETLAND ASSESSMENT TECHNIQUES



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FOREWORD

This paper has been prepared to (1) help federal, state and local government make better use of existing wetland assessment techniques in specific contexts, and (2) to facilitate development of new, more integrated, multi-objective assessment techniques which incorporate the promising features and avoid the weaknesses of existing techniques.

This paper begins with a summary/abstract of recommendations. It then provides background discussion on assessment approaches. This is followed by a discussion of the individual recommendations set forth in the summary/abstract. Appendix materials discuss individual issues in greater depth.

This paper draws on materials prepared for a study concerning the assessment of wetlands for regulatory purposes carried out by the Association of State Wetland Managers from 1996 - 2000 and updated in 2002, 2003, and 2004. It has been prepared with funding from the U.S. Environmental Protection Agency, Division of Wetlands, Region 2 which is much appreciated. Additional funding from U.S. Geological Survey and the USDA Natural Resources Conservation Service which is gratefully acknowledged.

The opinions expressed are the author's and should not be attributed to the sponsoring agencies.

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PREFACE

In 1996, the Association of State Wetland Managers (ASWM) began a project to help local, state and federal resource agency staff, legislators, planners and lawyers understand and improve wetland assessment techniques for regulatory purposes. This project involved a literature review, three workshops and a national symposium on wetland assessment, a legal study of assessment needs, and many hundreds of interviews with regulators and scientists working with wetland assessment methods. It produced four reports that were published in draft form and distributed for review. Three of these, *Assessing Wetland Functions and Values*, *Wetland Assessment in the Courts* and *Integrating Wetland Assessment Into Regulatory Permitting*, have been posted on the ASWM Web site as PDF files.

In 1996, federal agencies had announced that they intended for the Hydrogeomorphic (HGM) assessment method to be used on 80 percent of the Section 404 regulatory permits in two years. The 1996 project therefore first focused on HGM, including a workshop conducted that year and a national symposium held in 1997.

However, as the project progressed, it became apparent that the initial expectations for the HGM assessment method would not be met, HGM guidebook development would take time, and regulators were having considerable difficulty implementing HGM in regulatory contexts. ASWM therefore broadened its assessment project to address the full range of information gathering and analysis techniques not limited to HGM or rapid assessment.

In late 2002 and 2003 we updated the results of the earlier study, including revised legal analysis, bibliography, Web research and interviews.

During the duration of the study, we found little agreement among the federal, state or local agency field staff on the use of HGM or any other assessment approach. There was little use of the HGM and other methodologies in regulatory contexts, except on an experimental basis. A number of states, such as Washington, Oregon and Alaska, had developed and were using modified HGM models for some wetlands in general planning and policy contexts. Some states, such as Wisconsin and Minnesota, were using WET models. Others, such as Ohio and Minnesota, were using IBI models. Maryland and North Carolina were using GIS models.

In early 2003, ASWM decided to undertake a two-year follow-on project to (1) help build consensus concerning the application of various existing assessment techniques, including HGM and IBI, in specific contexts, and (2) to develop recommendations for the formulation of more integrated techniques that will avoid the weaknesses of existing approaches and build on their strengths.

This two-year project has involved the following:

- The preparation and revision of this paper and a companion paper dealing with the integrated assessment of streams/rivers, riverine wetlands, riparian areas and floodplains.
- The conduct of a national symposium on landscape level wetland assessment and management held in Nashua, New Hampshire, October 20-24, 2003.
- The conduct of two workshops concerning the reconciliation of wetland assessment techniques in Washington, D.C. in May 2003 and in Amherst, Massachusetts in November, 2005.

The following report begins with an abstract/summary. Part 1, which follows, provides an overview of wetland assessment approaches, issues, and problems. Part 2 examines, in greater depth, recommendations for making better use of existing approaches. Part 3 considers recommendations for future approaches. Appendices provide more detailed discussion of selected issues.

EXECUTIVE SUMMARY:
RECOMMENDATIONS

A wide variety of wetland assessment methods have been developed in the last two decades. Many of these have proven useful in specific contexts. Considerable experience has been gained in designing techniques. Nevertheless, there is limited agreement among field staff at all levels of government with regard to the use of specific techniques, the definition of basic terms such as "functions", and the features of wetlands which should be inventoried. Despite the lack of overall agreement, existing techniques and experience can provide the basis for improving the use of existing techniques and developing new ones.

Recommendations set forth below include recommendations for (1) making better use of existing wetland assessment methods, and (2) improving future efforts to develop and reconcile assessment methods:

(1) MAKE BETTER USE OF EXISTING WETLAND ASSESSMENT METHODS.

Government agencies, academics and others could make better use of existing assessment methods by (See Part 2 for more detailed discussion pertaining to each of the recommendations):

- A. Recognizing that the information needs of wetland decision-makers are quite variable, depending upon the management tool and context. These needs should be better documented and assessment techniques should be matched with tools and contexts. A variety of assessment methods and techniques are needed to meet specific information needs. There is no single "silver bullet" assessment method for developing all needed information. And, there are substantial limitations upon the accuracy of all techniques.

- B. Recognizing that wetland decision-makers information need more than information concerning wetland "functions" and "condition" although these are other important types of information as well.

- C. Recognizing that wetland regulators have a number of "special" needs. For example, they need wetland maps using the wetland definitions set forth in state statutes and federal and state regulations. They need sufficient information to evaluate the adequacy of impact reduction and compensation measures in achieving no net loss of wetland functions, acreages and values goals. They need sufficient information to prepared EA and Environmental Impact Statements (in some but not all cases). They need the information required to sustain regulations against Constitutional challenges (e.g., health and safety, nuisance-impacts related information). They need sufficient information to monitor wetlands over time for enforcement purposes.

- D. Better tapping existing sources of information and expertise through team approaches to assessment (e.g., HGM A teams, New England Highway Methodology regulatory teams), shared data bases (e.g. digital information on the internet), and requiring that landowners or their consultants develop much of the needed information for projects impacting wetlands.

- E. Carrying out field testing for assessment methods (including various functional submodels) in terms of accuracy of results, costs, and practicality.

- F. Preparing improved guidance for the selection and use of particular techniques in specific circumstances.

- G. Broadly distributing this improved guidance on the use of techniques to potential users.

- H. Better training government agencies, consultants, others in the selection and use of various techniques.

- I. Acknowledging limitations on assessment techniques; and reflecting these limitations in the use of techniques and continued "alternatives analysis" requirements, calculating compensation ratios, using conservancy zoning, and implementing other measures.

- J. Developing preliminary assessment procedures for carrying out multilevel wetland assessments beginning with generalized assessments including landscape context analysis, red-flagging, yellow flagging, and other overview identification of issues, problems, and possible functions and values. This may be followed with more detailed assessments of specific issues, problems, functions and values.

- K. Refining issue-specific assessment models such as IBI, HEC, and other models. See below.

(2) IMPROVE FUTURE ASSESSMENT EFFORTS

Government agencies, academics and others can reconcile and improve future assessment methods by (see Part 3 for more detail):

- A. Rethinking assessment in terms of the full range of wetland decision-maker critical information needs, what has been learned about meeting those needs, and how information gathering and analysis efforts can best, simultaneously, meet those needs. This should involve more clearly identifying regulatory and non-regulatory information gathering and assessment needs and assessing the experience gained in applying specific techniques.

- B. Forming a federal/state interagency working group or National Academy of Sciences Panel to more formally review the full range of assessment models (not just a single one) in terms of what might be applied where in terms of what is working and what is not working including the time and costs.

- C. Building consensus among wetland decision-makers and those developing wetland assessment approaches concerning the use of basic terms such as "functions", "values", and "condition".

- D. More realistically addressing legal needs when developing wetland assessment methods for regulatory purposes. See specific recommendations in Part 3.

- E. Continuing to map and remap wetlands at adequate scales and with adequate degrees of accuracy for regulatory and other purposes. Map information should also be available digitally.

- F. Refining issue-specific assessment models (e.g., HEC models for flooding).

- G. Continuing to develop and test IBI models; develop guidance for their use.

- H. Continuing to develop and test HGM models; develop guidance for their use.

- I. Establishing state-wide or regional "reference" systems like the reference system that Robert Brooks and colleagues have established in Pennsylvania. .

- J. Developing and testing processes for better utilizing a combination of initial, broad qualitative assessment with more detailed analysis for specific functions, functions/values and problems (as needed).

- K. Combining case-by-case analysis with upfront information gathering and landscape profiling techniques for wetlands and broader areas. This should include developing and testing digitally-based landscape or watershed-scale wetland assessment models which will help address "opportunity' and "social significance" as well as natural processes.

- L. Developing improved procedures for assessing "opportunity" and "social significance" as well as natural processes and condition.

- M. Over time, developing an integrated assessment model for not only wetlands but related ecosystems such as rivers, streams, lakes, estuaries, riparian areas and floodplains (and perhaps uplands) that includes features of HGM, IBI and other techniques for use on a landscape basis.

- N. Filling the critical gaps in scientific knowledge needed for assessment such as the habitat requirements of various plants and animals.

- O. Improving information dissemination and assessment training for wetland decision-makers.

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PART ONE:
"RECONCILING" ASSESSMENT METHODS

SEARCH FOR THE "SILVER BULLET"

There is great interest in improved techniques for analyzing wetlands including "functions" and "values", wetland boundaries, and other wetland characteristics (see discussion below) by regulatory agencies, resource management agencies, not-for-profit environmental organizations, wetland landowners, and others. These groups and individuals seek improved, more systematic, more accurate and more reproducible wetland assessment methods to meet a variety of wetland analysis and decision-making needs including, but not limited to, regulatory purposes. See Appendices G, H, I, J. Other purposes include wetland acquisition, restoration, active management (e.g. control of exotics), public land management, infrastructure planning and construction, watershed planning and comprehensive planning. See Appendix I. For regulatory purposes, agencies need wetland maps and the information to evaluate the impact of proposed projects in wetland areas upon "functions" and "values" (See 1989 M.O.U. Between the U.S. Army Corps of Engineers and U.S. Environmental Protection Agency) and the adequacy of proposed impact reduction and compensation (wetland restoration, creation, enhancement) measures. See Appendix F, G.

In response to this interest and the need to become more systematic and rigorous in information gathering and analyses, scientists and regulators have attempted to develop, during the last two decades, a "silver bullet" rapid assessment approach for wetland functions and values which would permit inexpensive and accurate assessment of project impacts and the adequacy of impact reduction and compensation measures. These include WET, state versions of WET, HGM, IBI and other approaches. See discussion below. Forty of these methods were profiled in a report by Candy Bartoldus in 1999 (Bartoldus, 1999). Dozen of additional HGI, IBI, GIS and other models have been developed since then. In addition, many hydrologic, stream stability, and other natural resource assessment methods have been used, to a greater of lesser extent, by wetland regulators. All told, there may be more than 100 methods in use or proposed.

Despite these efforts, no silver bullet approach has emerged.

In the 1980s, many in the wetland community believed WET would become the silver bullet technique for wetland assessment and the standard method at all levels of governance. In the mid-1990s, many then believed HGM would be the silver bullet. In the late 1990s, many viewed IBI models as the most productive direction for wetland assessment. Recently many federal agencies, states, and local governments have developed GIS models which digitally combine elements of various approaches at a landscape scale.

Methods developed specifically for wetlands and those developed for other purposes but applied to wetlands vary considerably in terms of their goals, the issues addressed, the types of information provided, the levels of detail and accuracy of the information, costs, necessary expertise, and other characteristics. Washington, Oregon and Alaska have developed HGM-related models. Ohio is using IBI models. Minnesota and many other states have developed WET-related models. There has also been some use of specialist methods for studies, such as hydrologic analysis of flood flows (e.g., HEC models) and analysis for stream stability (e.g.,

Rosgen procedures). Several states, such as Maryland and Louisiana, are using GIS-based systems to identify restoration sites. Florida is developing its own assessment method for regulatory purposes.

USDA Natural Resources Conservation Service (NRCS), National Oceanic Atmospheric Administration (NOAA), the U.S. Army Corps of Engineers (Corps) and the U.S. Environmental Protection Agency (EPA) have developed HGM and IBI models, as well as some of their own assessment techniques. BLM and the USDA Forest Service have developed the Proper Functioning Condition methodology for riparian areas. Federal and state agencies have also applied and various "Rosgen" and other stream stability models to riverine wetland systems.

However, none of the "rapid" assessment approaches for assessing functions and values have been widely used by regulators for a variety of reasons including high cost, conceptual problems with the approaches, too many simplifying assumptions, narrow scope, and inaccuracies. See Appendix I. There is limited agreement and much confusion among federal, state, and local regulators and other decision-makers concerning the use of wetland assessment methods.

Decision-makers have often found that suggested approaches provide too little of the need information. This is not to suggest that these approaches do not have some uses.

If scientists are to be faulted in their efforts, it is also not for lack of trying. The technical and budgetary problems encountered with wetland assessment are considerable. Wetlands are complicated and dynamic systems and this makes assessment difficult. There are millions of individual wetlands (an estimated 25 million in the Prairie Pothole Region alone) and detailed assessment for even a small number is expensive. Many important wetland features such a long term hydrology cannot be readily assessed from air photos, satellite imagery, or even a single field visit. Time series information is needed for accurate assessment.

The Hydrogeomorphic Wetland Assessment Method (HGM) epitomizes a dilemma faced by scientists and regulators. In 1996 federal agencies announced in the Federal Register their intent to develop the HGM methodology and use it on 80% of the Section 404 permits by 1998. Eight years later (2005) there has still been little use of HGM on individual permits. The HGM approach includes many innovative features and holds promise, if implemented, for more accurate evaluation of wetland natural processes and for improved determination of project impacts and wetland mitigation needs. But, it employs highly technical language and is complicated, time consuming, and expensive (at least for early phases). It contains simplifying assumptions such as a close relationship between wetland condition and the goods and services (functions/values) produced by wetlands. It assumes that accurate models can be developed for various wetland processes. The method also does not necessarily (in its present form) develop species-specific information needed to apply Endangered Species Act and species-specific regulatory criteria such as biocriteria for state water quality standards. HGM does not assess "values" including opportunity and social significance for functions. It does not address aesthetic, archaeological, historic, or other cultural features of wetlands. It does not consider who benefits and who suffers costs when decisions are made to destroy or degrade wetlands. In short, HGM holds much promise in developing certain types of valuable ecological and other "process" information but is costly and develops only a portion of the functions/values information needed by regulators in applying the federal Section 404 "public interest" review process and similar processes at state and local levels. See Box 1.

The issue for federal, state, or local wetland decision-makers with HGM and other approaches is not whether an assessment approach for evaluating functions and values has some uses. The issue is whether the approach develops enough essential information and can be practically utilized by those undertaking much of the information gathering (e.g., developer's consultants), given the many other information needs and the limited budgets, time frames, and staffing of the management agency.

At present there is continued interest in HGM, IBI and other models, but no widespread agreement on their use in specific contexts by wetland decision-makers. The application of various wetland assessment techniques in specific contexts appears often to be based more on a coin toss or the preferences of a particular wetland decision-maker than sound, factual or policy-based distinctions. Consequently, one assessment technique may be applied to one project and a different technique to an adjacent project, with quite different results in terms of mitigation needs and overall project acceptability. On the other hand, assessment needs are quite different, depending upon the context and the management tool. Therefore, application of different techniques in different situations does make sense if based upon real distinctions in contextual needs and the capabilities on individual assessment techniques.

ASSESSMENT GOALS

Scientists have developed various assessment models to help decision-makers achieve a number of goals:

- **Develop the critical information needed for decision-making.**

- **Develop this information "rapidly" and "inexpensively**", **consistent with staffing, expertise, budgetary and other limitations.**

- **Lend certainty, predictability, and reproducibility to information gathering and analysis processes.** The goal of many assessment methods has been, in part, to reduce the use of "professional judgment" in decision-making and substitute professional judgment with more systematic approaches.

Unfortunately, assessment techniques have often only partially met these goals for a variety of reasons. Each goal will now be briefly examined:

Develop the critical information needed by decision-makers.

One of the reasons for the proliferation in wetland assessment techniques and the limited use of many techniques by managers is that only limited agreement exists as to what decision-makers need. (See Appendices F-J for more detailed discussion of needs). For example:

- **Regulatory agencies** (Section 404, state, local) need information to apply the wetland-related criteria set forth in statutes and regulations such as wetland maps, wetland boundary information (delineation), and information pertaining to the "public interest" review factors listed in Section 404 implementing regulations. See Box 1. This includes both information concerning the goods and services provided by specific wetlands to society and the importance of these goods and services to society. See Box 1. They need time series information on wetlands to detect violations and undertake enforcement actions.

- **Infrastructure agencies** (e.g., highway departments) need information pertaining to wetland functions and values and in some instances comparative information so they can evaluate alternative transportation corridors.

- **Public land management agencies** (e.g. BLM, USDA Forest Service, National Park Service, U.S. Fish and Wildlife Service) need wetland maps and or georeferenced digital information so that they can determine the location and types of wetlands on public lands. They need land ownership maps to distinguish public from private wetlands. For management purposes they need to know where endangered species are located. They need to know the location of exotic and nuisance plant and animal species. The need to know wetland function and values as part of management efforts.

- **Wetland restoration and management agencies** (e.g. NRCS, NOAA, EPA) need inventories of potential restoration sites including existing and potential functions and values of sites and the relative costs of restoration. Existing functions and values are often less important than information pertaining to potential functions and values after restoration. This cannot be determined by looking at existing wetland processes (functions) alone.

Scientists have developed many reports setting forth specific assessment techniques (See Appendix L). But, there has been little effort to carefully evaluate or synthesize assessment needs. It is not surprising, therefore, that assessment methods often do not meet decision-making needs such as the information needs of Corps staff in evaluating the factors which are to be considered in a Section 404 permit "public interest" review. See Box 1.

Box 1
Factors to Be Considered
in the Section 404 Public Interest Review

Section 320.4 (a)(1) of the U.S. Army Corps of Engineers Administrative Regulations requires the consideration of the following factors in evaluating a Section 404 permit application. Information gathering and analysis methods used by staff, therefore, need to provide information pertaining to the following factors.

- conservation
- economics
- aesthetics
- general environmental concerns
- wetlands
- historic properties
- fish and wildlife values
- flood hazards
- floodplain values
- land use
- navigation
- shore erosion and accretion
- recreation
- water supply and conservation
- water quality
- energy needs
- safety
- food and fiber production
- mineral needs
- consideration of property owners
- the needs and welfare of the people

Provide rapid and inexpensive approaches.

Wetland decision-makers lack the time, staff, expertise, and funds to undertake detailed investigations pertaining to wetland condition, functions, values, boundary delineation, and other information factors for a single wetland much less thousands of wetlands in a jurisdiction. Wetlands are complex systems and that developing a detailed and accurate understanding of the hydrology, soils, water chemistry, plants, animals or even a single wetland can require hundreds or thousands of hours of investigation.

This has led to the development of a variety of "rapid" wetland assessment techniques which attempt to rapidly imply certain functions, values, condition, or other characteristics from office, field or some combination of office and field evaluation. The rapid techniques typically focus on a relatively limited number of factors. See discussion below.

However, the simplifications and assumptions incorporated in rapid methods and limited field evaluation comes at a price. In many instances the surrogates or indicators chosen do not accurately reflect the functions or other characteristics that they are supposed to represent. Most have not been field tested for accuracy (e.g., the use of habitat functions to imply other functions.) In addition, scientists developing the techniques also often fail to articulate their simplification and assumptions.

Simplifications and assumptions are needed but they also interject subjectivity. The proliferation of wetland assessment techniques and the lack of agreement concerning their use is due, in part, to a subjective disagreements with regard to what should be evaluated. It is not, perhaps, surprising, that hydrologists often favor hydrologic and hydraulic studies to determine wetland flood storage and conveyance, geologist often favor geologic studies of stream stability, plant ecologists often favor vegetation analysis, herpetologists want to examine the snakes and other reptiles, and ornithologists want to focus on the birds. Who is to say, in a given circumstance, that plants are less or more important than birds or snakes?

Decision-makers have been discouraged from using the "rapid" approaches because many approaches have proven to be neither "rapid" nor inexpensive. See Appendix H. The combination of narrow perspectives, time-consuming procedures, failure of models to fit given situations, expense, and relatively low levels of accuracy have proven unacceptable to wetland managers. Agencies have often lost confidence in an assessment method when the results applied to a project do not make sense or can be generated more quickly with a field visit and a little logic. For example, agencies have often found that a quick, holistic look at a wetland and a team, qualitative evaluation with other resource agencies provides a more accurate and focused evaluation of functions and values and other project features than the use of a narrow, more quantitative rapid assessment approach. (See the New England District Corps of Engineers, *The Highway Methodology Workbook Supplement* for an example of such a qualitative approach.)

As part of our 1996-2000 assessment project, we interviewed hundreds of regulators at state, tribal, federal and local levels. Regulators commonly used the terms *unrealistic, unusable* and *impractical* to describe many of the existing and proposed rapid assessment approaches, although most regulators were also keenly interested in the improvement of assessment methods. Many wetland consultants who worked for private and public landowners were also interviewed. Three prominent consultants indicated that they or their firms had been collectively responsible for more than 6,000 wetland permits. They reported that they had not systematically used any of

the formal, rapid wetland assessment techniques, nor had they been asked to do so by a regulatory agency. They had, however, undertaken relatively detailed field investigations on thousands of wetlands and had on occasion applied HEC and other more detailed assessment models. This limited use of existing "rapid" models should, at a minimum, suggest that these rapid assessment techniques are only partially meeting the needs of their intended users.

Box 2
Restraints Upon
The Application of Assessment Techniques

- **Staffing:** Wetland programs at all levels of government are subject to staffing limitations. Problems with limited staffing are worsening with cuts in federal, state, and local budgets and grants. In addition, as wetland management and assessment techniques become more sophisticated, more staff time is often required per permit or project.
- **Expertise:** Few agencies have the combination of biology, botany, soils, geology, hydrology and other experts desirable to carry out all aspects of detailed and accurate wetland assessment. Without such expertise, agencies cannot generate or use important data.
- **Budgets:** Lack of money is an increasing constraint on gathering data, hiring staff and carrying out assessments. Field studies are particularly costly. For example, a detailed ground water study on a two-acre wetland that involves a nest of piezometers (test wells) and piezometers over a period of several years could cost hundreds of thousands of dollars.
- **Statutory time deadlines:** Time limitations for processing permits are contained in many statutes or agency regulations.
- **Statutory, administrative regulation and constitutional requirements:** Statutes typically establish specific wetland definition and delineation criteria, mapping requirements, notice and hearing requirements, which must be followed by the regulatory agencies.
- **Limitations of scientific knowledge and available scientific procedures:** Many questions remain in spite of what has been learned scientifically about wetlands in the last fifty years.

Lend certainty, predictability, and reproducibility to information gathering and analyses.

Wetland scientists have developed rapid assessment methods and approaches, in part, to reduce the use of professional judgment in evaluation of functions, values, and other features. It has been hoped that more systematic approaches will lend more certainty, predictability, and reproducibility in measuring or implying the capacity of a wetland to provide wetland goods and services in a specific circumstance, the impact of proposed activities on the goods and services, the adequacy of impact reduction techniques, and the adequacy of proposed compensation in meeting a no net loss of functions/values/acreage goal. See Appendix E. Even the rapid assessment methods, therefore, typically set forth quite specific analysis procedures.

However, efforts to provide certainty and reproducibility and to reduce professional judgment have not necessarily improved accuracy. As indicated above, to reduce costs, rapid assessment methods typically contain many assumptions and simplifications. By omitting consideration of many relevant factors (e.g., changing hydrology in urbanizing conditions) the accuracy of the resulting assessments is seriously compromised. Systematic procedures do not insure an accurate result unless the overall methodology is sound.

In some instances the use of professional judgment is merely shifted from more obvious to less obvious portions of an assessment process. For example, HGM procedures reduce professional judgment in early phases of analyses by providing a useful analytical framework (e.g., classification, identification of process). However, the results of an HGM analysis for a wetland depends, to a considerable extent, upon the "processes" (i.e. "functions") selected for analysis and the reference sites selected. Professional judgment is used in these selections. Subjectivity is also a problem with the way the results of the HGM are to be used. The use of sophisticated techniques in HGM to evaluate relative condition but a highly simplified formula which considers only a small portion of relevant issues to calculate mitigation ratios (relative condition x acreage) also leads to oversimplified results. See Box 4.

Box 3
Examples of Simplifying Assumptions

Rapid assessment methods typically make a variety of simplifying assumptions to reduce complexity and make assessment a "doable" task. Unfortunately, these simplifications also reduce accuracy.

Simplifying Assumption: Existing hydrology (as observed or deduced) will stay the same into the future.
Reality: Wetland/related resource hydrology in typical regulatory permitting conditions (urban areas) is often changing at the time of a permit application and will be subject to other major modifications in the future.

Simplifying Assumption: Wetland/related resource functions and values are based upon wetland onsite characteristics.
Reality: Many wetland/related resource functions/values depend as much upon offsite characteristics such as hydrologic connections and ecosystem context as onsite characteristics (depth, vegetation). Therefore, any assessment effort focusing on onsite conditions alone often produces inaccurate results.

Simplifying Assumption: Wetland/related resource functions/values are uniform throughout a wetland.
Reality: The functions of various areas within a wetland often vary considerably. For example, the area immediately adjacent to a river in a large riverine wetland may be particularly important for conveying flood flows, but not outer areas; the outlet of depressional wetland may be particularly important to the ability of the wetland to store flood flows; the interface area between a wetland and lake may be particularly important for fish spawning. Assessment methods which do not consider the differences between different areas within a wetland often underestimate or overestimate project impacts.

Simplifying Assumption: A specific wetland/related resource feature or small number of features can be used as a surrogate to measure or indicate other functions and values.
Reality: Surrogates (e.g., vegetation) may imply other long term characteristics (e.g., wetland hydrology) to a greater or lesser extent. Often this relationship is poor, particularly during times of drought or unusually high precipitation levels.

Simplifying Assumption: A natural wetland in an undisturbed condition has the highest functions.
Reality: Wetlands in natural conditions do usually provide the highest habitat value. But, many altered and partially degraded wetlands may have flood storage, flood conveyance, pollution buffering, erosion control, pollution treatment, and other functions equal to or wetlands in a natural condition. In addition, there may be more "opportunity" for altered wetlands in urban contexts to provide specific benefits.

Simplifying Assumption: Altered wetlands/related resource areas in urban areas have the lowest "values".
Reality: As already suggested above, many altered, urban wetlands have reduced habitat functions. However, even an urban wetland with diminished habitat functions may have relatively high "value" to society. Urban wetlands may play significant pollution control, flood conveyance, flood storage and other roles which are of great value to society. For example an urban wetland may protect an urban water supply reservoir or provide flood storage for a large number of homes.

Box 4
Observing Versus "Deducing"
Wetland Hydrology, Wildlife, and Other Features

It is difficult to assess the capacity of wetlands to produce certain goods and services because it is often not possible to use a single field visit, air photo, or other "one shot" observation to accurately describe long-term hydrology, vegetation, and wildlife since water levels vary seasonally throughout the year and from year to year.

Four principal approaches have been used by scientists and regulators to address this problem.

The first is to actually conduct time-series studies involving multiple observations such as multi-year stream gauging for a river, monitoring of piezometers for ground water elevation, the use of time-series air photos, and multiple field visits to observe plants/wildlife. Long-term studies have the advantage of providing "real" information but they are time-consuming and costly. And, they cannot be carried out in the typical short time frame of regulatory permitting. Such long-term studies are rare in a regulatory context and only typically occur when an endangered species is threatened, a well field, or there is some other major threat.

Second, use a variety of techniques to "capture" whatever time series information is available even if it is quite subjectvie. These include interviews and workshops with local birders, hunters, landowners, and others who may have made long-term, qualitative observations at particular sites.

Third, extrapolate from known to unknown areas. For example, wetland regulators may use stream flow and ecological information from one study stream in a region to suggest stream flow characteristics and ecological characteristics for another stream.

Fourth, use various indicators, surrogates, and "models" to calculate, deduce, or infer long-term hydrology and plant/animal species from "one shot" field observations, air photos, or other limited information. For example, soils information may be used to infer long-term hydrology because soils reflect long-term saturation. Hydrologic models may be used to predict runoff and flood heights based upon estimated, regional rainfall amounts. Various combinations of vegetation, land form, soils, and other characteristics may "deduce" or characterize the capability of particular areas to produce certain plants and wildlife (e.g., WET, WETHINGS, HEP, HGM). Surrogates (e.g., one species of plant or animal) may be used to suggest the capability of an area to produce a broader suit of plants and animals.

The fourth approach is broadly used in wetland assessment methods. But, because of the broad range of simplifying assumptions, this approach is also typically subject to substantial margins of error.

Changing Perspectives.

Scientists designing wetland assessment techniques in the 1980's and 1990 in general focused on the evaluation of both wetland "functions" and "values" (goods and services) provided to society. They attempted to assess the potential impact of various activities on those functions and values. See Boxes 7 and 8 for lists of "functions" below. Such a focus is consistent with the goals for wetland protection stated in federal, state, and local wetland protection statutes. It is consistent with determination of the "public interest" review required by federal Section 404 regulations and many state and local regulations.

To facilitate such an analysis the Corps, EPA, and a broad range of partners developed the Wetland Evaluation Technique (WET) and various state variations on WET, as will be described below to help evaluate functions and values based primarily upon existing data (wetland maps, air photos, topographic information) combined with limited field investigations. A decision-maker wishing to evaluate a wetland using WET filled out a quite complicated questionnaire based upon these information sources and professional judgment. The WET method considered three sets of factors in evaluating functions and values—"capacity", "opportunity" and "social significance".

Experience with WET and WET related models over a period of years was mixed. These models did require a more systematic approach to evaluation of functions and values than the use of professional judgment alone. The evaluations also provided some "feel" with regard to the comparative functions and values of various wetlands. But WET evaluations tended to be highly complex and mixed apples and oranges in terms of functions and values. Applying the same analysis to every wetland was time-consuming and expensive and, to some extent, unnecessary in light of the differences between wetland types. WET analyses were also ultimately based upon professional judgment. Such an analysis did not provide an adequate, quantitative basis for establishing mitigation ratios in regulatory programs.

Because of the problems with this approach and the increasing attachment of mitigation conditions to Section 404 permits due to the adoption of the "no net loss" goal in 1989, the Corps in 1996 with the help of EPA and other federal agencies took a new approach. A meeting in

Georgia laid the groundwork for this new assessment approach—the Hydrogeomorphic Method (HGM). This approach introduced several new ideas:

- Grouping (classifying) wetlands by overall hydrologic class and subclass to improve evaluation and reduce unnecessary and inappropriate evaluation,
- Examination of wetland scientific "processes" to reduce subjectivity in evaluation and improve the science base for evaluation, and
- Establishing "reference" based upon sample sites for specific classes and subclasses across a "condition" gradient.

The intended goal was to provide an evaluation framework which would allow the development of various comparative "scores" related to these natural processes which could then be multiplied by acreage to develop mitigation ratios.

However, it quickly became apparent that the method had limitations. For a start, the method did not evaluate "opportunity" and "social significance" as the WET and WET-related models had done. And, wetland "value" is important to Section 404 and other regulators in carrying out a "public interest" review. See Box 1 above. A second problem was oversimplification in the formula suggested for calculation of mitigation ratios—condition x acreage. See Box 5 above. While condition is important, a broad range of other factors which are not taken into account are also relevant to mitigation ratios.

It was also discovered in developing HGM models that reliable surrogates in many instances could not be easily found to predict various wetland processes. There have been other problems as well. Unfortunately, development of models has proven more time consuming and expensive than originally anticipated. Many of the numerical models for various processes and their linkages to goods and services are not yet field tested. The lineages between "processes" and good and services are yet to be confirmed and at least one study by the Washington Department of Ecology challenges the assumption that condition and functions (good and services) are, in some instances, closely linked. In addition, wetland decision-makers have been left to their own devices in considering "value". Finally, professional judgment is reduced with the HGM approach but professional judgment continues to play a significant role in the selection of processes, the development of process models, and the selection of reference sites as suggested above.

The HGM method has not been the only attempt during the last decade to develop more rigorous, systematic and accurate assessment models more specifically related to natural processes and the indicators of such processes. Prominent among these other efforts have been efforts to develop Indices of Biological Integrity (IBI) models for wetlands and related waters. These models involve the identification of plant and animal species which characterize wetland "condition" across a gradient from natural wetland to highly degraded. IBI models have also been used for rivers and streams and proven useful in determining the relative condition of wetlands and waters, setting restoration goals, and monitoring the effectiveness of restoration efforts.

Although useful, IBI models, like their HGM counterparts, have proven expensive and time consuming to develop due to the complexity and dynamic nature of wetlands. They also do not evaluate the full range of goods and services provided by wetlands except to the extent other the full range of good and services may be inferred by relative condition. They, like HGM models, do not take into account "opportunity" and "social significance".

Many more detailed assessment models designed specifically for wetlands or usable for wetlands have also been developed during the last decade. These include hydrologic and hydraulic assessment models (e.g., HEC), stream stability models (e.g. "Rosgen"), instream flow models and a host of other models.

Many GIS models have also been developed to help evaluate functions and values, condition, watershed context, restoration potential and other features. These models typically combine a variety of digital data layers on a governmental unit or watershed basis such wetland maps, flood maps, soil maps, topographic maps, existing use information, demographic information, land ownership information, ecological data (e.g., sites of endangered species) to provide an assessment of functions and, in some instances, values. These models are proving to be particularly useful in examining natural resource and societal "context" including the identification of restoration sites. However, they also operate a relatively large scale and have limitations for site-analysis.

Ironically, many of the GIS models have gone somewhat full circle by using many of WET assumptions and criteria and placing more emphasis, again, upon determining opportunity and social significance.

Assessment methods are discussed in greater depth below.

Box 5
Factors Relevant to the Establishment of Mitigation (Compensation) Ratios

The following factors are relevant to the establishment of mitigation (compensation) ratios and not simply wetland "condition" and "acreage". See generally Wetland Restoration and Creation: Status of the Science, Kusler and Kentula, eds.

1. **The types and magnitude of functions/values of the original wetland versus the probable range of functions/values of the replacement wetland.** Larger ratios are justified when a replacement wetland will have a smaller number of functions/values, with lesser magnitude than the original wetland.
2. **The overall ecological condition (persistence, biodiversity, ecosystem integrity) of the original wetland versus the probable ecological condition of the replacement wetland.** Larger ratios are justified when a replacement wetland will be less persistent, diverse or have less ecosystem integrity than the original wetland.
3. **The original wetland's availability for public use versus the probable availability of the replacement wetland.** Larger ratios are justified when a replacement wetland will be less available for public use; smaller ratios are justified when a replacement wetland will be more accessible to a larger number of people.

4. **The wetland/resource type and probable success or failure of restoration for this type.** Larger ratios are justified for the wetland types that have proved most difficult to restore or create, with resulting increased possibility of project failure. Difficulty is determined, in large measure, by the ease with which comparable hydrology can be restored or created. In general, difficulty increases in the following order: (a) estuarine (shallow and deep marsh), (b) coastal (shallow and deep marsh), (c) lake fringe and stream fringe (shallow and deep marsh), (d) depressional (shallow and deep marsh), and (e) flat and slope (shallow and deep marsh, shrub).
5. **Whether restoration or creation is involved.** Larger ratios are needed for the difficult efforts to create functions/values with the lowest probability of success, such as restoration or creation of endangered or threatened species habitat. Smaller ratios are justified for less difficult efforts to restore or create functions, such as flood conveyance or storage, which also has a greater probability of success.
6. **The expertise of those proposing to carry out the project.** Larger ratios are justified for less expert and less experienced project proponents.
7. **The length of time it will take for the restoration to become fully functioning.** Larger ratios are justified when it will take many years for a project to be fully functioning.
8. **Threats to the restoration site.** Larger ratios are justified when there are threats to compensation sites, such as changes in hydrology, sedimentation, water pollution, etc.; smaller ratios are justified when there are none.
9. **Whether the site will be susceptible to monitoring and mid-course corrections.** Larger ratios are justified when the site has little monitoring and mid-course correction capability; smaller ratios are justified when there is more monitoring correction capability.
10. **Whether active management will take place over time.** Larger ratios are justified when there will be no active management (e.g., fencing, exotic weed control, controlled burns); smaller ratios are justified when active management will be undertaken.
11. **The relative costs and equities between onsite restoration/creation versus offsite restoration/creation.** Larger ratios may be justified based on equity grounds for offsite restoration (e.g., a rural area) when the cost is less than the cost of onsite restoration/creation (e.g. an urban area). Project proponents who are allowed to use offsite restoration/creation should not gain large financial advantages over those required to carry out onsite restoration/creation.

Can "Values" Be Ignored?

As indicated above, new assessment methods including HGM and IBI models in the last decade have focused upon the measurement or use of indicators or surrogates to imply wetland scientific processes. There has been limited attention to criteria and procedures for measuring "value". Several reasons have been given for this. Value tends to be quite subjective. For example, fisherman may favor an open water wetland and duck hunters a vegetated one. It is also difficult to measure value.

However, there are also significant problems with ignoring value. Regulations for the Section 404 permitting program and similar regulations for many state and local programs require regulators to decide whether a proposed activity is in the "public interest". See listing of factors in Box 1 above. How can the public interest be determined by examining scientific processes alone? For example, destruction of a wetland in the New York City water supply watershed which serves 8 million people may be of far greater value to society than destruction of a similar wetland in northern Maine, fifty miles from the nearest settlement. How objective is any evaluation process which fails to consider these differences?

There are legal considerations as well in failing to consider social context in evaluating impacts upon wetland process. Issuance of a permit for destruction of a small wetland which provides flood storage in an urban area with resulting flooding of neighboring properties may result in legal liability for the government agency issuing the permit and the landowner undertaking the wetland drainage and fill[1]. Yet, any assessment method which only considers natural processes may result in the issuance of a permit for wetland destruction in one area while providing compensatory mitigation at another site on in a mitigation bank ten or fifty miles away.

What sort of assessments are being done?

If wetland decision-makers are not using formal, rapid assessment techniques, what are they doing?

- Agencies rarely undertake systematic assessment of all wetland functions and values or other features (e.g., natural hazards) for any wetland or wetland project. This is due to the complexities encountered in analyzing functions/values, limitations upon staff and financial resources, limited time frames, and the need to spend limited funds on other critical assessments that need to be carried out such as delineation of boundaries. The degree of functions/values analysis actually undertaken depends, in large measure, upon the size and type of project and whether "red flags" or "yellow flags" are identified early-on in the regulatory process. See discussion below.

- Agencies use a variety of informal sorts of "red flagging", "yellow flagging", "screening", and "scoping" processes including informal checklists to determine whether significant functions/values may be present at a site and whether impacts may be significant. These

[1] For examples of cases holding a private or public landowner who drains or fills a wetland and increases flooding or erosion on other lands legally liable to the damaged landowner, see, Hendrickson v. Wagners, Inc. 598 N.W.2d 507 (S.D., 1999) (Injunction granted by the court to require landowner who drained wetlands with resulting flooding of servient estate to fill in drainage ditches.); Boren v. City of Olympia, 112 Wash. App. 359, 53 P.3d 1020 (Wash. 2002) (City was possibly negligent for increasing discharge of water to a wetland which damaged a landowner.); Snohomish County v. Postema, 978 P.2d 1101 (Wash. 1998) (Lower landowner had potential trespass action against upper landowner who cleared and drained wetland.); Lang et al v. Wonnenberg et al, 455 N.W.2d 832 (N.D., 1990) (Court upheld award of damages when one landowner drained a wetland resulting in periodic flooding of neighboring property.) Janice J. Cook &a. v. John D. Sullivan &a, 829 A.2d 1059 (N.H., 2003). (Landowner successfully sued adjacent landowner for filling a wetland and building a house in a jurisdictional wetland without a permit which resulted in flood damages. The court found that the house and fill were a nuisance and ordered removal of the fill and house.) In some instances the government agency permitting an activity which damages other property may also be liable. See discussion below. See, for example, Hurst v. United States, 739 F. Supp. 1377 (D.S.D. 1990) the U.S. Army Corps of Engineers (Corps) and cases cited below.

procedures often involve soliciting comments (for mid-size to larger projects) not only from the regulatory agency staff but other resource agencies, the landowners, not-for-profits, academics, and many others. These procedures typically involve not only some measure of "office" analysis and often a field visit by the regulatory agency, but the use of notice procedures, public hearings, and various team evaluation procedures.

- If an agency determines that specific significant functions/values may be present at a site, there may then be a more detailed investigation of those functions/values by the agency, the project applicant, or other regulatory agencies. More detailed input from academics, not-for-profits, and the public may be solicited through public notice and hearing processes. One or more hearings may be held.

- Decision-makers attempt to use "common sense" and "professional judgment" to take into account hard to address considerations not typically considered in rapid assessment methods such as changing watershed hydrology, the possibility that a wetland may disappear, and natural restoration potential.

The ultimate regulatory agency decision on a permit including conditions attached to a permit is usually based upon a combination of factual information and "values" information. See Appendix E. The determination of "public interest" requires that not only impacts be known but the acceptability of the impacts to the public be taken into account.

The analyses of wetland functions/values differs considerably not only upon the type of wetland and location but upon the type and size of project in regulatory contexts:

1. **Small fills and other alterations for residential, noncommercial purposes.** For small fills and other alterations for residential or other noncommercial purposes proposed by individual lot owners, a regulatory agency typically conducts only a "red flag/yellow flag" review of wetland functions/values to detect significant functions/values or glaring problems which might be caused by the activity. The review is limited for several reasons:

  - Many of these activities are totally or partially exempt from individual permit review pursuant to Nationwide Permits or state or local exemptions based on the types of regulated activities, size of regulated activities, or type or size of wetland.
  - Regulators lack the time and finances to carry out a detailed review.
  - The impact of the individual proposed fill upon functions and values (whatever they may be) is often quite small (although cumulative impacts may be significant).
  - It is not possible to shift the data-gathering and analysis burden to individual lot owners who lack the financial resources and expertise necessary to carry out detailed functional assessment.
  - There are financial and other practical limits to what an individual lot owner can do to mitigate impacts if such impacts are known. In other words, there are limited practical options available for onsite restoration/creation or enhancement.
  - There are often few practical location or design "alternatives" for individual lot owners, making functions/values information somewhat irrelevant.
  - There is a concern that denial of a permit, particularly if a small lot with a large amount of wetland is involved, will result in a successful "taking" challenge in court.

Public hearings are usually not held on these projects unless one or more red flags or yellow flags are identified.

Permits for such small projects are often granted unless serious red flags emerge from the analysis. Permits may be subject to "generic" impact reduction measures and, in some instances, compensation measures.

Typically, small proposals for fill or drainage for lake fringe, estuarine or coastal fringe, or river fringe wetlands receive more detailed review due to the high incidence of fishery, waterfowl, and water recreation functions/values of these wetlands and because the beds of many of these wetlands are in public ownership and the wetlands are subject to navigable servitude and trust values. Proposals for alteration of small depressional, slope, and "flats" wetlands typically receive less review.

2. **Mid-sized fills, dredging, and drainage.** For larger fills, dredging and drainage projects (particularly projects proposed by developers and other commercial ventures and those proposed by public agencies or public utilities), there is often both a "red flag/yellow flag" analysis of functions/values and a more detailed analysis by the regulatory agency, by other resource and regulatory agencies. More information is required from the project proponent. This is particularly true if lake fringe, estuarine or coastal fringe, or river fringe wetlands are involved.

Depending upon the nature of the project and the state, an environmental impact analysis and statement may be required for such projects.

The regulatory agency will often undertake more detailed office analysis of wetland functions/values based upon topographic maps, soils maps, endangered species maps and listings, NWI maps, and other sources of information. This will be supplemented with one or more site visits. Typically, the regulatory agency will not conduct a full-scale rapid assessment analysis for the entire wetland for a variety of reasons discussed above but may use some of the "questions" and indicators set forth in these methods. If this is a fairly large project and the project proponent has hired a wetland consultant, the consultant may be required to prepare an analysis of selected wetland functions/values and additional problems or issues. This will be submitted to the regulatory agency.

3. **Large projects (reservoirs, major dikes and levees, major highways, airports, malls, major subdivisions).** Typically, regulatory agencies require that project proponents and their consultants carry out quite extensive field studies of wetland characteristics for very large projects affecting whole wetlands or many wetlands. Often these projects require many different sorts of regulatory permits and regulatory agencies may jointly form an official or unofficial interagency and multi-government review team for the project. An environmental impact statement is often required.

Typically, a "red flag/yellow flag" procedure will be used by the regulatory agency or review team to help determine more detailed data gathering needs. One or more public notices and hearings are common. The project proponent is often required to carry out more detailed supplementary data gathering and analysis for functions/values, acreage impacts, compensation needs and restoration plans. Red flag procedures, notice and hearing, and intergovernmental review are particularly important.

The higher level of scrutiny for mid and large size projects versus lower levels of scrutiny for other projects may seem unfair but makes sense from several perspectives.

First, the impact of a large scale project such as a subdivision, major road, or industrial park upon wetland and associated ecosystems is likely to be greater than that of a small or mid-size project not only because of fills or alterations within the wetland or wetlands, but alterations to the surrounding upland ecosystems, and changes in the watershed hydrology and water quality. Size of impact, of course, is not the only consideration. Large-scale projects often involve major fills and/or drainage or flooding which irreversibly damage or destroy wetlands. The impact of smaller projects is often (but not always) less severe on the wetland system as a whole).

Second, the ability of various landowners to carry out certain types of assessments and to absorb the costs of assessment and compensation measures varies greatly. Developers and public infrastructure agencies (roads, sewers, water resources projects) typically employ surveyors, engineers, landscape architects and other consultants to design and construct a subdivision, mall, industrial park, road, airport, or other large-scale development. Detailed topographic, soils, and other information are typically gathered for the site for a broad range of purposes. Determination of wetland boundaries and functions and values and mitigation and compensation for impacts may be carried out as part of these broader activities. Costs may, to some extent, be passed on to buyers or the general public.

In contrast, the owners of residential lots, farmers, and small scale commercial operations do not typically carry out detailed resource assessments before they construct a house, a small road, or activity use of the land for forestry, agriculture, or other purposes. They have limited funds and expertise.

Somewhat different assessment issues are also raised by proposals for offsite as well as onsite mitigation which are now common for mid-sized and large projects. As long as compensation (restoration, creation, enhancement) are onsite and at least roughly “in kind” there is a greater likelihood that impacts to the ecosystem will be minimized and that the same segments of society will continue to be benefited by wetland functions and values. With offsite restoration or creation, more serious issues are raised with regard to “no net loss” of ecosystem function and shifts in values including who benefits and who suffers costs.

PROGRESS IN ASSESSMENT

Not all is gloom and doom with regard to assessment techniques. Much has been learned about assessment in the last two decades and considerable progress has been made in developing assessment techniques for application in particular circumstances and to meet specific information needs. See discussion below. Hundreds of studies have been carried out examining the use of various birds, amphibians, plants, diatoms, and others indicators of relative condition. Regulatory agencies are increasingly requiring project proponents to undertake studies pertaining to specific types of proposed impacts (e.g., use of HEC models to evaluate impacts of fills on flood flows), particularly on larger projects as suggested above. Many HGM and IBI models have been developed or are under development. Such models are likely to be increasingly useful once field verification of models and guidance has been completed and guidance concerning their use developed. A great deal of important wetland and natural resource information has been gathered nationally and is now available in digital form on the Internet. For example, wetland, floodplain and soil maps, and specialized information, such as land ownership and exist use information has become available for much of the country, as well as orthophotos, topographic maps and color infrared photos.

What should be done next? What can best capitalize upon the techniques already developed? What are productive future directions for develop and use of assessment methods?

The next two parts of this paper and the appendices address these questions. But, first, we will briefly examine assessment methods developed for wetland decision-makers or developed for other purposes and used by them.

EXAMPLES OF ASSESSMENT METHODS

Methods available for more detailed assessment of functions, values or other features of wetlands may be broadly divided into (1) rapid wetland assessment methods to provide qualitative or quasi-numerical assessment of wetlands functions/values, and (2) more detailed function/value, issue or problem-oriented assessment approaches that provide more specific analyses. Examples include the following (note, this is intended to illustrate major approaches and is not comprehensive).

Rapid Wetland Assessment Methods for Functions/Values

Much of the attention of wetland scientists over the last decade has been upon the development of "rapid" wetland assessment techniques for wetland functions or functions and values. Bartoldus described 40 rapid assessment techniques in 1999 (Bartoldus, 1999). Examples of rapid techniques include:

1. "Rapid" assessment models based on answers to lists of questions using existing maps and other information and limited field investigations. A relatively large number of rapid assessment methods have been developed to which provide generalized, comparative assessment of wetland functions/values through numerical scoring. These methods have not proven very useful for determination of compensation ratios because they lack specificity in determining no net loss of "function" and the adequacy of compensation measures. However, they have been more useful when combined with other approaches and in evaluating alternative proposed corridors (e.g., roads) where other wetlands may be impacted.

To use these methods, a regulatory agency must answer questions for each wetland, based on information provided in the permit application, available maps and surveys, and usually at least one field visit. These approaches attempt to provide analysis of functions and values for each wetland. Some attempt to assign weights to various functions and values. See, for example, Larson, J.S., ed. 1976. Models for Assessment of Freshwater Wetlands, Publication No. 32, Water Resources Research Center, University of Massachusetts, Amherst, MA.

WET and WET 2 were the first broad scale wetland assessment approach developed to evaluate a range of functions/values for specific wetlands in a regulatory context. The method was designed to evaluate 11 functions/values and the impact of proposed activities on targeted animal species. Wetlands are qualitatively evaluated through a series of questions that the assessor must answer. This creates a matrix. Capacity, opportunity and social significance are considered. See Adamus, P.R. et al. 1987. Wetland Evaluation Technique (WET), Technical Report Y-87, Volume II. U.S. Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS.

Hollands and Magee developed a similar approach, with numerical scores and weights. See Hollands, G.G., and D.W. Magee. 1985. "A Method for Assessing the Functions of Wetlands," Proceedings of the National Wetland Assessment Symposium (1985). Eds. J. Kusler and P. Riexinger; Association of State Wetland Managers, Berne, NY. pp. 108-118.

Many other models for comparison of wetlands were subsequently developed in Connecticut, New Hampshire, Maryland, Wisconsin, Oregon, Minnesota and Ontario, based on the Larson, WET and Hollands/Magee approaches. See, for example, U.S. Army Corps of Engineers. 1988. The Minnesota Wetland Evaluation Methodology for the North Central United States. Minnesota Wetland Evaluation Methodology Task Force and U.S. Army Corps of Engineers; St. Paul District, MN. Ammann, A.P. and A.L. Stone. 1991. Method for the Comparative Evaluation of Nontidal Wetlands in New Hampshire, NHDES-WRD-1991-3, New Hampshire Department of Environmental Services; Concord, NH. Euler, D.L. et al. 1983. An Evaluation System for Wetlands of Ontario South of the Precambrian Shield. Ontario Ministry of Natural Resources and Canadian Wildlife Service; Ontario, Canada.

With some of these matrices approaches (e.g., WET), wetlands are simply rated as high, medium and low, with regard to specific functions and values. With others (e.g., Hollands/Magee) nominal, non-interval, numeric scores are assigned to specific functions and values. Some approaches then weigh function scores to provide overall scores.

Consultants and some state, federal and local regulatory agencies used WET and similar matrices analysis approaches extensively in the late 1980s and early 1990s for regulatory permitting and assessment of wetlands for planning purposes (Advanced I.D.'s, Special Area Management). However, the use of these models has substantially diminished because these procedures are time consuming, complicated and have proven to be inadequate for evaluating impact reduction and compensation measures. In addition, the accuracy of these evaluations is limited by simplifications, assumptions and the failure to consider many relevant factors. These approaches are most helpful when evaluating, in a general sense, the relative value of various wetlands to determine the most appropriate location for a proposed highway or other large-scale project where alternative locations are possible.

2. Qualitative analysis of functions/values and other wetland features and issues without numerical scoring. The U.S. Army Corps of Engineers New England Division's descriptive approach (See the New England District Corps of Engineers, *The Highway Methodology Workbook Supplement*.) differs from other WET-related methods and retreats from the use of complicated matrices analysis and the assignment of numerical scores to functions and values. It was developed in a region where there has been extensive experimentation with WET, Hollands/Magee and other approaches, and is based on what has proven to be workable on individual permits for mid-sized and large projects. It has been quite extensively used in New England and elsewhere.

This approach has several features which have proven useful:

(1) It uses a multi-disciplinary regulatory team (applicant's consultant, Corps staff, and state and federal agency staff) to evaluate the impact of project proposals on 13 wetland functions and values: ground water recharge, discharge; flood flow alteration; fish and shellfish habitat; sediment, toxicant, pathogen retention; nutrient removal, retention, transformation; production export; sediment, shoreline stabilization; wildlife habitat; recreation, education, scientific value;

uniqueness, heritage; visual quality, aesthetics; and threatened or endangered species habitat. The document that establishes the assessment method recommends the project consultant first seek guidance from the Corps, then evaluate the wetlands. The regulatory team will either be a party to this effort directly or review work products and offer comments. The project applicant is required to submit an application with maps and photos which provide the regulatory team members with a clear picture of the project. The use of such teams has proven useful in bringing into the evaluation process various information sources and expertise in the agencies (e.g. hydrologic, botanical, biological). Early-one discussions between the developer's consultants and the team also have proven useful in identifying critical issues including functions and values which may need further investigation.

(2) The evaluation produces a description but not a numerical ranking of the physical characteristics of the wetlands, including a determination of the principal functions and values exhibited. The method rejects numerical methods, unless the data is available to support the analysis. It prohibits arbitrary weighing of wetland functions and the ranking of dissimilar functions. The guide provides a simple evaluation form and calls for attachments, such as a sketch of a wetland in relation to the impact area and surrounding landscape, and an inventory of vegetation and potential wildlife species. See The U.S. Army Corps of Engineers. 1995. The Highway Methodology Workbook Supplement, Wetland Functions and Values, A Descriptive Approach, NEDEP-360-1-30a.

Included in the workbook supplement are a draft evaluation form and an example of factors taken into account for a New Hampshire highway project. This approach ties into regulatory processes and can be used in conjunction with comment, notice and hearings. It is flexible and depends on discussion and negotiation. The approach asks for graphic, descriptive analysis that can be understood by all members of the regulatory team. It relies on professional judgment in initial phases of analysis and does not attempt to rigorously separate policy from scientific fact although detailed, objective studies (e.g. ground water monitoring) may be required if needed.

More Detailed Analysis of Functions/Values, Issues, Problems.

A variety of more detailed and specific assessment models and methods have been developed or are used by wetland managers. These include a variety of "no name" approaches and many assessment methods developed for broader purposes (e.g., hydrologic models, stream stability models, habitat models, instream flow models). They also include a wide variety of detailed assessment methods for specific issues or topics.

1. Detailed field observations/surveys. The most common approach for gathering more detailed information about a particular wetland feature or issue is to carry out (or require a landowner/consultant carry out) a field survey of the site. The field visit allows direct observation of waterfowl, fish, reptiles or other features. Field observations often do not involve a formal assessment technique. Nevertheless, they are persuasive in court and provide hard information for denial or conditioning of permits.

Field observations and surveys may be used to determine not only wetland functions and values, but also to gather other types of information, such as:

- Wetland boundaries
- Public/private ownership related to high water mark

- Existing uses
- Presence of rare or endangered species, or representative ecosystems
- Presence of archaeological or historical sites
- Use of wetlands by waterfowl for breeding, nesting and feeding
- Use of wetlands by fish; fish and shellfish propagation in wetlands
- Use of wetlands by mammals, reptiles, amphibians and other wildlife
- Recreational use of wetlands by birders, paddlers and fishermen
- Presence of natural crops, such as wild rice, cranberries and timber
- Evidence of flooding or erosion (natural hazards)

Some field surveys may involve the use of named techniques, such as wetland delineation using the 1987 Corps manual for the Delineation of Jurisdictional Wetlands. Transects and sampling procedures may also be used. More often, field surveys simply involve visual observations, with note-taking and photographs.

2. Hydrologic and hydraulic models (e.g., HEC, TR 20). Regulatory agencies, landowners and consultants are increasingly using hydrologic and hydraulic models to investigate flood conveyance, flood storage, erosion control and wave attenuation. These models can also be used to determine flood and erosion natural hazards at a site and the impact of a proposed activity on flood, wave and erosion hazards. For example, the Rational Formula and various variations and computerized models can be used to calculate the quantity of runoff from a defined watershed based on rainfall, slope, area and other factors.

See, for example, NRCS (SCS) TR-20 computer program for Project Formulation Hydrology and TR-55 Urban Hydrology for Small Watersheds. Engineers use the Computer Program HEC-2, "Water Surface Profiles," in hydrologic studies to determine floodplains, floodways and the effects of fills, culverts, bridges and other obstructions on water surface elevations. See U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1988). Floodway Determination Using Computer Program HEC-2. U.S. Army Corps of Engineers, Hydrologic Engineering Center. (1992). Computing Water Surface Profiles With HEC-2 on a Personal Computer. Training Document No. 26.

Hydrologic and hydraulic models have been used in other contexts for floodplain and stormwater management, watershed planning, and other water-related programs to predict runoff, floodplain and floodway boundaries and elevations, flow velocities and other features. They have been used to evaluate the seriousness of flood hazards at a site (e.g., the 100-year flood elevation) and the impacts of fills and other activities on such hazards (e.g., backwater computations using HEC). They can also be used to project future hydrologic conditions by assuming various degrees of urbanization, impermeable surface and density of development.

Hydrologic and hydraulic models typically make use of information gathered from stream gauging and rainfall estimates, combined with topographical, soils, vegetative cover and land use information. These models provide quantified outputs for analysis of project impacts and evaluation of the adequacy of impact reduction and compensation. They do not evaluate social significance. But, they can be used to determine the impact of various activities, for example land use changes on specific downstream flood heights at specific locations. Hydrologic and hydraulic models are increasingly combined with GIS models to help predict future changes in hydrology.

Hydrologic information generated by these models can be useful in evaluating wetland functions/values since all functions/values depend, in part, on water regime. This information can be used to determine flood conveyance and flood storage potential for a wetland, wave retardation and erosion control potential, as well as flood and erosion threats at a site and the impact of proposed wetland activities upon those threats. In addition, these models can be used to evaluate the adequacy of project impact reduction and compensation measures.

However, data gathering to apply these models is often expensive since detailed topographic and hydrologic (e.g., stream gauging) information is needed, although use of Global Positioning Systems is reducing the cost of topographic information.

3. Stream hydrologic/geomorphic stability assessment approaches (e.g., Rosgen). Wetland decision-makers agencies have used several models to evaluate the morphology and condition of unstable streams in order to determine functions/values, and restoration and management needs. The models evaluate the condition and stability of streams in terms of stream slope and form. These approaches are increasingly used to determine possible erosion, flooding and other problems, the impact of activities on these problems, and the adequacy of compensation measures. They are also used for planning and implementing restoration.

See Rosgen, D. (1997). Applied River Morphology. Wildland Hydrology; Pagosa Springs, Colorado; Leopold, L.B. (1994). A View of the River, Harvard University Press; Cambridge, MA.

4. Animal species and biological community evaluation models (e.g., HEP, WETHINGS, IBI). Wetland decision-makers can use a combination of field observations and various inferential (deductive) models to determine the capacity of particular wetland environments to serve as wildlife habitat. These models can be used not only to determine functions, but also to establish water quality standards for wetlands, enforce such standards and assist monitoring efforts.

For examples of these models, see:

HEP (Habitat Evaluation Procedures), U.S. Fish and Wildlife Service. (1980). Habitat Evaluation Procedures (HEP) Manual (102ESM). U.S. Fish and Wildlife Service; Washington, D.C.

Cable, T.T., V. Brack, Jr., and V.R. Holmes. (1989). "Simplified Method for Wetland Assessment." *Environmental Management* 13; pp. 207-213.

Whitlock, A.L, N. Jarman, J.A. Medina, and J. Larson. (1995). WETHINGS. The Environmental Institute, University of Massachusetts; Amherst

Adamus, P.R. and K. Brandt. (1990). Impacts on Quality of Inland Wetlands of the United States: A Survey of Indicators, Techniques, and Applications of Community-level Biomonitoring Data. EPA/600/3-90. Office of Research and Development, U.S. Environmental Protection Agency; Washington, D.C.

Davis, W.S., and T.P. Simon, eds. (1995). Biological Assessment and Criteria: Tools for Water Resource Planning and Decision Making. Lewis Publishers; Boca Raton, FL.

Many efforts are also underway to develop models for measuring the biological integrity (IBI's) and relative biological condition of wetlands. These efforts involve information gathering of particular plant and animal species for similar sites with various levels of anthropogenic impacts. Information gathering typically pertains to plants, animals, hydrogeomorphic setting and hydrology. Reference sites are identified with no or little disturbance; a suite of similar sites, representing various levels of disturbance, are also identified. Wildlife and other biological forms are compared at the various sites. Indicator species, which can be used to compare the relative condition or sites, are also identified. Quantitative indices are typically developed which allow the comparison of sites.

These biological surveys and indices have a number of important uses. First, the biological information gathered can be used to determine whether there are endangered species at the site and the impact of a proposed activity at the site on fish and wildlife. Biological information is also proving useful as a surrogate for the types and magnitudes of other wetland functions (e.g., food chain support, pollution control). Indices can also be used to establish water quality standards for a wetland. For example, such standards can specify that water quality and other features (e.g., depth, vegetation) cannot be degraded to the point that there will be a loss of specific indicator species in a wetland, lake or stretch of stream. Alternatively, standards can specify that water quality and other features must be restored to the point that the water body will again support indicator species. Emergence of indicator species will indicate success.

Biological indices, and the reference sites and background information gathered to prepare them hold promise for improving wetland assessment procedures for habitat functions/values. However, development of such indices is proving difficult, time consuming, and expensive. It is also very difficult to develop accurate indices because there are often many ecological zones within a single wetland and these zones shift by season and over a period of years as rainfall varies. The correspondence between biological integrity and many other wetland functions/values, such as flood storage, flood conveyance and erosion control has yet to be demonstrated.

Box 6
Advantages of Biological/Botanical Models and Information

- Virtually all wetland statutes and regulations include "habitat" protection goals and permitting criteria; biological/botanical information is needed to determine compliance with these goals and criteria.
- Biological/botanical information is needed to determine whether there are endangered species at a site (also required by statutes and regulations).
- Biological/botanical information including relative condition may determine other wetland features such as recreation values.
- Many wetland regulators are biologists and are comfortable dealing with biological/botanical information and less so with other types of information.

- Biological/botanical targets for compensatory mitigation are less subject to manipulation than wetland processes targets alone.

- Wetland biological and botanical information may allow integration of wetland assessment with lake, stream, estuary, and riparian/floodplain assessment since biological models and information are broadly used by scientists to gauge relative aquatic ecosystem health and set pollution control standards for these other types of waters.

- Biological/botanical targets for protection/restoration are understood by the public (e.g. salamanders, frogs, birds).

- Biological/botanical information can, in some instances, be gathered by relatively untrained and motivated volunteers (e.g. bird watchers, fishermen, waterfowl hunters).

5. Approaches to evaluate restoration potential, identify restoration sites. A number of models have been developed to help identify potential wetland restoration sites and to evaluate the restoration potential and needs of wetlands, related floodplains and aquatic ecosystems. See, for example, C. Bartoldus, E.W. Garbish, M. Kraus. (1994), Wetland Replacement Evaluation Procedure. Environmental Concern; St. Michaels, MD, which recommends a procedure for calculating differences between the wetland to be impacted and the replacement wetland in terms of six functions and 82 determinants. These functions include shoreline bank erosion control, sediment stabilization, water quality, wildlife, fish and uniqueness/heritage. For other guidance concerning evaluation of restoration potential and condition, see:

Bureau of Land Management, Riparian Area Management. (1993, 1995). Process for Assessing Proper Functioning Condition. U.S. Department of Interior, Bureau of Land Management, Service Center; Denver, CO.

Rosgen, Dave. (1997). Applied River Morphology. Wildland Hydrology; Pogosa Springs, CO.

Brown, C.R., F.O. Stayner, C.L. Page, C.A. Aulback-Smith. (1993). Toward No Net Loss, A Methodology for Identifying Potential Wetland Mitigation Sites Using a Geographic Information System. South Carolina Water Resources Commission Report No. 178. USEPA Report No. EPA904-R-94-001.

6. Assessment of overall ecological processes via HGM. As already discussed above, the HGM assessment method was formally proposed by the Corps and other federal agencies for use on Section 404 regulatory permits (see work plan published in the Federal Register, August 16, 1996). So far, the Corps has published a number of documents, in addition to this action plan, describing this approach in greater detail. The first is a procedural HGM document: Smith, D., A. Ammann, C. Bartoldus, and M. Brinson. (1995). An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices, U.S. Army Corps of Engineers, Waterways Experiment Station, Wetlands Research Program Technical Report WRP-DE-9. More documents are on the way.

HGM was designed to help regulators assess wetland overall ecological condition and to establish compensation ratios. This approach has many new and interesting features compared to earlier rapid wetland assessment approaches. As discussed above, it requires classification of wetlands by hydrogeomorphic setting (classes and subclasses), the establishment of profiles of classes through reference sites, and evaluation of wetland functions. It is the first technique to shift analysis from the end result – function/value – to the underlying biological and chemical processes. This encourages users to understand how wetlands work and facilitates analysis of the changes that projects will make in wetlands.

However, HGM is complicated and has a variety of limitations indicated above. The practicality of this approach for routine permitting activities remains to be seen. However, the regulatory classification system, the information in guidebooks that characterizes wetland processes, and the establishment of reference sites may improve assessment of wetland functions/values and those of related aquatic and floodplain/riparian ecosystems. Regional subclass guidebooks should also be useful in helping regulatory agencies evaluate capacity and the impact of activities on capacity.

7. Area-wide assessment of functions/values and other characteristics through the Synoptic Approach, various GIS approaches, and other landscape level approaches. The U.S. Environmental Protection Agency has proposed a "synoptic" approach to wetland assessment. This method looks at overall landscape features and wetland position in the landscape to help evaluate wetland functions/values. See, Abbruzzese, B., S.G. Leibowitz, and R. Sumner. (1990). Application of the Synoptic Approach to Wetland Designation: A Case Study Approach. EPA/600/3-90/072. U.S. EPA Environmental Research Lab; Corvallis, OR.

The Synoptic Approach is broad brush, but its strengths lay in evaluating wetlands in hydrologic, ecological and policy contexts. It does not attempt to evaluate the functions/values of individual wetlands.

A variety of approaches that use GIS systems to provide landscape-level analyses have also been developed in Michigan, Missouri, North Carolina and Maryland. These, like the Synoptic Approach, consider soils, topography and location, among other factors. GIS models have been used in regulatory permitting in North Carolina and Maryland, but not as a substitute for case-by-case, on-the-ground analysis.

PART TWO: RECOMMENDATIONS FOR MAKING BETTER USE OF EXISTING TECHNIQUES

How can wetland decision-makers make better use of these existing assessment techniques? Suggestions include:

A. Recognize that wetland decision-makers require many types of information, depending upon the management tool and context, and that a range of assessment methods and techniques are needed to provide this information.

Based upon has been learned over the last two decades, no single, silver bullet assessment method is appropriate for all wetlands because wetlands are so complex and needs differ between contexts and management tools. It has quite often been assumed that wetland decision-makers using regulations, acquisition, restoration, active management (e.g. control of exotics) and other techniques have identical information gathering needs. Some of the needs of the management tools are similar (e.g., mapping, wetland condition assessment, analysis of wetland habitat functions) but others are not. For example, comparative analysis of wetlands is needed in setting acquisition and restoration priorities but not in analyzing individual regulatory permits (in most instances).

Somewhat different techniques need to be applied in different physical contexts as well. For example, stream stability models (e.g. Rosgen) are needed for determination of project impact and design of impact compensation measures for high energy, altered streams and adjacent wetlands but not for low gradient streams with little sediment loading.

A range of assessment methods are, therefore, needed to meet these needs. There is no “silver bullet” method to meet all needs.

B. Recognize that decision-making information gathering and analysis needs are not confined to assessment of wetland functions or condition.

Assessment of wetland “functions” and “condition” are very important and assessment is a major goal of many wetland assessment techniques. But function/condition information constitutes only a portion of information that decision-makers must gather with limited funding, staff, staff expertise, and time. See Appendices A-J. Other needs include, for example, wetland maps, wetland boundary delineation, presence or absence of endangered species, existing uses, presence or absence of nuisance species, presence or absence of natural hazards, and the “opportunity” a wetland may have to serve particular functions (e.g. flood storage) to society. Assessment approaches must often be used in combination to meet these multiple needs.

C. Recognize that wetland regulations have a number of “special” needs.

Ostensibly many wetland assessment techniques have been developed to meet federal Section 404 and state and local regulatory permitting needs. However, these techniques have often been developed without a clear understanding of regulatory needs and what makes regulatory different from nonregulatory needs. See Appendices A. For example, regulations legally require the identification of wetlands and determination of wetland boundaries on the ground, either in advance of submission of individual permits or at the time of permitting. All regulations must

comply with the same overall federal Constitutional requirements and similar state requirements (e.g., they must not "take" property without payment of just compensation; they must be rational; they must not be discriminatory). The need sufficient information to prepare EA (Environmental Assessments) and Environmental Impact Statements (if needed). All require determination of project impacts. Most require mitigation and compensation of impacts, consistent with a no net loss of function standard. The need monitoring of regulations over time for enforcement purposes. See Appendix notes G and H.

D. Better tap existing sources of information and expertise.

Scientists and regulators utilizing wetland assessment techniques need to make better use of available information. They need to better tap and utilize the broad range of natural resource information relevant to wetland decision presently available and under development throughout the nation such as wetland maps (NWI and other maps), topographic maps, geologic maps, flood maps, floodway maps, water resources inventory data, existing use maps, natural area inventories, rare and endangered species inventories, air photos, satellite imagery, orthophotos and other sources of information. To do this, wetland decision-makers need to help develop and implement state, regional, or local information networks which allow rapid access to such information in permitting contexts such as posting the information to the Internet in readily retrievable form. They should use joint permitting procedures and collaborative, multidisciplinary "team" approaches to tap expertise and information in agencies. See Kusler, J., Integrating Wetland Assessment into Regulatory Permitting, Association of State Wetland Managers, Berne, N.Y. (2004). They can better tap landowners and their consultants for information by establishing clear information-gathering check lists and guidelines.

Wetland decision-makers also need to make better use of the "pool" of wetland experts in government agencies, academic institutions, consulting firms, and environmental not for profits. This pool has increased greatly in the last decade. To tap this expertise, regulatory agencies need to make better use of "notice" procedures and hearings to tap other resource agencies, regulatory agencies, not for profits, and other groups and individuals. They need to coordinate wetland and function assessment efforts with other resource assessment efforts such as information gathering for local comprehensive planning.

E. Carry out field-testing for assessment methods.

Unfortunately much of the funds and time spent in developing various assessment techniques has, to date, been spent on the "development" phase with limited field testing for accuracy, cost, and overall practically. A consortium of federal, state, and local agencies should, over time, conduct field test of existing and proposed assessment models. Results of the tests should be widely circulated and guidance concerning the use of particular techniques should be prepared.

F. Prepare improved guidance for the use of particular techniques in specific circumstances.

A federal/state/local interagency report should be prepared concerning the use of available techniques in specific circumstances. The list of 40 techniques Candy Bartoldus carried out in 1999 is a good start, and many other techniques can now be added to the list, including more detailed assessment methods not developed for wetlands but suitable for evaluating certain

aspects of wetlands (e.g., HEC models for hydrologic parameters). Such an update is underway by Bartoldus and her colleagues and is much welcome.

The descriptive guidance needs a detailed breakdown on what the techniques can do and how they can be used, as well as their strengths and weaknesses and coasts. Limitations on the accuracy of techniques should be acknowledged. To make better, selective use of existing assessment methods and techniques, regulators need to apply improved, "early-on", qualitative evaluation procedures which can help determine if more detailed examinations are needed and, if so, what sorts of more detailed assessment methods are most appropriate. See below.

G. Broadly distribute guidance on the use of techniques.

The report on the use of available techniques should be made broadly available. For example, Ms. Bartoldus's updated publication should be made available on the Internet, for free, to anyone interested. A CD Rom version at nominal costs should also be made available. Additional field-testing should be undertaken over time to determine accuracy, cost effectiveness and practicality of techniques.

H. Better train government agencies, consultants, others in the selection and use of various techniques.

Additional workshops and training sessions should be held to train agency staff, consultants and others in the selection and use of various techniques.

I. Acknowledge limitations on assessment methods; reflect uncertainties and margins of error in continued "alternatives analysis" requirements and mitigation ratios which reflect uncertainties.

Scientists and regulators utilizing existing assessment methods and designing assessment techniques should more clearly acknowledge the limitations upon assessment techniques rather than imply (in some instances) that accurate assessment can be accomplished in circumstances where it cannot. This is particularly true for "quasi-quantitative" models which give the appearance of accuracy but often fail to consider a broad range of critical factors, greatly reducing their accuracy. Scientists and regulators need to acknowledge that there can be no guarantee that proposals to destroy wetlands at one location and to compensate for this loss by restoring, creating, or enhancing them at another location will be successful because there are no accurate way of measuring and projecting before and after conditions. Due to the dynamic nature of wetlands due to fluctuating water levels and changing landscape contexts, accurate long term determination of functions/values is also difficult for many wetlands. Budgetary restraints are also a severe limitation upon detailed, accurate assessment. To deal with the uncertainties scientists and decision-makers should:

- More broadly acknowledge the overall gaps in scientific knowledge and other restraints upon assessment of functions and values.
- Honestly represent both the capabilities and limitations of functions/values assessment techniques and methods including assumptions and simplifications in assessing project impacts and the adequacy of mitigation measures.
- Avoid the use of quasi-quantitative models which have the appearance of accuracy but are often very inaccurate.

- Continue to apply alternative analysis requirements and other avoidance strategies particularly where sensitive wetlands systems are involved and where project impacts and the adequacy of mitigation and compensation measures are unclear.
- Apply relatively large compensation ratios for restoration, creation and enhancement which provide a margin of error in compensating for losses.
- Use "forgiving" approaches in regulation such as multiobjective conservancy zoning which can be based upon natural hazards, soils, topographic, and other types of information and does not detailed and accurate assessment of functions/values at every site because assessment of all functions/values of wetlands is often beyond the technical and financial capabilities of regulatory agencies.

This does not mean that assessment models are not of value and that substantial improvements are being made in assessment methods and procedures. But, a cautious approach to wetland destruction is justified. Alternatives analysis before wetland alteration will continue to make sense into the foreseeable future. Multiobjective efforts to protect and restore wetlands which are based upon a broad range of considerations and not simply functions and values also make sense.

Policy-makers also need to recognize that efforts to classify wetlands "once and for all" for regulatory purposes will fail unless users are willing to live with large margins of error due to inaccuracies and gaps in data and assessment methods and the changing and dynamic nature of wetlands due to fluctuations in precipitation and anthropomorphic influences. It may never be possible to inventory statewide or nationally on "once and for all" basis all of the critical characteristics of wetlands needed for advance decisions concerning wetland destruction and preservation.

J. Develop a preliminary assessment process to help mangers select the appropriate assessment techniques for use in specific circumstances.

Such a process should begin with a generalized, qualitative assessment including consideration of landscape context. It should involve red-flagging and yellow flagging, and overview identification of issues, problems, possible functions and values. This may be followed with more detailed assessments of specific issues, problems, functions and values, as needed. See generally J. Kusler, Integrating Wetland Assessment into Regulatory Permitting, ASWM 2004 for such a process. Such a process would be different than most "rapid" assessment techniques in that it would not be limited to functions or functions and values. Such a freestanding, preliminary assessment procedure is needed to determine whether more detailed assessments are necessary, and if so, what types. It is also needed to help agencies meet (EA) requirements of the National Environmental Policy Act, and comparable state or local acts. Such acts and regulations typically require that an agency prepare an initial assessment to determine whether an activity might have a significant environmental impact. If a significant impact is probable, then an agency must prepare a more detailed environmental impact statement.

What should some of the goals and features of such a preliminary process be? We suggest a workable process should:

- Help determine, on a preliminary and qualitative basis, whether significant wetland processes, functions and values might be impacted at a site. It so, data gathering and analysis can be quickly focused on the specific functions/values that may be impacted.

- Depend primarily on existing information, professional judgment and perhaps a single field visit.

- Provide all reviewers with a clear picture of the proposed project. The Corps recommends for applicant submissions in its Highway Supplemental Assessment Method: "The objective is to graphically display complex wetland information in a format that facilitates assimilation by reviewers and expedites regulatory decisions." Illustrations of graphic presentations are provided in this guidebook, including a wetland evaluation form with corresponding backup information and a study area graphic. The guide calls for display of other resources, in addition to wetlands, "in order to give the decision-maker a complete picture when evaluating alternatives." (New England District Highway Supplemental Assessment Method, the Highway Methodology Workbook supplement Wetland Functions and Values: A Descriptive Approach.)

- Recognize that landowners/consultants, local governments, state and federal agencies, and the public must often collaborate on information gathering and analysis, particularly for larger projects. There is simply not enough money and time for regulatory agencies to go it alone. Collaborative information gathering can build consensus among regulatory and commenting agencies concerning relevant facts (e.g., Is a site subject to severe flooding? Is an endangered species present?) and distribute costs. Collaboration also helps build consensus on wetland-related impacts and the adequacy of impact reduction and compensation measures. Consensus-building is particularly important when multiple agencies review a permit.

- Include a variety of "sorting" procedures (e.g., red and yellow flags), with various feedback loops to determine, early on, the issues and problems at the site and whether more detailed studies are needed. This corresponds with the requirements of the National Environmental Policy Act, which states that before preparing an environmental impact statement an agency must first take a hard look at potential impacts to see if they might be significant.

- Sequence information gathering to get the easy information first. For example, if a proposed fill is in a floodway and would violate floodway regulations, if a septic tank system is proposed for a saturated area where such system will not work, or if the site is an endangered species habitat, a simple "no" may be rational and legally defensible.

- Help the regulatory agency evaluate the proposed impact and the adequacy of reduction and compensation measures, including the adequacy of proposed monitoring procedures.

- For regulatory contexts, include at least a superficial evaluation of the impact of permit denial or conditioning on the landowner to determine whether possible takings challenges or other legal problems may result. If so, more detailed information gathering may be needed for the permit application. Data gathering may best focus more on health, safety and nuisance issues, which are given great weight by the courts.

- Be compatible with and encourage, over time, up-front mapping and other data gathering at the local and state levels, including prior planning, such as wetland and flood maps, endangered species maps, identification of wetland reference sites, and wetland and watershed management planning.

It is not, of course, easy to develop a rapid and inexpensive process that satisfies all of these goals.

PART THREE: LOOKING TO THE FUTURE

Recommendations for developing more responsive and integrated assessment methods in the future include the following:

A. Reevaluate overall strategy; rethink the full range of decision-maker information needs.

A shift in overall wetland assessment strategy is needed. Rather than a search for "one technique meets all" a new strategy should be "Right tool for the job". Development of wetland assessment method should not be approached as the search for the "Holy Grail" A single, accurate and rapid assessment technique for all wetlands and all functions and values is not practical. A new strategy should involve the refinement of specific assessment methods for particular functions and values combined with broader analytical procedures to help decide which assessment methods are most appropriate in a particular circumstances. It should involve improved coordination in use of approaches. See Kusler, J., Integrating Wetland Assessment Into Regulatory Permitting. It should involve, over time, the development of "umbrella" approaches for not only wetlands but related ecosystems such as rivers, coastal waters, lakes, riparian areas and floodplains.

A reevaluation of overall strategy should include better documentation of the full range of information needs and what has been learned about meeting those needs. Any attempt to reconcile wetland assessment methods and techniques must recognize the different needs, and match existing and future methods to them. For example, non-regulatory programs (e.g., acquisition, infrastructure planning and restoration efforts) typically need area-wide wetland inventories and comparisons between wetlands. Such inventories and comparisons are less important for case-by-case regulatory permitting.

Rethinking should build on existing assessment methods and information sources what has been learned about various assessment approaches in the last two decades. For example, much "how to" information has been learned about the development and use of HGM, IBI and other assessment models but this has not been summarized and made widely available. This rethinking must also recognize that there are significant policy, as well as scientific, considerations in defining terms, such as *assessment*, *functions*, *processes*, *values* and *condition*. There should be careful dialogue leading to greater agreement on how these terms are to be used in assessment and management.

B. Form an interagency "wetland assessment" task group or working group designed to help governmental units at all levels of government develop and apply wetland assessment methods.

Federal agencies should, in cooperation with states, local governments, academic institutions, and other organizations form an assessment working group not wedded to a specific assessment method. Alternatively, this could be a National Academy of Sciences Panel. This working group or panel should better document decision-making needs. It should examine commonalities and differences in assessment needs among the various wetland decision-makers. It should make recommendations for use of existing techniques. It should oversee testing of existing and new assessment approaches.

This working group should also set forth alternative definitions for the terms "function", value, "condition", and other key terms. These terms should be openly debated in light of the scientific and policy implications.

C. Build consensus concerning the use of basic terms.

Over the last decade, much of the attention in assessment has focused on "functions", "processes", "values" and "condition". Each of these terms is subject to different interpretations, and there are important but rarely recognized policy implications in defining these terms. The interagency work group (or National Academy Panel) should help develop consensus concerning the use of critical terms with consideration of not only scientific but policy issues. Such terms should include (but not be limited to):

"Function": The definition of "function" is most critical and controversial. The restricted HGM use of "function" to refer to natural processes is appropriate in scientific contexts. But, if the term is to be used in this limited sense, scientists should also make clear that they are not attempting to redefine the scope of Section 404 and similar regulatory project review procedures by apply a narrow "wetland process" concept of "function". Narrowing the concept of net loss of function to apply only to changes in natural processes has significant policy implications, which deserve public debate and review. Scientific convenience alone should not be the only consideration, without exploring these policy implications.

If assessment methods are to evaluate "function" for the purposes of the mitigation across a range of habitats, including wetlands, riparian areas, adjacent aquatic ecosystems and uplands, it is important that the subtle range of distinctions among processes be recognized. For example, evaluating the hydrologic, soils and vegetative processes of adjacent wetland, riparian area and aquatic ecosystems might (at least theoretically) suggest comparable flood retention capabilities, but the relative amphibian, reptile and other feeding and breeding capability will be very different.

"Value" and "Values": Assessment of "value" as well as natural processes continues to be important although assessment methods over the last decade have focused more on natural processes. Assessment should reflect the "opportunity" which wetlands have to produce particular goods and services meeting the needs of society. It should also reflect "social significance" including how people are impacted, how many, and how much. It should also reflect society's attitude toward wetlands and their functions.

"Condition": "Condition" is also a critical term because it is used to determine impact reduction and compensation needs in meeting a no net loss goal. A broad definition of condition is needed which reflects offsite as well as onsite factors including hydrologic context. Condition should reflect a degradation gradient. Condition should reflect restoration potential. It should be clearly recognized that condition and function are not the same although condition is relevant to function particularly habitat-related functions.

D. More realistically address regulatory needs when developing wetland assessment methods for regulatory purposes.

Wetland regulations are subject to more intense legal scrutiny than other wetland management techniques because these regulations limit the use of private lands. To meet statutory,

constitutional and other legal requirements that control private property, assessment methods must provide regulators with sufficient information to:

- **Comply with the assessment procedures** (if any) established in regulatory statutes, administrative regulations and ordinances (local regulators).
- **Apply the wetland definitions, goals and criteria** set forth in regulatory statutes and guidelines.
- Gather the sorts of information required **to make jurisdictional determinations** (e.g., is a wetland? If so, is it a regulated type of wetland? If so, is the proposed activity, a regulated activity? Is the site of the proposed activity public or private land (this often determines the regulations which apply at the state and local levels)?
- Map and/or carry out one the ground delineations **to delineate precise boundaries on the ground.** Some but not all regulations require mapping.
- Gather sufficient information early on **to determine whether the proposed project may have "significant" environmental impacts** (an Environmental Assessment).
- Gather sufficient information **to prepare an Environmental Impact Statement** is such a statement is required (federal agencies).
- Gather sufficient information **to determine whether there are practical alternatives** to the proposed activity.
- Gather sufficient information **to determine the functions (and values) of the wetland and any proposed "compensation" wetland** sufficient to apply regulatory criteria pertaining to functions and values such as a no net loss of functions and values goal (if the statute contains one), a determination whether a permit is in the "public interest" (Section 404); and compliance with water quality standards.
- Gather sufficient information to **determine "compensation" needs and the adequacy of compensation measures.** This may include not only functions information but "values", threats to compensation sites, the difficult likely to be encountered in undertaking compensation of this type of wetland in this setting, and other factors.
- Gather sufficient information **to apply other regulatory criteria** such as possible flooding threats and the impact of permit issuance on flood and erosion threats to other property.
- Monitor wetlands and gather other time-series information sufficient **to detect violations and provide enforcement.**
- Gather sufficient information **to defend regulations against "takings"** and other Constitutional challenges (nuisance prevention and health and safety information are often most powerful. Regulators must provide sufficient information to sustain regulations against Constitutional Due Process, discrimination, unreasonableness and takings challenges by private landowners.
- Gather sufficient information **to avoid liability problems in permitting** (e.g., issuance of permits that increase flood or erosion problems on other properties). Regulators need documented, time-series information for monitoring and enforcement.

E. Continue to map wetlands, remap wetlands at adequate scale and with adequate degree of accuracy for regulatory and other purposes.

Wetland maps which locate overall wetland boundaries and determine the types of wetlands are important for all wetland decision-makers although maps are no substitute for more specific field delineations in many instances. The NWI maps have been broadly used for a broad range of purposes. But such maps are not available for a portion of the nation. In addition, some of the

NWI maps are out of date and many do not detect smaller wetlands. Only a portion of the maps are available in digital form.

NWI and other mapping needs to be completed for the Nation. Existing maps in many instances need to be updated. Maps need to be available in digital form. More detailed, accurate maps are needed for specific areas under development pressure or requiring restoration or special protection and management. These require time series air photos or remote sensing from planes or satellites.

F. Refine issue-specific assessment models.

Continued research should be carried out to refine a wide range of assessment models which meet specific needs. The interagency group (see recommendations above) should select priority methods for further testing refinement. These models will include not only models dealing with functions (e.g., HGM), but hydrologic and stream stability models (e.g., Rosgen), habitat assessment (IBI and others) models, and landscape-based models including GIS models.

G. Continue to develop and test IBI models, develop guidance for their use.

Indices of Biological Integrity hold considerable promise for establishing water quality standards for wetlands, carrying out state 305(b) reporting, evaluating project impacts, setting acquisition and protection priorities, setting restoration priorities, setting performance standards for mitigation, and aiding with monitoring and enforcement. Further development of bio-criteria" for various plant and animal species in wetlands is therefore needed. Such models have broad potential over time but are proving difficult to develop due to the complexity and dynamic nature of wetlands.

Agency guidance (e.g., state agency EPA, Corps) is needed for the use of existing models. Such guidance could take the form (initially) of broad policy guidance. This could be followed by more specific guidance adopted as state water quality standards for wetlands (where IBI models are available and tested) or as part of other regulations.

Some starting points for such guidance could include:

Guidance should allow a regulatory agency to use tested and validated IBI models in setting agency mitigation goals and project monitoring standards.

- Guidance should allow regulatory agencies to require use of tested IBI models in appropriate circumstances on projects (assuming that an IBI is available for a particular type of water or wetland).
- Guidance should point out both uses and limitations of IBI models to help guide agency and project users.
- Guidance should point out IBI models do not assess opportunity and social significance which need to be considered separately.

H. Continue to develop and test HGM models, develop guidance for their use.

HGM models also hold promise, over time, to improve landscape level analyses of wetlands, the analysis of project impacts on wetlands, and the adequacy of impact reduction and compensation measures. HGM models should also continue to be developed. But, an overall appraisal of the

method including the many models in development or developed should be undertaken. This has not been done despite the many models developed over the last ten years. What has been learned about putting together HGM models? How long does it take? How much does it cost? How accurate are the submodels developed to assess particular functions in actually assessing these functions? Is the assumption that degree of disturbance (relative condition) determines level of function valid or invalid? Models actually measure function? What has been learned about applying HGM in regulatory and other contexts?

Agency guidance is also needed pertaining to the use of HGM. It, like guidance on other techniques, could take the form of information policy guidance or more formal regulations. Some starting points for such guidance could include:

- Regulatory agencies should not be required to use HGM on all permits because HGM models are not available for many subclasses, models have not been tested, and because it is too expensive for use on many permits. It should, at this point in time, be an optional method.
- Regulatory agencies applying HGM should first apply a broad, preliminary evaluation process (see discussion above) to help determine the functions, problems, and other special issues at a site and whether an HGM analysis and/or other analyses is to be required on a particular permit.
- Regulatory agencies should be required to consider more than a HGM score plus acreage determining mitigation needs. Consideration of only HGM score omits consideration of too many relevant factors. See Box 5.
- If project consultants are to undertake an HGM analysis, the regulatory agency should supervise selection of reference sites and the selection of functions (processes) to be examined because the reference sites and processes selected are so important in determining outcomes.
- Guidance should make clear that the regulatory agency should consider not only HGM scores but opportunity and social significance in evaluating permits and not simply HGM scores in deciding whether issuance of a permit is in the public interest and in establishing mitigation ratios.

I. Establish statewide or regional "reference" systems.

Over time, states, local governments, and federal agencies should establish regional systems of reference wetlands (as recommended by HGM, IBI, other methods) to develop factually-based profiles of wetlands, provide models and other information for restoration and creation, facilitate monitoring, and serve other objectives. Reference sites are also formally or informally used in other wetland assessment efforts to guide restoration efforts (types of plants, hydrology, soils) and to provide seed stocks for restoration. They are also being used to help determine success by comparing reference sites with restored, created, or enhanced wetlands. Wetland reference sites can also serve a broad range of important research, education, and interpretation objectives such as student research. They can be used to calibrate and test wetland methods.

HGM and IBI methods involve the establishment of reference sites. However, the establishment of more permanent reference sites permits the tracking of changes in such sites. Permanent sites can also be used and reused over time. Robert Brooks at Penn State University has created a state system of reference sites which has facilitated development, testing, and comparison of HGM, IBI and other assessment methods in that state.

Looking to the future, regulatory agencies should work with academic institutions, resource management agencies at all levels of government, and not for profits (e.g. Nature Conservancy, Trust for Public Lands) to establish regional or statewide systems of reference sites.

J. Develop and test procedures for carrying out a preliminary, broad qualitative assessment of wetlands and project impacts with more detailed analysis for specific functions, functions/values and problems (as needed).

As suggested in Part 1, experience indicates that "a one size fits all" approach to assessment involving the same analysis of the same functions/values and same level of detail and accuracy for all permits does not adequately reflect the wide variations encountered in wetland ecosystems nor the differences in the amounts and scale of functions and values information needed in specific contexts. There is not enough money or time or need for detailed assessment of all in all contexts. More specifically, scientists and regulators in developing future assessment methods should:

- Develop and utilize procedures which identify, early-on in a regulatory permitting situation, the types and amount of information and the needed accuracy. These include improved red flag, yellow flag, screening, and other mechanisms to identify, early on, significant functions/values, issues, and problems and the possible magnitude of project impact. Decisions should be based upon known or more easily obtained information wherever possible.
- Further explore ways of grouping wetlands and related ecosystems to help with preliminary and more detailed analysis. For example, the HGM overall classification of wetland types is useful to help characterize ecological functions and values and it is possible to use other classifications such as the National Wetland Classification system and NWI as well.

K. Combine case-by-case analysis (e.g. Section 404 permitting) with upfront information gathering and landscape profiling techniques for wetlands and broader areas.

More specifically, scientists and wetland decision makes should, over time:

- Prepare and make more broadly available various types of "up front" information which identifies specific functions and values at specific sites or can help regulators identify functions and values on a case by case basis. This may include many types of information in map, digital, and written form such as wetland maps, flood hazard maps, erosion hazard maps, inventories of endangered species, ecosystem studies, identification and description of fish and shellfish habitat, historic and archaeological site inventories, source water supply inventories, existing land use data, hydrologic regime information, water quality information, and wetland restoration site information. This up front information cannot only facilitate case-by-case assessments but provide greater up front certainty to landowners. This information can also be used not only for regulation but water and land use planning and management, wetland restoration, public land management and other purposes.
- Develop improved wetland/landscape wetland characterization techniques which can be used both up front and on a case by case basis to suggest functions/values including the "opportunity" and "social significance". These techniques should include improved function/values assessment techniques and methods which are applicable to not only wetlands but adjacent deep water habitats and uplands.

However, there are limits to the amount of detail and accuracy which can be provided by upfront assessments. Limitations upon funding and the dynamic nature of wetlands will require that some measure of continued, detailed case-by-case assessment for delineation, functional assessment, mitigation, and compensation will also be needed. Techniques for efficiently combining broad scale, up front surveys and some measure of detailed case-by-case assessment is needed.

L. Further develop and test digitally-based (e.g., GIS) landscape or watershed-scale wetland assessment models.

Assessing landscape context, as well as wetland level can be time consuming and expensive. However, a common sense approach that takes a qualitative look at the interrelationships between wetlands and broader areas is possible even on individual permits. In addition, a variety of up-front assessment approaches on a regional or watershed basis holds promise for improving and supplementing case-by-case wetland assessment. These approaches can help with red flagging and preliminary environmental analysis; assist regulators perform more detailed analysis of capacity, opportunity and social significance, and in monitoring and enforcement; aid in the establishment of compensation ratios; make wetland regulations more predictable and equitable; and reduce the administrative and financial burdens on private landowners. They can also help integrate and coordinate wetland regulations with comprehensive land and water planning.

However, the dream of an inexpensive wetland assessment method that will allow accurate, up-front evaluation of all wetlands within a given region and can entirely replace all case-by-case information gathering will not likely be realized in the foreseeable future. Wetlands are too complex and conditions change quickly. Regulatory information needs are too diverse and complicated. Approaches must combine up-front and case-by-case permitting in order to improve wetland permitting and other site-specific analyses.

M. Develop improved procedures for assessing "opportunity" and "social significance" as well as natural processes.

Early wetland assessment methods such as WET and WET 2 attempted to evaluate both wetland natural processes ("capacity") and the relevance of processes to people ("opportunity", "social significance"). More recently, models such as HGM and IBM have not attempted to evaluate the relevance of "processes" to people.

Several rationales have been offered for this. "Values" are more subjective and less subject to quantification than natural processes. Natural processes can be "objectively" studied and described. A focus on natural processes helps regulators understand natural systems, the impacts of proposed projects, and the adequacy of impact reduction and compensation measures.

National and regional guidebooks for the HGM method have attempted to focus on natural processes by redefining "function" to refer only natural processes. With such a redefinition, "no net loss" of "function", then, means no net loss of wetland processes and not loss of wetland process and the benefits of these processes to people. Such a redefinition results, however, in a variety of problems in the context of a Section 404 or Section "public interest review" permitting. It represents a significant shift in regulatory policy. See Appendix A for more detailed discussion.

Partial separation of objective and subjective factors is often desirable in project review. But, natural processes are not the only objective factors needing assessment. "Opportunity" and "social significance" due not readily lend themselves to quantified evaluation. But, this does not make them less important. Both natural processes and values should be assessed. Regulatory experience over the last several decades suggests that in combined consideration of objective and subjective factors is useful in initial, preliminary permit review to determine if a proposed project may have a significant impact. However, separate analysis of objective and subjective factors are often desirable for more detailed project review of specific functions/values or other issues and problems.

N. Over time, develop an integrated assessment model for not only wetlands but related ecosystems such as rivers, streams, lakes, estuaries, riparian areas and floodplains (and perhaps uplands that includes features of HGM, IBI and other techniques for use on a landscape basis.

Many elements of existing assessment approaches appear to have promise for reconciling and integrating assessment methods in the future. Some include:

- Use of the HGM or a related hydrogeomorphic classification system.
- Focus on assessment of processes.
- Use of reference and the development of state or regional systems of reference sites,
- Use of multiple levels of review.
- Development of IBI models over time and their integration with HGM.
- Use of specialized assessments for particular issues, such as impact on flood flows (e.g., HEC) or determination of river stability (Rosgen).
- Development of reasonable guidance for the application of model results in establishing mitigation ratios.

O. Fill the critical gaps in scientific knowledge.

Collaborative agency, academic institution, not for profit, and other scientific research is needed to fill critical gaps in scientific knowledge pertaining to assessment. Some priority wetland scientific research issues relevant to assessment of functions and values include:

- Determine the hydrologic and ecological requirements of various "priority" wetland plant and animal species (e.g., rare and endangered species, species of commercial or recreational importance). This has, to some extent, been done. But, more work is needed.
- Help regulators predict changes in wetland hydrology from watershed urbanization, deforestation of rural areas, channelization and other activities. Regulators also need to be able to predict the impacts of such changes.
- Identify indicators for specific functions/values in particular contexts such as the use of vegetation, flood frequency, and various animal species and determine their accuracy.
- Determine to what extent wetland "condition" is an accurate indicator of wetland function/values and, if so, how it is best evaluated.
- Compare the accuracy of various wetland function and value assessment approaches.
- Determine the extent to which offsite and out of kind mitigation maintains or compromises the functions/values and overall ecological integrity of wetland systems.
- Conduct long-term, multidisciplinary research concerning the impacts of various types activities on wetlands and the adequacy of various impact reduction and compensation measures.

P. Improve information dissemination and training concerning assessment techniques. Improved assessment can occur only if those responsible for such assessment receive training and education in assessment methods and techniques. To improve assessment information dissemination and training, scientists and decision-makers should:

- Translate highly complicated assessment concepts and approaches into understandable language and guidance with case study, "how to" examples. Guidance documents and materials should be posted to the Internet where they are can be available to all free of charge.
- Broadly distribute, through the Internet, available wetland-related resource information such as wetland, flood, erosion, endangered species, and other maps relevant to assessment of wetland functions and values.
- Provide training and education in assessment simultaneously to federal agencies, states, local governments, and consultants to encourage cross-communication and partnerships which can be continued in the years to come.

APPENDIX A:
THE USE OF TERMS IN THIS REPORT

Definitions: In this report, terms are used in the following ways:

- *Assessment.* The term wetland "assessment" is broadly used in this report to include wetland-related data gathering, data analysis, and the presentation of resulting information to decision-makers. It includes but is not limited to mapping, delineation, determination of ownership, natural hazards analysis, project impact analysis, analysis of functions and values, alternatives analysis, determination of mitigation needs and the design of mitigation measures, the determination of "compensation needs" including compensation ratios, and monitoring, and enforcement of regulations.
- *Capacity.* The ability of a wetland and related water and floodplain/riparian resources to produce various goods and services of use to society. Capacity is primarily dependent upon natural hydrologic, biological, and chemical processes but also depends on other characteristics such as soils, topography, and size.
- *Data.* "Raw information" such as air photos, vegetation information, soils information, topography, etc. not yet analyzed for a specific purpose.
- *Function.* The term function is primarily used in this report as a noun to refer to natural processes contributing to the "capacity" of a wetland and related ecosystems to provide certain goods and services.
- *Functions/values.* As used in this report, the term "functions/values" or "functional values" is used generally to refer to the goods and services provided by wetlands and their value to society. Functions/values are also referred to elsewhere in the wetland literature as "functions", "values", "functional values", or "valuable functions".
- *Information.* Data analyzed for a specific purpose; the results of such analysis.
- *Natural.* In an unaltered or relatively unaltered condition.
- *Opportunity.* The present or reasonably foreseen ability of a wetland with certain "capacities" to actually deliver goods or services to society. Opportunity depends upon overall context. For example, a wetland may have the natural capacity to intercept pollution but may not do so because there are no pollution sources. The presence of existing or reasonably anticipated up-slope pollution sources provides the "opportunity" for actually doing so.
- *Red flag.* In this guide, an issue or problem sufficient to warrant denial of a regulatory permit. Also see, yellow flag.
- *Social significance.* The existing and reasonably foreseen benefits and costs to people and their attitudes toward these benefits and costs. Social significance in a wetland function/value context depends upon not only capacity and opportunity but who benefits and suffers adverse impacts, how many benefit and suffer adverse impacts, how they benefit or suffer costs, how much they benefit and suffer costs, and how strongly segments of society feel about the benefits and costs.
- *Value.* In this report, "value" is primarily used to describe the attitudes of society toward various wetland goods and services. In other contexts, it is often used synonymously (or in approximately the same way) as *functions* (used in the broadest sense) or *functions/values.*
- *Yellow flag.* In this report, an issue or problem requiring more detailed investigation or study. A yellow flag issue may become a red flag after additional data gathering (e.g., confirmation of an endangered species)

Acronyms. This report uses the following acronyms.

EPA. U.S. Environmental Protection Agency.
GIS. Geoinformation System. A geo-referenced information storage and analytical system, usually computerized.
HGM. Hydrogeomorphic Assessment Method. This method is being developed by the U.S. Army Corps of Engineers in cooperation with other agencies.
IBI. Index of Biological Integrity. This is a biological reference standard of biological health and condition developed pursuant to various biological indicator assessment approaches (collectively referred to in this report as IBI assessment approaches).
NRCS. The Natural Resources Conservation Service, United States Department of Agriculture.
HEP. Habitat Evaluation Procedure. This is a wildlife assessment procedure developed by the U.S. Fish and Wildlife Service.
HEC. Hydrologic Engineering Center. A series of hydrologic and hydraulic assessment techniques developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers.
WET. Wetland Evaluation Technique. This is a rapid assessment approach which was developed by the Federal Highway Administration in cooperation with the U.S. Army Corps of Engineers and other agencies.

APPENDIX B:
SOME OF THE INFORMATION NEEDS OF WETLAND DECISION-MAKERS

Wetland decision-makers need varied types of information (e.g., biological, hydrologic, geologic) and resulting information products (e.g. maps, lists), depending upon the management tool, management goals, context and other factors. Variations in needs require different raw data gathering and analytical capabilities. Some examples of wetland information/analyses needs and resulting information products sought by wetland decision-makers include the following. Other needs are described in Appendices D, F, G, H, and I.

- **Assessment of basic wetland "processes" or "functions"** to determine whether an activity may have an adverse impact on ecological or other characteristics, the magnitude of this impact and the adequacy of proposed impact reduction and compensation measures in meeting no net loss or other goals. Assessment of "function" is an important need of virtually all wetland decision-makers wishing to alter a wetland or to evaluate a proposed evaluation by someone else.

- **Assessment of a wetland's "condition" relative to other wetlands.** Condition is often used as a surrogate to help determine the potential for wetlands to provide goods and services, and to determine restoration potential and compensation ratios (e.g. HGM, IBI) for regulatory, water planning, acquisition and a broad range of other decision-making needs. Condition is often used to imply "function" (processes) although it may or may not accurately do so.

- **The assessment of wetlands types and boundaries for wetland mapping purposes.** Wetland maps (or digital information with a georeferencing sufficient to preparation of maps) are needed by virtually all wetland decision-makers although the scale and accuracy of the needs differ. Mapping requires examination of certain features in the landscape (e.g., vegetation adapted to frequent flooding or high ground water conditions, hydric soils, visible water or evidence of water). For example, NWI, state and local wetland mapping efforts are based on aerial photo interpretation with some measure of field observations. Many state wetland regulatory statutes require local regulatory mapping consistent with state wetland definition criteria. Interestingly, a computerized search of all wetland court cases at federal and state levels conducted as part of this study revealed that the most common use of the term "assessment" in court decisions was in reference to mapping or delineation, not functional assessment.

- **Field evaluation of soils, hydrology and vegetation to more precisely "delineate" wetland boundaries** on the ground through the case-by-case application of delineation criteria and procedures (e.g., the 1987 Corps Manual for Delineating Jurisdictional Wetlands). Delineation of on the ground boundaries is needed by virtually all wetland decision-makers wishing to alter a wetland or to evaluate the proposal of someone proposing such an alteration. Delineation is often carried out through a combination of site inspections and use of aerial photos, soil surveys, topographic maps, air photos and other information sources. Delineation is a common, site-specific assessment need for individual regulatory permits.

- **The "monitoring of changes" in wetlands acreage and conditions to determine "status and trends"**, **and to carry out monitoring** (e.g., 305(b), enforcement of regulations). Monitoring may take place through aerial photo interpretation, sampling and other techniques. Monitoring information is needed by many wetland decision-makers although rarely available at adequate scale and with adequate accuracy. Monitoring wetlands can take place through the gathering, storage, and analysis of digital information pertaining to vegetation, hydrology, existing uses, etc. Such information may be gathered from air photos, satellites, airplane or helicopter-based scanners, and other approaches. Such information is increasingly used in GIS systems to help map wetlands, assess vegetation, assess the relationship of wetlands to other ecosystems, and answer other management questions.

- **The assessment of land ownership, parcel characteristics and land uses to aid in planning and permitting.** This information is needed by regulators, public land managers, and agencies carrying out acquisition and restoration. Some states have prepared ownership maps for some or all wetlands (e.g., Florida, Massachusetts, New York). Ownership, parcel and land use information are often needed by a regulatory agency to decide (a) whether particular wetlands are regulated (e.g., many statutes only regulate wetlands greater than a certain size); (b) what laws apply (e.g., a public waters statute often applies to lands owned by the state, while a wetland, shoreland or coastal zone statute may apply to private shoreland only a few feet away); (c) whether a project applicant owns the land where the proposed project is to be located; (d) whether adjacent landowners might be affected by a proposed activity (e.g., blockage of flood flows); (e) whether a landowner has sufficient upland so that alternative locations exist for a proposed wetland activity; and (f) what uses, economic and otherwise, are being made or might be made of the land (important in determining the public interest and whether there are economic uses for the land if a wetland permit is denied).

- **The assessment of natural and other hazards for wetlands and related areas and the potential impact of proposed activities on the natural hazards** (e.g., determination of whether a fill might back up flood water on adjacent lands through application of HEC 2 model). This information is needed by regulatory agencies, land acquisition agencies, restoration agencies, and others proposing specific management for wetland areas. The federal Section 404 program and most state wetland statutes require that regulatory agencies consider possible threats to health and safety for any proposed activity, including flood hazards. Assessment of hazards may take place by examining flood, soil and geologic maps and aerial photos of flooding. Other sources of information include soil boring and flood modeling (e.g., the Corps HEC models). The Federal Emergency Management Agency (FEMA) has prepared flood maps for most of the United States; it has mapped floodway utilizing backwater computations and an assumed maximum one-foot rise of floodwaters in thousands of communities.

- **The assessment of man-made hazards, such as pollutants (e.g., buried toxics at a potential Superfund site).** This information is needed by regulatory agencies, planning agencies, public land management agencies, and other proposing to alter or restore wetland areas. Such an assessment may take place on a proposed permit application, particularly if evidence shows that a wetland was at one time used as a dump site. Man-made hazards in wetlands are more common than one would suppose because wetlands have long been used as dump sites. Hazards are relevant to protection of public health and safety, proposed drainage or channelization and onsite water supply, among other aspects of proposed uses.

- **The assessment of the suitability of wetlands and adjacent uplands for onsite, domestic waste disposal.** This is a common assessment need for regulators and land managers on proposed permit applications in locations where sewers are not available. Septic tanks/soil absorption fields do not function in wetland areas and adjacent lands with high ground water conditions. Local governments and states commonly assess for waste disposal through percolation tests, soil borings or soil mapping. Often a proposed permit application for a fill and residential development is denied at the local level if the permit applicant cannot first show that adequate onsite disposal of wastes can be provided, as required by state and local sanitary codes.

- **Legal assessment of wetlands in terms of navigable servitude and public trust** to help decide whether the public has a right to fish, paddle or otherwise use a particular wetland, and public/private rights in such a wetland. This assessment may be undertaken by regulators (often with the help of their lawyers) to help determine property ownership (e.g., the public owns the beds of navigable waters in most states) and landowner rights and duties. It is also useful in deciding whether a landowner may have a valid taking claim if a permit is denied. Restriction of an activity in a wetland is much less likely to be held a taking where public trust or navigable servitude doctrines apply. This type of assessment often involves determining the navigability of the adjacent water (Section 404 determinations), determination of high water mark and consideration of the wetland location and type (is it a wetland adjacent to a navigable water?) and historical use (e.g., recreational boating, canoeing), among other factors.

- **Environmental impact assessment** of a proposed activity on wetlands, adjacent lands and waters to comply with the National Environmental Policy Act (NEPA) and similar state and local requirements. NEPA and a variety of state statutes and local ordinances require that a regulatory, public land management or other agency wishing to alter a wetland or to evaluate a proposal to alter a wetland carry out an environmental impact analyses to determine the individual and cumulative impact of a proposed activity on the environment, including wetland areas. Impact assessment includes: (a) impacts on wetland functions and values; (b) impacts on flooding, erosion and other natural hazards; and (c) impacts on adjacent land uses and the community (e.g., proposed industrial use in a residential zone). Impact assessment is often a two-step procedure, involving a preliminary environmental assessment to (EA) determine whether there may be significant impacts, and preparation of an Environmental Impact Statement if significant impacts are a possibility.

- **Comparative rating of functions/values for establishment of restoration, acquisition, or regulatory purposes.** Such an assessment is particularly needed by land acquisition, public land management and infrastructure agencies. A variety of methods have been developed for relative ranking of wetlands. Although broadly proposed and discussed, regulators have rarely undertaken this type of assessment. Most permit applications do not involve the choice of placing an activity in one wetland or another, but allowing an activity on a wetland or upland site. Where it has been undertaken, relative ranking has been based on a wide variety of data sources, such as NWI wetland maps, topographic and soils maps, etc.

- **Classification of wetlands for regulatory or planning purposes.** This may be undertaken by a management agency to help determine functions and values and other features. The categorization may be based on size, hazards, location, functions, values, threats etc. Assessment for the purposes of regulatory classification has not taken place broadly or in much detail, except for New York State on wetlands larger than 12.4 acres, and in a small number of communities with advanced identification projects or special area management planning.

- **Assessing the wetland restoration, creation or enhancement potential for a particular wetland or wetlands.** This information is needed by regulatory agencies, restoration agencies, land management and infrastructure agencies. In determining the impact of a proposed activity and whether proposed impact reduction or compensation measures are adequate, regulators often need to decide whether the damage to a wetland will naturally heal (e.g., vegetation will grow back). Regulators also need to determine whether there are restoration/creation/ enhancement sites on or near the parcel of land where a regulated activity is proposed. This helps to determine whether onsite compensation is possible and practical. Finally, they need to evaluate the offsite restoration/creation/enhancement potential of particular sites if the landowner is proposing offsite mitigation.

Local or regional identification of restoration sites has also taken place in some states for mitigation banking (e.g., efforts now underway in California, Massachusetts). Soils and topographic maps, federal, state and local wetland maps, flood maps and other sources of information are often combined with field visits to evaluate restoration potential.

- **Assessing the relative suitability of wetlands and other lands for development and protection as part of comprehensive land use land use planning for municipal planning and zoning purposes to allocate lands throughout a community to their most suitable uses.** Such an analysis is particularly needed by local planning and zoning agencies. Such planning analyses typically take into account overall functions/values (broad generalizations applying to all wetlands, but not on a wetland-by-wetland basis), hazards, available public services and compatibility of adjacent uses, among other factors. Allocating lands throughout a community, region or state to their most suitable uses is the overall goal of most land use planning and zoning statutes. Local governments have been adopting regulations based on multi-objective resource analyses, including conservancy zones for wetlands in thousands of local communities.

- **Assessment of threats posed to wetlands from external development activities, changes in hydrologic regimes, exotics or other factors.** This information is particularly needed by regulatory agencies, restoration agencies, and other land management agencies. Some agencies have carried out various types of risk analyses for wetlands within specific areas to help target watershed planning, restoration, mitigation banking, permit tracking or other activities. Various types of data may be used for such risk analyses, such as wetland maps, maps showing urbanization and building permits, building permit records, time-series aerial photos and flood maps.

- **Assessment of the potential economic uses of wetlands** for various activities such as agriculture, forestry, aquaculture, urban development, residential development and roads. This information is often most needed by landowners and developers but may also be needed by regulators and public land managers, depending upon the content of regulations. Public and private landowners and developers often examine wetlands from this perspective for their own use and for development planning. They may submit such information as part of a regulatory permit application to suggest the public interest and the need for issuance of the permit. They may also submit such information in support of a variance or permit with the argument that the proposed activity is needed otherwise there will be no economic use of the land. Regulatory agencies rarely undertake a separate investigation of economic use potential, although it is often an issue considered in permitting, including determination of the public interest. A regulatory agency often examines economic use potential with more care when a landowner applies for a variance (state or local level) or claims a taking.

- **Assessment of landowner compliance with regulations** (e.g., coastal zone management, pollution control, floodplain management, zoning, sanitary codes). This is most needed by regulatory agencies. This may involve the use of aerial photography and site inspections. Often the issue is not just compliance with wetland regulations, but also compliance with other laws. A broad range of local government, state and federal laws often apply to wetland sites. In some instances, a regulatory permit cannot be issued, such as a Section 404 permit, when the application does not comply with other regulations (e.g., Section 401 Water Quality Certification, Coastal Zone Management). It often makes no sense to carry out a detailed assessment of wetland hazards, functions and values or other features if a proposed activity is prohibited by regulations.

The above list of various types of wetland information and information products desired by decision-makers is not exhaustive. There is obvious overlap between categories of information gathering. However, the list illustrates a point—there are many legitimate wetland information gathering and analysis needs, depending on the context, goals and management program.

APPENDIX C:
DEFINING CRITICAL TERMS

INTRODUCTION

Any future effort to reconcile wetland assessment approaches needs to help build consensus building on the use of basic terms in assessment models. This appendix note examines some of the more important terms.

"ASSESSMENT"

Appendix B above describes some of the information gathering and analysis needs and resulting information products sought by wetland decision-makers. All are, in our estimation, "assessment" needs.

In recent years, much of the discussion of wetland assessment has applied term "assessment" to assessment of "functions". But, wetland decision-makers--regulators, planners, restoration experts, land managers, infrastructure development agencies, etc.—have a much broader range of information-gathering and analysis needs. We, therefore, suggest that the term "assessment" be used in a much broader sense to include the full range of information gathering and analysis needs.

"FUNCTIONS"

No definition is more critical or controversial than that of "function". Many regulatory programs, such as the Section 404 program, require that activities seeking a regulatory permit result in no net loss of wetland "function". The definition of function, therefore, determines, indirectly, which wetlands are to be protected or destroyed and the adequacy of impact reduction and compensation measures.

Function has historically been used in two ways. Most statures and regulations require that regulators determine the impact of proposed activities on the "goods and services", such as flood storage and conveyance, which wetlands provide and have been generically referred to as functions or values. More recently, the term "function" has been used to refer to natural processes.

A little historical perspective on the use of this term may be helpful.

The Conservation Foundation Report, Protecting America's Wetlands: An Action Agenda in 1989 recommended, "the nation establish a national wetlands protection policy to achieve no overall net loss of the Nation's remaining wetlands base, as defined by acreage and function…" In this report, the Conservation Foundation used function to refer to flood conveyance, flood storage, pollution control and a range of services provided by wetlands, including cultural and aesthetic values (See Figure 1 in that report, Wetland Functions). This report led the EPA and the Corps of Engineers to adopt a 1989 Memorandum of Understanding pertaining to mitigation, which incorporated the no net loss of function and values standard into Corps regulatory permitting. It is to be noted that both function and values are included in this MOU.

Until 1995, functions and values were often used interchangeably in statutes, regulations and reports at federal, state and local levels to refer to goods and services provided by wetlands to society, such as habitat for waterfowl, production of fish, habitat for rare and endangered species, control of pollution, storage of flood waters, and cultural and heritage functions (e.g., shell mounds, recreation, historic sites).

In 1995, the U.S. Army Corps of Engineers Waterways Experiment Station attempted to more specifically define function in a Hydrogeomorphic Method Procedural Guide. The guide (see Smith et al., 1995) defined functions "as the normal or characteristic activities that take place in wetland ecosystems or simply the things that wetlands do." In its procedures the guide more specifically focuses (see Table 2 in Smith et al., 1995) on the analysis of wetland natural resource processes relevant to the ecological suitability of wetlands. The goal was, in part, to separate objective investigation of project impacts on wetland processes from more subjective analysis of the value of such changes. A second goal was to permit the determination of relative wetland condition to help decide restoration needs and mitigation ratios.

The more specific definition of function in the HGM Procedural Guide, combined with a focus on ecological functions in the guidebooks developed to implement HGM, represent a narrowing of factors considered in wetland assessment, compared to the WET approach that the Corps had previously used. WET considered efficiency or capacity, opportunity and social significance in assessing functions and values. HMG only considers capacity or efficiency.

Use of the Term "Function" to Apply to Ecological Processes

Most wetland regulatory statutes and regulations in their goal statements or regulatory criteria emphasize the importance of protecting fish, wildlife and other ecological functions/values. Placing emphasis in assessment on natural processes is partially consistent with these statutes, as long as the other goals are not ignored.

Another benefit of the HGM use of the term function as natural functions is that it focuses on objective (or at least partially objective) fact-finding. The separation of objective fact-finding from the more subjective determination of value is useful in assessing wetlands in regulatory and scientific contexts. Physical features of wetlands, processes and impacts can be categorized, studied, described and measured by experts with a fair amount of objectivity. Agreeing on facts can be an important step in reaching later agreement on policy.

Objective fact-finding should, therefore, be an important part of detailed wetland assessment. However, objective fact-finding should not be confined to natural processes (the principal focus of HGM). A broad range of wetland characteristics and the relationship between these characteristics and society can be objectively described, measured or modeled. This can apply to existing uses, adjacent land uses, threats, historic sites, archaeological sites and a host of other factors relevant to the impact of an activity on a wetland and the adequacy of impact reduction, compensation measures and the use of mitigation. Objective fact-finding can include use of models to measure the possible impacts of changes in wetlands on people, such as increases in flood heights and possible levee breaches resulting from protection or destruction of a wetland. A critical issue from a regulator's perspective is how what is happening hydrologically and hydraulically will affect particular segments of society (e.g., flooding of specific downstream property owners).

However desirable it may be to improve evaluation of ecological processes by separating scientific facts from more the subjective determination of value, it must also be recognized that the redefinition of functions, as proposed in HGM, poses problems.

1. Regulatory staff has limited funds and time, and an increase in one sort of information gathering often results in the decrease in another. While an HGM assessment may increase the amount and quality of ecological information available on a particular wetland, it may decrease the amount of information pertaining to archaeological, aesthetic, historical and other wetland characteristics important to society. The redefinition of function to refer only to natural processes may also change the sort of information available to a regulator carrying out a public interest review, if continued emphasis is not placed on these additional factors.

It should also be noted that state and local regulatory statutes and administrative regulations (e.g., the Section 404 public interest criteria) similarly require determination of project impact on flooding, pollution, erosion and other wetland goods and services that affect people, not impacts on biological or hydrologic processes alone.

2. There is often not a clear relationship between ecological processes and the sort of impacts or public interest factors that a Section 404 regulator is supposed to consider in reviewing a permit. (See Box 3 in the text above.) For example, how do natural processes relate to land use, navigation, water supply, energy needs, mineral needs, consideration of property owners, aesthetics or general environmental concerns? How do they relate to flood hazards and floodplain values? Dense wetland vegetation may retard runoff. Yet, flood storage more often depends on the shape and size of a wetland, including the topographic contours and overall flood regimen of the adjacent flood regime, than vegetation type or density.

3. Efforts to develop numerical models to characterize wetland processes, based on limited structural characteristics, such as plant species and density, have proven difficult, although a fair number of such models have been proposed. There has apparently been little detailed field verification of models.

4. A narrow definition of function in assessment is inconsistent with the use of the term in many models and the literature. More than half of the assessment approaches reviewed by Bartoldus in 1999 use the term function in a broad way and not simply to refer to natural processes. This is confusing. Use of a term in a specialized manner, inconsistent with general usage, should be avoided unless absolutely necessary.

5. While overall distinctions between functions and values may be useful, they leave a void in terminology for the combinations of natural processes and other characteristics that make wetlands valuable to society. Is there any satisfactory alternative to function (verb) to describe the ability of wetlands to produce goods or services? Also, what are these combinations of processes and other characteristics to be called if not functions— “functional values”, “valuable functions?

6. There are practical impediments to evaluating wetland processes alone, without simultaneous consideration of the end product “services” of the processes—flood storage, pollution control, etc. For many reasons it is impossible for regulators to determine all of the processes for a particular class or subclass of wetland, or even a specific wetland, without some way of narrowing which processes and changes to these processes may be of greatest importance in a

particular context. Some method of sorting and focusing must occur early on in an evaluation process. This can best be done with some preliminary consideration of the good and services produced by the original wetland and by the replacement wetland if mitigation is to be used.

For example, what processes should a regulator examine to determine the recreational potential of a wetland to be impacted and a potential replacement wetland? Recreation may include paddling, recreational boating, bird and other wildlife viewing, swimming and waterfowl hunting. Each has different requirements in terms of water depth, acreage and quality, scenic qualities, vegetation, access and corresponding processes. It is impossible and often impractical to gather all of the process-oriented information pertaining to all possible recreational uses. This means some preliminary consideration of the end products of the processes—maintaining or providing as compensation a wetland suitable for specific types of recreation —prior to carrying out any analysis of processes.

Future Use of the Term "Function"

How, then, should function be used in regulatory contexts, including the mitigation action plan and efforts to reconcile wetland assessment approaches?

The restricted HGM use of function to refer to natural processes is appropriate in scientific contexts. But, if the term is to be used in a limited sense to apply only to natural process, scientists should also make clear that they are not attempting to redefine the scope of Section 404 and similar regulatory project review procedures. Narrowing the concept of net loss of function to apply only to changes in natural processes has significant policy implications that deserve public debate and review. Decisions should not be based on scientific convenience alone, without consideration of policy implications.

On the other hand, if scientists wish to select a single term to describe natural processes, could they not call them natural processes?

The continued use of "function" as a verb in nonscientific, regulatory contexts to refer to the ability of wetlands to produce certain goods and services is probably desirable because there is no satisfactory alternative term.

If assessment methods are to evaluate function for the purposes of the mitigation across a range of habitats, for example, wetlands, riparian areas, adjacent aquatic ecosystems and uplands, it is important that the subtle distinctions among the processes and end result services in these areas be recognized. For example, evaluating the hydrologic, soils and vegetative processes of adjacent wetland, riparian area and aquatic ecosystems might (at least theoretically) suggest comparable flood retention capabilities, but the relative wildlife feeding and breeding capability will be very different.

Box 7
Examples of Wetland
"Goods and Services"

The following is a list of environmental goods and services provided by wetlands, related water and floodplain/riparian areas that may be impacted by a proposed activity. The list has been drawn from statutes, ordinances, regulations and literature. These have been variously termed "functions", "values", "functional values", "valuable functions". We simply refer to them as goods and services to avoid confusion with the use of the term "function" to apply to natural processes.

Provide flood storage. Some riverine, depressional and other wetlands and floodplains temporarily store flood waters and reduce flood heights and velocities that affect downstream lands.

Provide flood conveyance. Some riverine wetlands convey flood waters, thereby reducing flood heights and velocities at upstream, adjacent and downstream lands.

Reduce wave damage. Some estuarine and coastal, lake and river fringe wetlands and floodplains reduce the force of waves and thereby reduce wave and erosion damage to backlying properties and structures.

Provide erosion control. Many estuarine and coastal, lake and river fringe wetlands and floodplains help control streambank, streambed, lakeshore, estuarine shore and other types of erosion by reducing water velocities and binding the soil.

Reduce sediment loadings in lakes, reservoirs, streams, estuaries and coastal systems. Many fringing wetlands and floodplains, as well as other wetlands (depressional, flats) reduce the sediment flowing into lakes, streams and estuaries by intercepting and trapping sediment.

Prevent and treat pollution:

- **Prevent pollution from entering a water body.** Virtually all types of wetlands and floodplains may intercept sediment, nutrients, debris, chemicals, etc. from upland sources before they reach down-gradient bodies of water.
- **Treat (remove) pollution in a water body.** Wetlands located in lakes, streams, estuaries, depressions and at other locations may, to some extent, remove pollutants from these waters.

Produce crops and timbers. Many types of wetlands and floodplains produce cranberry, blueberry, saltmarsh hay, aquaculture, wild rice, forestry and other crops.

Provide groundwater recharge. Some riverine and depressional wetlands provide groundwater recharge, although most are discharge areas much of the year.

Provide groundwater discharge. Some wetlands and floodplains help maintain the base flow of streams and help to reduce ground water levels, which would otherwise flood basements and cause other problems, by providing groundwater discharge.

Provide habitat for fish, produce fish. Wetlands adjacent to lakes, streams, estuaries and oceans can provide food chain support, spawning and rearing areas and shelter for fish.

Provide habitat for shellfish, produce shellfish. Estuarine and coastal wetlands may provide shellfish habitat.

Provide habitat for mammals, reptiles, amphibians, and birds. All types of wetlands and floodplains/riparian areas may provide important habitat for mammals, reptiles, amphibians and birds.

Provide habitat for endangered and threatened species. Virtually all types of wetlands and floodplain and riparian areas may provide food chain support, feeding, nesting and substrate for endangered and threatened animals and plants.

Provide habitat for waterfowl, produce waterfowl. Many depression, river fringe, lake fringe, coastal and estuarine fringe wetlands and floodplains provide food supply, nesting and water for waterfowl.

Provide scenic beauty. Many wetlands and floodplains have aesthetic value. Scenic beauty may enhance real estate values, provide opportunities for recreation and enhance ecotourism.

Provide recreational opportunities. Many wetlands and floodplains provide canoeing, boating, birding, hiking, wildlife viewing and other recreational opportunities.

Provide historical, archaeological and heritage value. Some wetlands and floodplains, such as the Concord Marshes or the Everglades, have historical value. Many others have archaeological values (shell mounds, burial sites).

Provide educational and research opportunities. Many wetlands provide education and research opportunities for schools and government agencies.

Provide atmospheric gas exchange potentially important to moderation of global warming. Wetlands and floodplains produce oxygen due to photosynthesis by plants. Some wetlands are carbon or methane sinks.

Provide micro-climate modification. Wetlands and floodplains, particularly those near cities and large devegetated areas, may reduce temperatures and pollution levels.

Box 8
HGM
Wetland "Functions" and Their Values

(From Smith et al., 1995. *An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices*). In HGM, various natural processes are referred to a "functions".

Functions Related to Hydrologic Processes	**Benefits, Products and Services Resulting From the Wetland Function**
Short-Term Storage of Surface Water: the temporary storage of surface water for short periods.	Onsite: Replenish soil moisture, import/export materials, conduit for organisms. Offsite: Reduce downstream peak discharge and volume, help maintain and improve water quality.
Long-Term Storage of Surface Water: the temporary storage of surface water for long periods.	Onsite: Provide habitat and maintain physical and biogeochemical processes. Offsite: Reduce dissolved and particulate loading, help maintain and improve surface water quality.
Storage of Subsurface Water: the storage of subsurface water.	Onsite: Maintain biogeochemical processes. Offsite: Recharge superficial aquifers, maintain baseflow and seasonal flow in streams.
Moderation of Groundwater Flow or Discharge: the moderation of groundwater flow or groundwater discharge.	Onsite: Maintain habitat. Offsite: Maintain groundwater storage, baseflow, seasonal flows and surface water temperatures.
Dissipation of Energy: the reduction of energy in moving water at the land/water interface.	Onsite: Contribute to nutrient capital of ecosystem Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality.
Functions Related to Biogeochemical Processes	**Benefits, Products and Services Resulting From the Wetland Functions**
Cycling of Nutrients: the conversion of elements from one form to another through biotic processes.	Onsite: Contributes to nutrient capital or ecosystem. Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality.
Removal of Elements and Compounds: the removal of nutrients, contaminants or other elements and compounds on a short-term or long-term basis through burial, incorporation into biomass or biochemical reactions.	Onsite: Contributes to nutrient capital of ecosystem. Contaminants are removed or rendered innocuous. Offsite: Reduced downstream loading helps to maintain or improve surface water quality.

Functions Related to Hydrologic Processes	Benefits, Products and Services Resulting From the Wetland Function
Retention of Particulates: the retention of organic and inorganic particulates on a short-term or long-term basis through physical processes.	Onsite: Contributes to nutrient capital or ecosystem. Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality.
Export of Organic Carbon: the export of dissolved or particulate organic carbon. Maintenance of Plant and Animal Communities: the maintenance of plant and animal community with respect to species composition, abundance and age structure.	Onsite: Enhances decomposition and mobilization of metals. Offsite: Supports aquatic food webs and downstream biogeochemical processes. Onsite: Maintain habitat for plants, animals and agriculture products, and aesthetic, recreational and educational opportunities. Offsite: Maintain corridors between habitat islands and landscape/regional biodiversity.

"CONDITION"

Many assessment and monitoring models now attempt to evaluate relative wetland "condition". These include the various HGM, IBI, Proper Functioning Condition, "Rosgen", water quality monitoring and other models. Most models use "reference" to help determine relative condition.

Assessment of condition is particularly useful in evaluating restoration potential. It can also help managers:

- **Assess the magnitude of existing functions/values of a wetland and to project the potential functions/values of a replacement wetland, although condition is not necessarily an indication of the magnitude of functions/values in a specific circumstance.** A wetland in a natural or semi-natural condition often has a greater ability to produce particular goods and services than that of an altered wetland. This is particularly true for habitat. This is not always true, however, for specific functions because the ability of altered wetlands to produce a particular good or service (e.g., flood storage or conveyance) may be greater, in some instances, than that of a comparable natural wetland.
- **Assess the longevity or persistence of a wetland and its functions/values.** The condition of a wetland quite often suggests the longevity or persistence of a wetland. Altered wetlands in a degraded condition are often subject to high rates of sedimentation, lowered water tables due to incising streams, or lack of natural flood regimes. And, longevity or persistence of a wetland is relevant to its functions and value. The long-term functions and value of a wetland that is quickly disappearing will be less than one that exists perpetually.

- **Assess the restoration potential of a wetland.** Assessment of condition can help a manager determine the restoration potential of a wetland and whether a wetland is undergoing natural restoration. Restoration potential is important in deciding whether impact reduction and compensation measures proposed by a project applicant are adequate.
- **Establish water quality standards for waters and wetlands.** Evaluation of wetland and water condition in terms of particular animal species and suites of species can help establish water quality standards for particular wetlands and waters. Biological monitoring can also help enforce these standards over time.
- **Implement mitigation banking.** Assessment of condition can help regulators establish mitigation ratios, although many additional factors are also relevant to such ratios.

Although there is broad interest in assessing "condition", there is no general agreement on its definition and how it is to be evaluated.

Relative condition based on a comparison of basic processes does appear highly relevant to ecological values, including biodiversity. For example, a wetland in a natural or unaltered condition may be of special value as endangered or rare species habitat and may also have the greatest ability, depending on the circumstances, to provide other goods and services. But, it is clear that some wetland functions/values are not directly related to relative condition. For example, the flood conveyance capacity of a wetland stripped of vegetation is often higher than that of a heavily vegetated wetland (See use of "Mannings formula"). Similarly, the flood storage capacity of a wetland may be increased by alterations that restrict the rate of runoff (e.g., the Charles River wetland storage area). The erosion control and wave retardation capacities of phragmetes dominated wetlands may be higher than for some natural wetlands. This may also be true for some pollution control and buffering capabilities. So, an urban wetland in very poor ecological condition may, nevertheless, have high value for flood storage and/or conveyance, wave retardation, erosion and pollution control and should not be destroyed despite its degraded ecological condition.

The definition used for condition and the factors selected for measuring condition are of great importance if relative condition is to be a primary factor in deciding whether a particular wetland should be protected, restored, damaged or destroyed and the compensation ratio if damage or destruction is allowed. Box 9 lists some of the factors relevant to condition. As with function, the definition used for condition is policy-laden.

Subtle differences in the definition of condition can also make big differences in evaluating restoration potential. Compare two highly degraded wetlands. One has been filled and the other drained. Both may show no present evidence of wetland vegetation and no wetland wildlife. Are they in the same "condition" in terms of protection and restoration needs? The drained wetland will revert to a natural or semi-natural state if the drainage ditches or dikes are not maintained or beavers move in. This wetland has a relatively high restoration potential. In contrast, unless flushed by hurricane or excavated, the filled wetland will never again demonstrate wetland characteristics. From a restoration perspective, the condition of the two is quite different.

Box 9
Factors Determining Condition

The capacity of a wetland/related resource area to produce goods and services depends, in part, on the condition of the wetland and how it will be managed and used over time. Some factors relevant to the definition and assessment of condition include:

- **What are the plant, animals, soil and hydrologic characteristics of a wetland in comparison to an unaltered or partially altered wetland of the same class?** These characteristics may be measured on the ground or through remote sensing. There may be more detailed, comparative analysis of processes based on the characteristics observed.
- **How has the wetland/related resource area been altered?** What has caused the degraded condition (if any)? Has it been partly drained? Filled? Is the wetland subject to high rates of sedimentation or other threats that may soon destroy it? Is it subject to pollution? Is the wetland now undergoing natural restoration (e.g., water levels increasing in a partly drained wetland)? Most functions/values are diminished by alterations. However, certain functions may be enhanced. For example, partial drainage and clearing of vegetation may increase flood conveyance.
- **What will happen to the causes of the degradation if the wetland is left alone?** Will degradation continue into the future? If not, what will happen to the wetland? Will it revert?
- **Is the hydrology of the wetland/related resource area changing due to urbanization in the watershed or other factors?** If so, what does this mean to wetland characteristics? Urbanization will usually increase peak flood flows and total runoff. It will also increase pollution and sediment loadings.
- **What is happening to adjacent areas?** Wetlands/related resources protected by buffers or adjacent to public open space lands have greater long-term habitat value. They are also less likely to be subject to pollution and sedimentation problems.
- **Will the wetland/related resource area be actively managed in accordance with the proposed activity?** A wetland with exotic weed control, water level control or fencing of cattle often has enhanced habitat functions/values.
- **How difficult and costly will restoration be?**

"VALUE"

In carrying out a Section 404 "public interest review" of a proposed wetland permit, regulators need to know the physical impacts of a proposed activity on wetland processes and the goods and services produced by the processes. (See Box 1.) Regulators also need to consider the significance of these impacts to the public. This means that they must consider "value", however imperfect this consideration may be.

Value has been used in two different ways in wetland contexts. It has often been used to describe how society feels (i.e., attitudes and relative weights) about combinations of wetland functions and processes, and other characteristics, such as:

- Economic value
- Health and safety value
- Historical, heritage value

- Education, research, scientific value
- Aesthetic value

Value has also been used, like function to describe the ability of wetlands to provide certain goods and services of value to society. For example, a wetland may be said to have a flood storage value, a flood conveyance value, etc.

Determination of the values attached to wetland processes and the potential for a wetland to provide certain goods and services is difficult because there are many intangibles involved. Different segments of society place different weights on various functions/values. For example, a fisherman often prefers production of fish in a wetland, which requires open water, to production of song birds, which requires trees. Even a given segment of society (e.g., fishermen) may attach different values to different species (e.g., trout versus pan fish).

Because of both conceptual and substantive problems in assessing wetland values, proposals have been made to focus on wetland functions alone in wetland assessment (e.g., the HGM approach) and determination of compensation ratios.

But, there is a real difference between the value to society of a wetland that protects the water supply of eight million people (e.g., the New York water supply) than one with similar physical features and processes, but far from any water supply. How, then, can the "public interest" be determined by examining natural processes alone?

It is unlikely that quantitative economic models that evaluate wetland values will ever be used on every permit application. They are too expensive and have encountered a range of difficulties. Economic models have been used in some instances to evaluate the costs and benefits of wetland good and services, but even these are difficult to apply and provide highly variable results, depending on the assumptions used.

What then, should be done? The WET procedure developed by the Corps and used in the 1980s and early 1990s suggested that three factors needed to be considered in wetland assessment to reflect both the physical features of wetlands and their importance to society. These included capacity or efficiency, opportunity and social significance. The first relates primarily to wetland processes, the second and third to the importance of wetlands to human beings. WET had substantial implementation limitations. Nevertheless, these three evaluation factors were conceptually sound although WET's detailed ranking procedures had both conceptual and practical problems. See Box 10.

Box 10
Capacity, Opportunity and Social Significance

Capacity or **efficiency** refers to the ability of a wetland, related water and land resources to produce various goods and services of use to society. Capacity depends primarily on hydrologic, biological and chemical processes, as well as on other characteristics such as soils, topography and size.

Opportunity describes the wetland's ability to perform functions or to deliver certain goods or services to the public. For example, a wetland in a rural, wilderness setting may have a certain capacity to remove pollutants, but there may be no pollutants to remove in such a setting. A wetland in an inaccessible rural area may have recreational potential, but there may be few users due to lack of access and long travel distances. These wetlands lack present opportunity to provide pollution control or recreation, but may have considerable future opportunity if development occurs in the area.

Social significance refers to the importance of wetlands/related resources to people and not simply the inherent capacity of wetlands to produce goods or services or the opportunity for such wetlands to perform specific functions. It requires the simultaneous consideration of capacity, opportunity and the people who may benefit or suffer costs from the change in a wetland. Assessing social significance requires a determination of how a project impacts goods and services and the attitudes and values of people.

A variety of methods are available for qualitatively determining opportunity and social significance in a particular context. None are perfect, but they are better than no consideration of value when it comes to determining whether proposed impacts, mitigation and compensation measures are in the "public interest". Consideration of "value" is needed--the attitudes of society toward various wetland goods and services.

The next Appendix note discusses assessment of "opportunity" and "social significance". Both are relevant to determination of "value".

APPENDIX D:
DETERMINING "OPPORTUNITY" AND "SOCIAL SIGNIFICANCE?

As indicated above, evaluation of both "opportunity" and "social significance" are needed to determine "value". Wetland decision-makers may use a variety of techniques to assess opportunity and social significance although these approaches are highly qualitative.

ASSESSING OPPORTUNITY

The opportunity a wetland has now, or may have in the future, to provide certain goods and services to society depends not only upon its natural resource characteristics (e.g., size, depth, vegetation, natural processes) but its location, accessibility, the presence or absence of "needs", numbers of potential users and other factors. Some approaches for evaluating opportunity available to wetland decision-makers include:

- Examine land and water use inventories for an area to evaluate the "opportunity" an existing wetland or proposed mitigation or restoration wetland has to prevent or ameliorate existing or potential water or land use problems, such as water pollution or flooding. This can be done manually or through GIS systems, which have particular promise for these sorts of analyses.

- Determine which groups of people use or would potentially use a wetland for fishing, hunting, bird-watching by examining aerial photos, visiting the wetland, contacting local sporting organizations, etc.

- Examine demographic data to suggest the relationship of wetlands to the numbers and types of existing and potential users in areas for education, recreation, pollution control, flood and stormwater control, among other purposes. GIS systems may be useful for this as well.

- Carry out quantitative studies, such as HEC flood studies, to determine the importance of a wetland in storing or conveying flood waters and the possible impact on upstream or downstream levees, houses and other activities if these services are not provided.

- Distribute notices concerning proposed projects to groups (e.g., bird watching and fishing clubs) and publish notices in newspapers to solicit comments concerning existing and potential uses.

- Hold public hearings to solicit comments concerning existing and potential users and uses of wetland areas.

EVALUATING SOCIAL SIGNIFICANCE

Consideration of "social importance" is also needed to determine the public interest in evaluating a Section 404 permit and in applying similar broad criteria in state and local regulations. Consideration of social importance is also needed to make environmental equity determinations required by the Environmental Equity Executive Order 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations (1994).

If the proposed activity may have substantial impact on society, even limited impact on the resource may be unacceptable. For example, proposed damage to a wetland may be unacceptable when protecting the water supply of several million people, even if limited damage were proposed.

A wetland manager can analyze social significance by answering the following questions and using the sorts of techniques outlined in Box 11.

1. **Who will be affected by the project impacts?** This is significant from a number of perspectives. First, it can help determine whether a wetland impact is of state or national significance, not just local importance. Second, it can help characterize the interests involved. For example, private landowner riparian rights may be involved or public trust rights. Such legal rights may deserve special consideration in permitting. Third, it is relevant to social equity and social justice. For example, an urban wetland may be more important to minorities than a rural wetland.

2. **How many will be impacted?** A generalized evaluation of the number of individuals suffering potential impacts is also relevant to the public interest. For example, a wetland that helps protect the New York City water supply may provide benefits to more than 8 million people, while another wetland may provide benefits to only a small number of individuals.

3. **How will people be impacted?** Wetland/related resources provide goods and services that affect society in different ways and have varying levels of importance. For example, impacts to a wetland that stores flood waters, thereby reducing downstream flash flooding have health and safety implications. Similarly, a floodway that conveys flood waters without significant increase in flood heights will help prevent nuisances. Protection of health and safety and prevention of nuisances are afforded special consideration by the courts.

4. **What weight does society attach to these interests?** Different segments of society often attach different weight to particular interests. Nevertheless, weights can be qualitatively considered through common sense and a variety of approaches (see Box 8).

Typically, a regulatory agency will combine several of the following approaches for assessing social significance. For example, the agency may distribute the proposed permit application to a broad range of interest groups, publish a notice for comment, and hold a public hearing. The resulting assessment will be qualitative but often, nevertheless, very useful.

Box 11
Some Options for Assessing Social Significance

Agencies have available a variety of approaches to help assess public attitudes toward a project and the weight attached by society to particular functions/values of wetlands which may be impacted. The first four are most commonly used; the remainder are too time consuming for most permits, but may be used in special circumstances:

Commonly Used Approaches:

Regulatory agencies can elicit response from various segments of society by providing notices and circulating permit applications for review. The most broadly used technique to evaluate public opinion is to provide notices of proposed permit applications to other agencies and the public, and to examine the resulting comments to the proposed activity. Responses do give the regulatory agency some idea of the types, numbers and seriousness of interests and concerns.

Regulatory agencies can elicit response from various segments of society by conducting hearings. Agencies also use public hearings to gather information and to gauge public opinion, particularly on controversial projects. Hearings can also give regulatory agencies some idea of the types, numbers and seriousness of public concerns.

Regulatory staff can use their ears, eyes and professional judgment to recognize values held by society. Regulatory agencies can use their common sense and general knowledge (newspapers, TV, interaction with interest groups, interaction with the public) to identify values broadly held by the public. This is, admittedly, subjective, but a regulatory agency does not need an independent poll to determine that the public does not want wetland landowners to pollute a public water supply.

Regulatory agencies can consult locally adopted plans and regulations to determine local priorities for protection and restoration. For example, the Lane County Regional Planning Agency undertook a wetland assessment process and prepared a detailed plan for West Eugene, Oregon. This process used a broad range of techniques, including one-on-one consultations, questionnaires and public workshops, to gain feedback from various groups and individuals concerning what wetlands should be protected. The plan was ultimately submitted to the electorate for approval and is now used as the basis for regulatory permitting.

Regulatory agencies can examine statutes, ordinances and other legislative acts to determine possible weight of specific interests. For example, national, state and local endangered species acts and regulations establish clear public values in protecting endangered species. Flood plain management acts often state a goal of preventing future increases in flood damages.

Other Approaches that May be Applied in Special Contexts

Regulatory agencies can, with the help of legal documents and their attorneys, determine wetland functions and values that have been afforded legal status as rights and duties. Some wetland functions/values, such as recreation, may be protected under public trust concepts in a state. Others, such as flood conveyance, may also have legal status in terms of landowner common law or statutory rights and duties. For example, in most states a wetland landowner who blocks such flows through a fill may be successfully sued by other landowners on nuisance, trespass, negligence or other grounds.

Regulatory agencies can undertake economic analyses for wetland functions and values at specific sites. Economic valuation is typically time consuming, expensive and subject to many assumptions and uncertainties, particularly with regard to non-market values. Nevertheless, economic analysis may also be useful.

Regulatory agencies can, in some instances, subject the question of value directly to local elected officials. For example, a wetland regulatory agency may submit a proposed special exception, variance, wetland permit or proposed conservancy zone amendment for a vote to determine how the legislative body feels about protecting a specific wetland area.

Regulatory agencies can subject the question of value to executive commissions or committees. Quite often local regulators submit proposed permit applications to appointed soil and water conservation boards, commissions or planning agencies for reaction and comment.

Regulatory agencies can, in some instances, subject the question of value to direct vote by the public. At the local level, proposed zoning amendments that may accompany permit applications may be placed on voting ballets. Or, local land or water use plans with wetland components, such as wetland acquisition plans, may be subjected to direct vote.

APPENDIX E:
EXAMPLES OF THE "NO NET LOSS" GOAL INCORPORATED IN FEDERAL AND STATE STATUTES, REGULATIONS, POLICIES

FEDERAL

EPA and Department of Army
Memorandum of Agreement Concerning the Determination of Mitigation Under the Clean Water Act Section 404(b)(l) Guidelines, 54 FR 51319, December 14, 1989
"…will strive to achieve a goal of no overall net loss of values and functions."
"…no net loss of functions and values…"

"In most cases a minimum of 1 to 1 acreage replacement of wetlands will be required to achieve no net loss of values. However, this ratio may be greater where the functional values of the area being impacted are demonstrably high. Conversely, the ration may be less than 1 for 1 for areas where the functional values associated with the area being impacted are demonstrably low and the likelihood of success associated with the mitigation proposal is high."

National Wetlands Mitigation Action Plan, December 24, 2002
"Commitment to the goal of no net loss of the Nation's wetlands….begin increasing overall functions and values …."
"….help insure effective restoration and protection of the functions and values of our Nation's wetlands…."

Regulatory Guidance Letter, No. 02-2, December 24, 2002. U.S. Army Corps of Engineers, Compensatory Mitigation Projects for Resource Impacts: Section 404 and Section 10 Programs
"no overall net loss"
"replace functional losses to aquatic resources"
"functional assessment methods"
"functional scores"
"functional replacement"

STATE

Alaska. Alaska Admin. Code 60.315 (2003), Title 18. Solid Waste Management. "…steps have been taken to achieve no net loss of wetlands, as defined by acreage and function…"

Arizona. Regulation of Solid Waste. A.R.S. 49-772 (2003**).** "no net loss of wetlands defined in acreage and functions…."

California. CCR 3912, Title 23 (2003). Regional Water Quality Control Boards. San Francisco Bay Region. "…by adding policy of no-net-loss of wetland acreage and no-net-loss of wetland value within the Region…"

California. Cal. Fish and Game Code 1780 (2003). Sacramento-San Joaquin Valley Wetlands Mitigation Bank Act of 1993. "The purpose of this chapter is to ensure that no net loss of wetland acreage or habitat values…"

Delaware. CDR 70-500-001 (2003) Marina Regulations. "Compensation plans must provide for the creation or restoration of an area of wetlands that is of equal or greater value than the area that will be compensated or destroyed so that there is no net loss of wetlands."

Hawaii. WCHR 11-58.1WCHR 11-58.1, Title 11 (2003). Department of Health, Solid Waste Management Control "…taken to achieve no net loss of wetlands (as defined by acreage and function)

Kansas. K.R.R. 28-29-102 (2003). Solid Waste Management Plans. "…steps have been taken to attempt to achieve no net loss of wetlands, as defined by acreage and function…."

Louisiana. LAC 33:VII.709, Title 33. Solid Waste Standards. "…taken to attempt to achieve no net loss of wetlands (as defined by acreage and functions…."

Maine. CMR 06-096-310 (2003), Wetland Protection Rules. "…the Board of Environmental Protection supports the nation-wide goal of no net loss of wetland functions and values…."…mitigation necessary to achieve no net loss of wetland functions and values through…"…goal of compensation is to achieve no net loss of wetland functions and values…."

Massachusetts. 779 MAREG 29 (Issue date, 1995), Executive Office of Transportation and Construction, "Adhere to the policy of "no net loss of wetlands" due to transportation projects…."

Minnesota. Minn. Stat. 103G.2243 (2003), Water. Waters of the State. Local comprehensive wetland protection and management plans. "Provided there is no net loss of wetland values…."

Minnesota. Minn. R. 8420.0650. Wetland Conservation. Local Comprehensive Wetland Protection and Management Plans "…must result in no net loss of wetland quantity, quality, and biological diversity…."

Missouri. 10 CSR 80-3.010 (2003), Title 10. Sanitary Landfill."…Steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function…)

Nevada. NAC 444.679NAC. Solid Waste Disposal "…actions have been taken to achieve no net loss of wetlands as defined by acreage and function"
North Carolina. 15N.C.A.C. 13B.1622 Solid Waste Management…"steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function…"

Oregon. Or. Admin. R. 141-120-0030. Division of State Lands. Wetland Conservation Plan Wetland Resource Designations and Analysis of Alternatives. "Functions and Values" means no net loss of wetlands functions or values."

Ohio. 2003 OH Reg. 8110009 (2003). Sanitary Landfill Facility Permit to Install. "…steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function…."

Rhode Island. CRIR 04-000-017 (2003). Rules and Regulations Governing the Protection and Management of Freshwater Wetlands in the Vicinity of the Coast. "The Council supports a goal of no net loss of wetland area or functions and values of freshwater wetlands in the vicinity of the coast."

Rhode Island. CRIR 12-030-022 (2003). Solid Waste Regulation. "…steps have been taken to achieve no net loss of wetlands (as defined by acreage and function)…."

South Carolina. S.C. Code Regs. 61-107.13 (2003). Solid Waste Management. "…steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function."

Tennessee. Tenn. Comp. R. & Regs. R. 1200-1-7-.04 (2003). Solid Waste Processing and Disposal. "demonstrate that ecological resources in the wetland are sufficiently protected." "….steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function)…."

Texas. 30 TAC 297.53 (2003). Issuance and Conditions of Water Rights. "The goal of the mitigation of wetlands is to achieve "no net loss" of wetland functions and values. In addition to aquatic and wildlife habitat, wetland functions also include, but are not limited to, water quality protection through sediment catchment and filtration, storage plans for flood control…."

Texas. 21 TEXREG 10383 (TAC 352.10-352.32) Industrial Solid Waste. "…steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function)…."

Utah. U.A.C. R315-302-1 (2003). Solid Waste Facility Location Standards. "…steps have been taken to attempt to achieve no net loss of wetlands, as defined by acreage and function…."

Vermont. CVR 12-004-056 (2003). Vermont Wetland Rules. "It is the policy of the State of Vermont to identify and protect significant wetlands and the values and functions they serve in such a manner that the goal of no net loss of such wetlands and their functions is achieved."

Virginia. Va. Code Ann. 62.1-44.15.5 (2003). State Water Control Law. "…dedicated to achieving no net loss of wetland acreage and functions."

Virginia. 9 VAC 20-80-260 (2003). Solid Waste Disposal Facility Standards. "…steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function)…."

Virginia. 9 VAC 20-80-270 (2003). Virginia Water Protection Permit Program Regulation. "In order for contribution to an in-lieu fee fund to be an acceptable form of compensatory mitigation, the fund must be approved for use by the board and must be dedicated to the achievement of no net loss of wetland or stream acreage and function through the preservation, restoration and creation of wetlands and streams."

Washington. WAC 173-26-220 (2003) State Master Program Approval/Amendment Procedures and Shoreline Master Program Guidelines. “Use regulations shall address the following uses to achieve, at a minimum, no net loss of wetland area and functions, including the lost time when the wetland does not perform the function:”….”Master program provisions addressing alterations to wetlands shall be consistent with the policy of no net loss of wetland area and functions, wetland rating, scientific and technical information, and the mitigation priority sequence defined in ….”

Washington. WAC 173-351-130 (2003). Criteria for Municipal Solid Waste Landfills. “…steps have been taken to attempt to achieve no net loss of wetlands (as defined by acreage and function) by: “

Washington. WAC 222-24-015 (2003). Forest Practices Board, Road Construction and Maintenance.
”In order to assure that there is no net loss of wetland function….”

Wyoming. WCWR 020-120-002 (2003). Sanitary Landfill Regulations. “There will be no net loss of wetlands, considering any mitigation steps taken by the owner;”

APPENDIX F:
WETLAND ASSESSMENT IN THE COURTS

Should legal requirements be a concern to scientists and regulators designing wetland assessment techniques for regulators? How have assessment models, such as HGM and WET, fared in the courts? From a legal perspective, what sorts of data needs to be gathered, with what levels of accuracy, to meet specific regulatory purposes? Does an agency need to use the best possible scientific assessment techniques? Must wetlands be rated and ranked? Can a portion of the information gathering burden be shifted to permit applicants? What information can help an agency avoid and meet "takings" challenges?

An ASWM publication, J. Kusler, Wetland Assessment in the Courts, addresses these and other issues. Some conclusions may be briefly summarized in the following discussion and Box 12.

1. Wetland regulations are subject to more intense legal scrutiny than other wetland management techniques because these regulations limit the use of private lands. To meet statutory, constitutional and other legal requirements in controlling private property, regulations must comply with the information gathering and analysis procedures called for in regulatory statutes, administrative regulations and ordinances. This is needed in order to provide due process to private landowners. Regulators must also obtain the factual information needed to apply statutory and other regulatory criteria and procedures. Regulators must provide sufficient information to sustain regulations against constitutional due process, discrimination, unreasonableness and "takings" court challenges by private landowners. Regulators also need sufficient information to avoid liability problems in regulatory permitting (e.g., avoiding issuance of permits that increase flood or erosion problems on other properties). Regulators need documented time-series information for monitoring and enforcement.

2. To meet legal requirements, regulatory agencies must gather the right types of data at the appropriate scales and levels of accuracy to support regulations and sustain regulatory decisions on a permit-by-permit basis, if regulations or regulatory decisions are challenged. Agencies must gather sufficient information to support regulatory decisions against potential challenges that decisions are irrational, arbitrary, discriminatory or "take" private property without payment of just compensation.

3. Few state, federal or local wetland statutes or regulations mandate specific types, scales or degrees of accuracy in data gathering and analysis (except wetland mapping at the state level in some states); but statutes typically set forth wetland definitions, regulatory goals and criteria for permits, which have information gathering and analysis implications. Statutes and other regulations often contain permit analysis procedures (e.g., notice, hearing, time frames). Many set forth special procedures dealing with mitigation banks, administrative appeals and enforcement. These statutory, administrative regulation and ordinance provisions collectively determine wetland assessment needs for regulatory purposes and the length of time available to regulatory agencies for meeting such needs.

4. The types and accuracy of wetland information needed to meet legal requirements vary somewhat from one regulatory program to the next, and within a program. Nevertheless, certain types of information, such as jurisdiction information (is it a regulated wetland?), wetland boundaries, public/private ownership, natural hazards information and impact on wetland

functions/values are legally needed by virtually all regulatory programs to carry out statutory and regulatory tasks.

5. The Corps and other agencies that administer the Section 404 program must comply with the legal requirements of the Clean Water Act, the National Environmental Policy Act, the Endangered Species Act, the Fish and Wildlife Coordination Act and other environmental legislation. State and local regulatory agencies must also comply with a number of state environmental acts, in addition to state wetland regulatory statutes. These add important requirements to wetland assessment, such as the need for field surveys, to determine whether there may be an impact on endangered species. Federal agencies or permit applicants must typically prepare an EA to determine whether a proposed Section 404 permit may have a significant impact on the environment. Corps regulations and the statutes and regulations of many states specifically require that the regulatory agency apply certain criteria, such as determination of impact of proposed activities on fish and wildlife, as part of permit processing. Permits will be subject to legal challenge if they fail to carry out such required analyses.

6. Only a few court cases have specifically addressed wetland assessment methods and procedures, although many cases address broader natural resource information gathering and analysis. Courts have held that agencies have broad discretion in selecting assessment approaches. However, one court held that application of an HGM model to wetlands in a NEPA context provided insufficient information to determine impacts on migratory birds and remanded the decision to an agency for further investigation. Courts in several other cases have held that various ecological models were insufficient to evaluate potential impacts of forest management plans on endangered species and have required population surveys. These cases suggest that ecological models may not meet legal needs if they fail to provide specific information for the application of regulatory criteria.

7. Regulatory agencies are aided in their wetland information gathering and analysis by a general legal presumption of validity for regulations. Landowners challenging regulations must show that the regulations are invalid and that the actions of regulatory agencies were not supported by substantial evidence. Regulatory agencies are also aided by the weight usually given by courts to factual determinations of expert agencies. However, courts examine with particular care the basis for regulations when regulations, permit denial or attached conditions have severe economic impact on permit applicants. This is particularly true when regulations may prevent all economic use of entire parcels of private land.

8. No court has held that wetlands must be rated or ranked. Courts do not require agencies to use the best available assessment techniques or to develop the best possible data, but agencies need a rational basis for regulatory decision-making. Agencies may use professional judgment in information gathering and have considerable discretion in wetland assessment methods and procedures. Courts have sustained wetland maps with some inaccuracies, particularly if maps are combined with field verification procedures to correct inaccuracies and more specifically define wetland boundaries on a case-by-case basis.

9. Regulators can shift a portion of the information gathering burden to permit applicants and the amount of information can vary, depending on the types and seriousness of the anticipated project impacts and the proposed impact reduction and compensation techniques.

10. Regulators need to be concerned about possible "takings" challenges to regulations because of a series of conservative U.S. Supreme Court decisions on this issue in the last decade and an increased number of successful "takings" challenges for wetlands by federal and state courts. Regulators may best, early on in evaluating a permit application, determine whether denial of the permit would deny all economic use of an entire property, which may pose a "takings" challenge. Particularly detailed and accurate information gathering and analysis may then be justified, with an emphasis on the possible nuisance impact of the proposed activity, such as blockage of flood flows or water pollution, since courts hold that landowners have no right to make a nuisance of themselves.

Box 12
Common Legal/Technical Questions Pertaining to Wetland Information Gathering

(See J. Kusler, Wetland Assessment in the Courts for more detailed discussion and case law citations.)

- **What sort of information is needed to support the general validity of wetland regulations?** Courts have broadly upheld the general validity of federal, state, and local wetland regulations based on the information concerning wetland functions/values and other characteristics contained in scientific books, reports, scientific articles and expert testimony. General validity is important for assessment purposes because it also establishes a strong presumption of validity for case-by-case information gathering and regulatory decision making, as applied to specific properties. Landowners must overcome this presumption in a specific instance.

- **Does general validity mean that regulations are valid for all properties?** No. A landowner may attack the constitutionality of regulations as applied to his or her property even when regulations are valid in general. Regulatory agencies need to be able to support the validity of the regulations as applied to this specific property against claims of uncompensated taking, denial, due process or other challenges. However, the overall presumption of validity for regulations and a presumption of correctness for regulatory agency information gathering and decision-making help the agency meet this burden. A court decision of site-specific constitutionality or unconstitutionality will not determine decisions about other properties.

- **Are federal, state or local regulatory agency factual determinations (e.g., assessment of functions, values,) presumed to be correct?** Yes. The burden is on the landowner to prove incorrectness. In general, courts overturn agency fact-finding only if it finds substantial evidence or some similar standard to be lacking. Courts are likely to uphold factual determinations of federal and state expert agencies. They have also given broad support to local government, multi-objective regulatory efforts (functions/values, natural hazards, infrastructure costs, etc.) based on comprehensive land and water inventories and plans. However, courts look more closely at the adequacy of the information gathering when regulations have severe economic impact on specific properties.

- **How closely must regulatory standards, including conditions, be tailored to regulatory goals?** Courts have broadly upheld wetland and other resource protection regulations against challenges that they lack reasonable nexus to regulatory goals. However, courts are now requiring a stronger showing of nexus than a decade ago, particularly where regulations have severe economic impact on property owners. Courts are also increasingly requiring that regulatory agencies show that conditions attached to permits are roughly proportional to the impacts of the proposed activity, particularly where dedications are involved. This means that the detail and accuracy of information gathering should increase as the severity of impacts increase, and there should be a proportional relationship between conditions attached to regulatory permits and achievement of no net loss or other goals.

- **Have the courts endorsed one wetland assessment approach more often than another?** No. Courts have in only three reported cases addressed the sufficiency of wetland assessment techniques, per se. They held that the techniques used by the regulatory agency were sufficient in all three. However, courts do require regulatory agencies to follow procedures set forth in their enabling statute or regulations (e.g., mapping, notice and hearing, impact analysis). And, the outcome of every legal challenge to wetland regulations depends, to a considerable extent, on the overall sufficiency of the agency's data gathering and analytical processes and the strength of the factual base.

- **Must a regulatory agency accept one scientific opinion over another?** No. Courts have afforded considerable discretion in deciding which scientific opinion to accept, as long as the final decision is supported by substantial evidence. Also, courts have held that regulatory agencies do not need to eliminate all uncertainties in fact-finding.

- **Does an agency need to quantitatively prove that each wetland is characterized by certain functions and values?** No. Courts have broadly upheld conservancy zoning and other types of regulations for wetlands based on a range of factors relevant to the suitability of wetland sites for particular purposes, without determination of specific functions and values. Courts have also sustained agency adoption of multi-objective, case-by-case permitting approaches, without determination of the functions and values of individual wetlands. No court has invalidated regulations for failing to distinguish the relative ecological values of individual wetlands. However, courts have required that regulatory agencies demonstrate the rationality of individual permit decisions, and this has required, in some instances, the documentation of functions, values, hazards and other factors relevant to permitting criteria.

- **Is a quantitative assessment approach more legally defensible than a qualitative approach?** Not necessarily. Quantification of wetland functions, such as flood storage or conveyance, may provide a more accurate and defensible basis for evaluation of impacts and for determination of the adequacy of impact reduction and compensation measures. But, quantitative approaches may also be more vulnerable to legal attack than qualitative, professional judgment approaches if they are conceptually flawed or if the regulatory agency cannot competently undertake the assessment set forth in the regulations. For example, a regulatory agency may be vulnerable when asked to defend a specific calculation for a function or value if the calculation is based on limited data or incorporates a broad range of simplifying assumptions that may not be valid in the specific context. Also, agencies should be careful in formally adopting any assessment method that requires quantitative evaluation because agencies are held to their own standards by courts, including standards that may be impractical or difficult to achieve.

- **What sorts of information may agencies use in regulatory assessment?** Agencies may use many types of information in permit evaluation, including personnel observations, aerial photos, wetland maps, reports and information prepared by other agencies, opinion evidence of experts and even information provided by adjacent landowners and citizens. The strict legal rules of evidence do not apply to most public hearings and information gathering and analyses processes.

- **May an agency be subject to successful judicial attack for failure to consider important factors in assessment?** Yes, in some circumstances. For example, courts have quite often held that specific agency environmental impact statements, required at the federal level for some Section 404 permits and at the state level for wetland permit in many states, are invalid for failing to consider the full range of factors relevant to environmental impact. Courts have also invalidated regulatory decisions for failing to consider impacts of proposed activities on pollution, habitat or other factors listed in regulatory criteria.

- **Do assessments need to be updated if conditions change?** Yes. In some instances courts have held that maps and other assessments, such as environmental impact statements, need to be updated if conditions substantially change and new information becomes available.

- **Does an agency need to follow the assessment requirements set forth in its enabling statute or regulations?** Yes. Agencies must comply with statutory, administrative regulation and ordinance procedural requirements. They must also apply the permitting criteria contained in statutes and regulations. However, few statutes contain highly specific assessment requirements. Agencies generally have discretion in selection of assessment approaches.

- **May an agency regulate wetlands other than those specified in an enabling statute?** No. Agencies can only regulate the types of wetlands and the areas specified in the enabling statute.

- **Must wetlands be mapped?** No, not unless a statute or regulation says they must be mapped.

- **Are wetland maps invalid if they contain some inaccuracies?** No. Courts have upheld maps with some inaccuracies, particularly if there are regulatory procedures available for refining wetland map information on a case-by-case basis.

- **May landowners be required to carry out wetland delineations or provide other types of assessment data?** Yes. Courts have held that regulatory agencies can shift a considerable portion of the assessment burden to landowners and that the amount of information required may vary, depending on the issues and severity of impact posed by a specific permit. And, agencies can charge reasonable fees for permitting. However, the burdens must be reasonable and courts may consider the costs of such data gathering to be relevant to the overall reasonableness of regulations and whether a taking has occurred.

- **Can some landowners be required to provide more information than others?** Yes. Regulatory agencies can vary information requirements depending on the types and magnitude of issues raised by a permit application. For example, regulatory agencies can require detailed habitat information where a rare or endangered species may be present. Regulatory agencies can require more detailed flood hazard information for a proposed activity near a stream or soil borings for possible toxics in a wetland that was used as a dump.

- **Have courts endorsed one wetland definition over another?** No court has held that one wetland definition is right and another wrong. Courts have held that wetland definitions are up to legislative bodies and administrative agencies. Agencies must apply the definition adopted in enabling legislation or administrative regulations.

- **Why is land ownership information important in regulatory permitting?** Land ownership often determines who has jurisdiction over specific lands, waters and activities at state or local levels. It also greatly affects "takings" determinations. Only landowners have the right to challenge regulations as an uncompensated "taking." No landowner has the right to place fill or alter a wetland on public lands or other private lands, although they may have a riparian right to make certain uses of public waters.

- **What types of wetland data are important to meeting "takings" challenges?** Land ownership, type of water (navigable or not), natural hazards, threats to public safety and nuisance impacts information are particularly important in meeting "takings" challenges in some contexts.

- **Can an agency rely on best professional judgment in fact-finding?** Yes. This is the way most assessment decisions are made, and courts have given agencies great leeway in use of professional judgment.

- **Is economic impact on landowners validly considered in wetland regulatory permitting?** Yes. Courts often examine the factual basis for regulations more carefully where the regulations have severe economic impact on private property owners. Also, under regulations (e.g., Section 404) requiring a public interest review a balance in permitting must occur between the public need for the regulation and the impact on private property owners. Under other regulations, consideration of economic impact may not be relevant during initial phases of permitting, but becomes relevant if a permit is denied and the permit applicant applies for a variance. Variances are typically issued at the local level only if a landowner can show that absent the variance, no economic uses are possible for the land.

- **Are highly restrictive wetland regulations, including buffers and large lot sizes, valid?** Courts have upheld highly restrictive wetland regulations in many contexts, particularly where a proposed activity may have nuisance impacts on other properties. However, courts have also held wetland regulations to be a taking without payment of compensation in a few cases where the regulations denied all economic use of entire parcels of land.

- **Do all wetlands need to be assessed and regulated at once?** Do the same assessment procedures need to be applied to all wetlands? No and no, provided there are rational reasons for distinctions.

- **Does comprehensive planning for a town or region prior to regulation help meet legal challenges?** Yes. Courts have endorsed comprehensive planning and regulatory approaches as improving the rationality of regulations, although they have also upheld regulations not preceded by such planning in many instances.

- **Under what circumstances is a court most likely to hold that wetland regulations "take" private property?** Courts are likely to find a taking where regulations deny all reasonable economic uses of entire properties, and proposed activities will not have offsite nuisance impacts. Reasonable economic uses are those that would be permitted under the common law of a state and would not threaten public health or safety or cause nuisances.

- **May a regulatory agency be liable for issuing a permit for an activity that damages other private property?** In some instances, yes, if the permitted activity results in flood, erosion or other physical damage to private property. This is usually not a major concern to agencies, except in wetland flood and erosion hazard areas.

APPENDIX G:
THE INFORMATION NEEDS OF REGULATORS

The following appendix note addresses the information needs of regulators. See also discussion of legal needs above.

THE SPECIAL NEEDS OF REGULATORS

Ostensibly, many of the wetland assessment methods developed over the last decade have been designed for use in regulatory contexts. However, scientists developing such techniques have apparently assumed that regulatory needs are the same as the assessment needs for wetland acquisition, restoration, public land management, infrastructure planning and other purposes. There are similarities, but also important differences as will be discussed below. Future efforts to develop wetland assessment methods for regulators need to better reflect these special needs.

Wetland assessment needs for regulatory purposes are quite similar to one another at federal, state and local levels due to several factors:

- Wetland regulatory statutes are similar in terms of goals, regulated activities and regulatory processes, although there are differences in jurisdictional scope of programs (i.e., types of regulated wetlands) and specific regulatory criteria.
- Wetland regulatory programs are subject to the same overall legal requirements and challenges under the U.S. Constitution.
- Wetland regulatory programs are subject to similar budgetary and staffing limitations and to relatively short time frames for regulatory permitting.
- Wetland regulatory programs are subject to the same scientific problems and limitations in assessment, such as the complexity of wetlands, inadequate assessment techniques for some functions, such as atmospheric gas exchange, problems in addressing long-term fluctuating water levels, and problems in assessment due to changing hydrology.

Wetland regulations at all of these levels have a number of features which give rise to somewhat special information and analysis needs (see Boxes 13-16).

Box 13
What is Special About Regulations?

1. Private lands and landowner rights are involved (this has legal, political and administrative implications).

2. Private landowners and consultants do much of the actual assessment on mid to large-size projects.

3. Changes are typically proposed for wetlands (e.g., fills, drainage). These changes need to be evaluated in terms of before and after conditions.

4. Wetland regulations are subject to jurisdictional (legal) requirements (statutory, administrative regulation, ordinance) such as:

- Regulated wetland or not
- Regulated activity
- Boundaries
- Public/private ownership

5. Regulatory agencies must apply broad-based statutory goals and permitting criteria. Local and state regulators often need to be able to determine the suitability (local zoning, federal/state alternatives analysis) or appropriateness of placing a proposed activity in a wetland versus an upland or aquatic area. Federal regulators need to determine the public interest. Suitability and the public interest depend, in part, on:

- Flooding, other hazards
- Infrastructure costs
- Functions and values
- Compatibility with adjacent uses

6. Regulatory agencies must comply with procedural requirements of regulatory statutes, administrative regulations and ordinances: time frames, notices, hearings, appeal procedures, etc.

7. Regulatory agencies must be able to defend regulations against constitutional challenges (discrimination, unreasonableness, "taking").

8. The typical regulatory permitting situation is often not the typical wetland situation. It involves:

- urban or urbanizing area
- altered wetland and altered hydrology
- changing hydrology
- small fill proposed
- only a portion of a wetland affected

9. Some (but not all) regulatory agencies need up-front mapping and characterization on a geographical basis to comply with statutory requirements.

10. Regulatory agencies need monitoring information to enforce regulators.

Box 14
Similarities
Between Federal, State and Local
Regulations, with Assessment Implications

1. Similar broad goals and regulatory criteria:

- Protect health/safety
- Prevent nuisances
- Reduce losses from flood and other natural hazards
- Protect various functions and values – recreation, fisheries, pollution control, etc.
- Achieve no net loss or comparable goal.
- Consistent with public interest

2. Similar need to evaluate:

- Wetlands in an existing (natural, altered) condition.
- Wetlands in an altered condition (with project, with restoration, etc.).

3. Similar need to evaluate:

- Wetland functions
- Significance to society

This need varies from program to program, but both natural resource and social/cultural factors are relevant to the determination of public interest in all programs.

4. Similar overall permit application procedures, notice and hearing requirements, and administrative and/or appeal procedures.

5. Similar short time frames for permitting, although these may be extended for insufficient information or on other grounds.

6. All are subject to Constitutional requirements.

7. All are subject to the limitations of scientific knowledge, data and data-gathering techniques.

8. All are subject to budgetary, staff and expertise limitations.

Differences Among Regulatory Programs

There are also some differences in regulatory assessment needs at federal, state, and local levels as indicated in Box 15.

Box 15
Differences in Assessment Needs and Capabilities Among Federal, State and Local Regulations

1. Up-front regulatory mapping requirements (state and local) versus no regulatory mapping requirements (Federal Section 404).

2. Wetland regulations adopted as part of geographically comprehensive planning and regulatory efforts (local, some state) that requires community-wide information gathering versus regulations that only apply to wetlands and waters (Federal Section 404, Section 10).

3. Conservation zone approaches (local zoning, state order procedures, Federal 404(c) advanced identification) versus case-by-case permitting (Federal Section 404, most state, some local).

4. Moderate to high level of expertise (federal, state) versus more limited expertise (many local).

Priority Information Needs

Despite differences in regulatory programs, regulatory programs share certain priority information gathering and analysis needs, depending on the level of government and the specifics of the regulatory program. Priority information needs include the information needed to answer the following questions. The questions are listed in the order in which information gathering is typically carried out, not necessarily importance.

1. Is it a regulated wetland pursuant to a particular statute or regulation? All wetland regulatory agencies must make jurisdictional determinations on permit applications to assess whether or not the agency has the legal power to regulate specific wetlands. Agencies can require a permit and impose restrictions only if they have regulatory jurisdiction over the type, size and location of a regulated wetland. Virtually all wetland programs (including the Section 404 program) regulate particular types or sizes of wetlands, or wetlands in particular areas. They do not regulate or require individual permits for all wetlands.

Whether a wetland is regulated or not is often easily determined if it is adjacent to a lake, river or ocean because most statutes clearly regulate such wetlands. But, it is often a more difficult determination for headwater and isolated wetlands because of statutory or administrative regulatory limitations on size or location. It is also more difficult to assess jurisdiction for partially drained or otherwise altered wetlands, such as prior converted wetlands.

Often determination of regulatory jurisdiction (at least on a preliminary basis) is an office task based primarily on wetland and topographic maps, and other sources of information. Field investigation may be needed in some instances.

2. Is the proposed activity a regulated or exempted activity? All regulatory programs must also make this initial determination. The Section 404 program, state and local wetland programs typically exempt a number of activities altogether or from individual permits, such as repair of existing structures (constructed at the time regulations are adopted), normal farming, normal agriculture and emergency repairs after a disaster.

Determining whether or not an activity is regulated often does not require any assessment of the wetland itself, but it can. For example, normal agricultural or forestry activities may be exempted, but not those involving substantial hydrologic modifications. A field visit may be needed to determine whether an access road, maintenance of a drainage system or other activity involves a substantial hydrologic modification. Similarly, a field visit may be needed to determine whether a wetland is, in fact, a prior converted wetland pursuant to Swampbuster and whether agriculture or other activities have been abandoned, resulting in re-establishment of a wetland.

3. Where are the wetland boundaries in relationship to the proposed project or activity? All regulatory programs require, in the processing of permits, the determination of wetland boundaries as related to the proposed project to determine whether the regulatory agency has jurisdiction over a project and the actual jurisdiction/non-jurisdictional line on the ground. If a proposed project or part of a project does not lie within the boundaries of a regulated wetland or a regulatory buffer, the agency usually has no jurisdiction over that portion of the activity. Increasingly, however, states and local governments regulate wetland buffers so those determinations must be made as well.

The Corps in many districts require landowners to undertake initial delineations. It's the only way for permit applicants in some districts to insure timely consideration of permits. State and local wetland agencies more often undertake initial delineations themselves.

Usually precise boundary delineation (within 10 feet) is not required for a wetland as a whole, but for the portion of the wetland that may be impacted by the proposed project.

Delineation of precise boundaries is needed at different times for federal, state and local regulations. For the Section 404 program, delineation is not needed in advance of permits since there is no advance regulatory mapping of wetlands. For state and local regulations, where wetland regulatory maps are required, preliminary boundaries must be shown on maps. Maps typically establish a presumption concerning the exact location of boundaries on the ground. However, maps are typically drawn at too small a scale to determine precise boundaries and often contain some inaccuracies. Regulators must identify more precise boundaries on the ground though field investigations if disputes arise.

Information needs for precise wetland delineation differ somewhat at federal, state and local levels, depending on the wetland definition and delineation criteria. Section 404 delineations typically involve field examination of vegetation, soils and hydrology to apply the wetland definition contained in the Section 404(b)(1) regulations. The 1987 Federal Manual is usually used, although NRCS uses its own slightly different manual.

State and local wetland regulators must use state statutory wetland definition criteria that are often, but not always, comparable to the federal criteria. Several states, such as New York and Michigan, have developed their own wetland delineation manuals.

4. Is an individual permit required? This is an issue for many activities authorized by nationwide permits pursuant to the Section 404 program and for activities subject to certain state general permits. As discussed in Chapter 1, notices for many types of activities subject to Corps nationwide or programmatic permits must be provided to Corps district offices for a preliminary determination to decide whether an individual permit will be required.

If the regulatory agency determines, based on this notice, that no individual permit is required, the landowner may go forward with the proposed activities subject to any Best Management Practices or other conditions. If an individual permit is required, the permit applicant must go through the full permitting process.

The determination of whether an individual permit is required is often based on the type and size of the project. But, the determination may also reflect wetland characteristics, such as possible endangered species, recreational use or natural hazards.

A somewhat similar issue is faced with activities subject to state assumed Section 404 program permits. The state regulatory agency must submit notices of proposed permits to the EPA and other federal agencies for certain classes of activities. If the Corps or EPA determines that the proposed permits raise no red or yellow flags, the state can continue to process the permit without further federal involvement. If the Corps or EPA raises a red flag, an individual permit may then be required from the Corps. The type and size of a project are typically important in determining whether direct federal review is needed, but wetland type and characteristics may also be relevant to the decision.

5. Who owns the site of the proposed wetland activity? Regulators at all levels of government need to determine ownership and parcel characteristics, although this information is more important for some programs than others.

At state and local levels, the regulatory jurisdiction of the agency often depends, to some extent, on land ownership. State statutes typically make a distinction between private and public lands in terms of regulatory permitting requirements. State public water statutes usually apply to publicly owned rivers, lakes and coastal waters, and a permit must be sought from one agency for alteration of public waters. State wetland statutes may apply to other private wetlands and a different agency or bureau may issue permits for them. Ownership is also significant to local wetland regulations. Local governments do not typically regulate public waters. However, local governments may regulate other waters and wetlands. Ownership determines who has regulatory authority.

Ownership is also important in deciding the appropriateness and legality of proposed activities. Courts have held under public trust doctrines and the doctrine of navigable servitude that landowners have no "right" to fill, drain or otherwise modify publicly owned wetlands or to impair public rights in such waters, although landowners may have riparian and water appropriate rights for certain uses and activities in such waters. Courts have held that landowners cannot claim any taking of their property when they propose to undertake activities on public lands or proposed activities on private lands (e.g., the privately owned bed of a river) and interfere with public trust or navigable servitude. Property ownership and rights become particularly important when a landowner challenges a permit denial in court as a "taking."

Finally, ownership is important in deciding whether a landowner may be encroaching on the rights of other landowners in carrying out a proposed wetland activity. Often, landowners do not know where their precise underwater (or under wetland) property lines are located. Placing a fill in a wetland at such a site may "trespass" on adjacent property.

If there is any question about ownership, the regulatory agency may require the permit applicant to submit more detailed information showing boundaries or may undertake a field investigation (e.g., determine high water mark). Determination of property ownership is a particular problem for lake fringe, estuarine and coastal fringe, and riverine wetlands where fluctuating water levels and accretion and reliction may further complicate boundary definition.

6. Are there practical alternatives to the proposed activity? The size, shape, topography, existing use and use potential of the entire parcel of land owned by the individual proposing a wetland permit are important to Section 404 permit analysis, and to most state and local permit analyses. Parcel characteristics, the nature of the proposed use, and the use and characteristics of adjacent parcels determine, to a considerable extent, whether the use is water dependent, whether there are practical alternatives for the proposed wetland activity, and whether all realistic measures will be undertaken to reduce project impacts. For example, a proposed permit for a fill and residence in a ½-acre portion of a 3-acre parcel would often fail alternatives analysis, if there were buildable sites on the other 2½-acres.

Existing use of an entire parcel and potential use of the parcel are also relevant to the economic benefit and/or cost to society of the proposed activity (relevant to the public interest review). Parcel characteristics, including topography, soils, vegetation, existing uses and other features are also relevant to whether onsite restoration/creation or enhancement is possible or practical on a site.

Regulatory agencies typically make alternatives analysis determinations and establish parcel characteristics based on (a) information provided by the project applicant in the permit application; (b) aerial photos, soil, topographic and wetland maps; and (c) site visits, where necessary.

7. What is the potential economic impact of the regulation on the private property owner? The potential economic impact of the regulation on the private property owner is often (informally) considered at an early stage of permit processing at all levels of government. The U.S. Supreme Court and state courts typically hold that regulations which deny all economic use of land are a taking of private property, unless the proposed activity would be prohibited pursuant to state concepts of property law (i.e., create a nuisance, create a public health threat).

It is highly relevant whether a parcel as a whole has current or potential economic use, without altering a wetland. At state or local levels, this is a key factor for which a variance should or might be granted for the proposed activity. (Variances are not available under the Section 404 program, but are available in accordance with most local wetland regulations and some state programs.) This is also an important factor in terms of the Section 404 public interest balancing test.

If a regulatory agency determines that denial of a proposed permit may deny all economic use of land, the regulatory agency must undertake wetland assessment with particular care (e.g., boundaries, natural hazards). The gathering of health, safety, nuisance, public/private ownership, public trust and navigable servitude information is also important.

8. Are there natural hazards at the site? Do they threaten the proposed activity? Will the proposed activity increase natural hazards on other lands? Regulatory agencies that implement the Section 404 public interest review process must consider flood hazards and other natural hazards at a project site. Most state wetland statutes and statutes authorizing local regulations place even more emphasis on protection of health and safety, prevention of flood and other hazards, and prevention of nuisances. Some programs, such as the Massachusetts inland wetland program, define wetlands to include the 100-year floodplain.

Evaluation of natural hazards plays an important role in evaluating permit applications for several reasons:

- Protection of health and safety, and prevention of increased flood and other damage has become an increasingly important community and state land use objective. More than 18,300 communities have adopted floodplain regulations. Control of wetlands is typically undertaken to serve the dual objectives of protection of ecological values and prevention or reduction of natural hazard losses.
- Local governments, states and to a lesser extent federal agencies fear successful “liability” law suits if they permit activities that increase flood, erosion or other hazards on other private lands. There have been many successful suits where communities have increased flood and other hazards on private lands.
- Prevention of nuisances and nuisance-like uses is a strongly sanctioned regulatory objective by local, state and federal courts. Courts almost invariably uphold floodplain, wetland and other regulations designed to prevent nuisance or threats to safety. Courts give such objectives great weight in balancing public and private rights because private landowners have no “right” to make a nuisance of themselves. Documentation of the nuisance impacts of proposed wetland activities has become increasingly important, as the U.S. Supreme Court and lower courts have taken an attitude toward regulations.

Flooding, including high velocity water and wave action, is the natural hazard of greatest concern in most wetland regulatory contexts. However, erosion, lack of structural bearing capacity of wetland soils and potential earthquake damage, which may be much more severe over filled wetlands than elsewhere, are also problems in some instances.

Wetland regulators typically look to other agencies, such as floodplain management agencies, for evaluation of natural hazards, the impact of proposed activities on natural hazards and the adequacy of protection or mitigation measures. They also often rely, on a preliminary basis, on existing flood, floodway, earthquake and other maps to identify possible floods or other hazards. Additional studies and information may be required from a project applicant or undertaken by the agency if hazards are a potentially serious problem.

9. Does the proposed project comply with all other applicable regulations? In some instances, a regulatory agency will not issue a permit for a wetland activity if a proposed project does not comply with all other applicable regulations. For example, the Corps of Engineers will not ordinarily issue a Section 404 permit when a state has denied water quality certification on such a permit or the state has notified the Corps that the permit will violate an approved Coastal Zone Management program. The Corps will also not issue a permit if the permit will violate the Endangered Species Act or another federal statute.

Similarly, states and local governments often deny permits for activities in wetlands if they do not comply with local zoning, floodplain and subdivision regulations, sanitary, building and grading codes, among other regulations. For example, an applicant that proposes to place fill in a wetland for an industrial use will be denied if the wetland is contained in a broader residential zone.

One of the most common grounds for denying a state or local application for a proposed fill and residential use of a wetland is failure to comply with sanitary codes pertaining to the use of septic tanks and soil absorption systems for the disposal of domestic, liquid wastes. Local governments often refuse to issue permits for fills in wetlands, where the fills will be used for residential purposes, if the landowner cannot first show adequate onsite water supply and waste disposal. Sanitary regulations typically require septic tank/soil absorption systems be provided for residences and other structures in unsewered areas. Sanitary regulations typically prohibit septic tank/soil absorption systems within a certain distance of lakes, streams and coastal waters. They also prohibit septic tank/soil absorption fields in high ground water areas and areas with tight soils.

Denial of permits based on noncompliance with other permits, in some instances, raises “chicken or egg” problems. It may not be possible to determine whether a proposed permit will comply with other regulations until an application is submitted and the permit is denied, accepted or conditionally accepted. In such circumstances, regulatory agencies may grant a wetland permit subject to “obtaining” other permits.

Regulatory agencies tend to require that other permits be obtained when evaluation of a wetland permit may involve substantial fact finding, with great costs to the agency or landowner.

Regulatory agencies determine compliance with other regulations by either examining the regulations (e.g., local zoning) or, more commonly, by providing notices of permit applications to local, state or federal regulatory agencies, with a request that other agencies determine compliance.

10. What are the impacts of the proposed project on wetland functions/values? It is extremely difficult to accurately assess the functions and values of a particular wetland, and to determine the adequacy of various mitigation and compensation measures for the loss of functions. For this reason, wetland regulatory agencies often first determine the compliance of a proposed permit, with all easily applied regulatory criteria pertaining to land ownership, alternatives analysis, water dependency, natural hazards and lack of nuisance impact.
If a permit application survives these tests, the regulatory agency may apply further red and yellow flag analysis, with regard to significant functions and values, to determine whether there may be significant ecological impacts. Regulatory agencies typically go through a multi-step process, beginning with various levels of red and yellow flagging and proceeding to more specific analysis:

- Existing documents are often examined in the office to quickly evaluate the wetland that may be impacted and the proposed project site. These may include wetland maps, lists and maps of endangered species and natural areas, lake and stream surveys (contain lists of lakes with characteristics, including fish), waterfowl surveys and lists of recreation areas. The goal is to see whether any red or yellow flags arise at the specific wetland and site.
- A site visit may be made to identify possible ecological functions/values.
- Notices of the proposed activity may be sent to a broad range of federal, state and local resource agencies and possibly to interest groups, such a the National Audubon Society, the Nature Conservancy, local birding clubs, hunting groups, etc.
- A public hearing may be held to solicit further comments and public input, particularly if the proposed activity is large or some preliminary red flags have been identified.

If, using the above techniques, the regulatory agency determines that significant impacts to ecological functions/values may be involved; the landowner may be required to submit more detailed information. Or, the agency may, in cooperation with other agencies, carry out a more detailed investigation.

The regulatory agency is primarily concerned with the portion of the wetland that will be impacted by the proposed activity. The ecological function of the wetland as a whole may be important in determining the impact of the activity on a particular portion, but rarely do regulatory agencies carry out detailed fact-finding for whole wetlands where only small portions may be affected.

11. How adequate are the project applicant's proposed efforts to reduce and, in some instances, compensate for impacts? The regulatory agency must also determine the adequacy of the project applicant's efforts to reduce impacts and, if a no net loss goal is applied in the regulatory program, to compensate for impacts through wetland restoration, creation or enhancement. This is not an easy determination for several reasons. There is limited hard science in the literature on the effectiveness of various measures to reduce impacts because few detailed, scientific follow-up studies have been done on impact reduction measures. And, the design and evaluation of compensation measures may require a great deal of information and expertise that is not available.

Practicality is another issue. There are often many potential measures to minimize impacts, such as confining project activities to dry periods, using sediment control measures and constructing buildings on pilings rather than fill. But, what is practical and common sense in the specific

situation is another matter, particularly when small projects are proposed by residential lot owners.

More information is needed if the project applicant is proposing to use offsite compensation, such as a mitigation bank, including the full range of functions and values of the original wetland and those of the replacement wetland, and who benefits and who pays.
Often regulatory agencies allow permit applicants to undertake wetland restoration or creation without detailed determination of all of the functions and values of the original wetland when the restoration will be onsite, of the same type, connected to the same water body and involve relatively high compensation ratios.

If ecological impacts may be significant and additional mitigation or compensation measures will not be of value, the regulatory agency may deny the permit. More often, the agency will deny the permit "without prejudice," suggest further necessary studies and how the permit might be resubmitted with more satisfactory mitigation and compensation. Or, the regulatory agency may conditionally approve the permit, subject to additional, specified mitigation and compensation measures.

Box 16
Elements of Federal, State and Local Wetland Regulatory Statutes and Regulations with Data/Gathering and Analysis Implications

Definition of regulated wetlands (vegetation, soil, hydrology, size, location, etc.) The definition of wetland used in a statute or administrative regulation determines the factors which must be examined by the regulatory agency in deciding whether a regulated wetland exists at a site and boundaries of this wetland. The Clean Water Act does not establish a statutory definition for regulated wetlands, but the Corps and the EPA have defined wetlands in administrative regulations.

State wetland statutes usually establish very specific wetland definition criteria for state and local regulatory purposes, including the types of wetlands to be regulated by the state agency and/or local governments. These definitions are, in general, quite similar to the Section 404 definition, although the specific criteria differ.

Mapping and delineation requirements for regulated wetlands. The Clean Water Act does not require regulatory mapping of wetlands at the federal level. The Corps and other federal agencies delineate wetlands on a case-by-case basis as permit applications are submitted. The Corps uses its 1987 Manual for the Delineation of Jurisdictional Wetlands.

Many state statutes require that state regulatory agencies map wetlands. Generally, statutes allow state agencies broad discretion in map scales and procedures. However maps must coincide with regulatory wetland definitions and must be adopted consistent with statutory procedures (e.g., notification of landowners in some instances, hearing requirements, filing maps).

Definition of regulated and exempted activities. The Clean Water Act exempts a number of activities from Section 404 permits. The Corps has also adopted nationwide and programmatic permits to define activities that are wholly or partially exempted from individual Section 404 permits. However, landowners proposing to carry out some of these activities may need to provide notices to the Corps, even though they do not need to apply for individual permits on a routine basis.

All state wetland statutes define regulated and exempted activities. State and local regulatory agencies have, in some instances, adopted more detailed administrative regulations and policies to further define such activities.

Permit application and permit processing procedures. The Clean Water Act and other federal statutes, such as the Fish and Wildlife Coordinate Act, require that the Corps provide notice to other federal agencies about proposed Section 404 permits. The Clean Water Act authorizes the Corps to conduct public hearings. Most of the Section 404 permit processing procedures are contained in administrative regulations and policy guidance.

State statutes establish procedures for state and local processing of regulatory permit applications, including notice and hearing requirements and, in some instances, time deadlines. More detailed procedures are typically set forth in state administrative regulations.

Goals and permit criteria. The Clean Water Act does not contain detailed criteria for the processing of Section 404 permits. However, Section 101 of the Clean Water Act sets forth a broad goal to "restore and protect the chemical, physical, and biological integrity of the nation's waters." The Corps of Engineers and the EPA have developed more specific criteria for processing wetland permits. These are contained in various administrative regulations, including the Section 404(b)(1) guidelines, various policy guidance documents and memorandum of agreement or understanding.

State statutes set forth various goals and criteria for state and local processing of regulatory permits, such as alternatives analysis, consideration of flood and other natural hazards, determination of the impact of proposed activities on functions and values, mitigation of impacts, and no net loss. Statutes may also refer to goal statements and findings of fact. Statutory criteria may be supplemented through administrative regulations or ordinances.

Goals and permit criteria are the real meat of the statutes and regulations in terms of wetland assessment needs, in addition to definition, delineation criteria and mapping requirements. However, no state or federal statute requires a regulatory agency to use a particular wetland assessment technique or approach to assess alternatives, functions, etc.

Appeals procedures. The Clean Water Act and other federal statutes establish judicial appeals procedures for federal Section 404 permits. Some, but not all, issues may be appealed. The Corps has proposed administrative appeal procedures for certain issues of the Section 404 program, which have data-gathering implications. State statutes establish appeals procedures for state and local wetland regulatory decisions. Some states, such as Massachusetts, authorize administrative appeals, followed by judicial appeals if necessary. Appeal boards or courts are, in some instances, specifically authorized to undertake independent data-gathering and analysis. Others are limited to the record. Some statutes set forth specific criteria for judicial challenge. For example, Massachusetts, Connecticut and Rhode Island allow landowners to challenge permit denials as a taking all economic use of land is denied.

Penalties and enforcement. The Clean Water Act sets forth civil and criminal penalties for violation of the Act or implementing regulations. Enforcement requires monitoring of activities in wetlands. Administratively, restoration is often required for major violations, which requires further assessment. Federal courts have developed a considerable body of law pertaining to restoration.

All state statutes establish penalties for violation of the statute or regulations. Some statutes allow courts to order restoration of damaged wetlands.

Special provisions with assessment implications. At the federal level, Congress has also adopted a broad range of statutes that have wetland assessment regulatory implications because regulators must consider them in Section 404 permitting. These include, but are not limited to, the Endangered Species Act, the Historical and Archaeological Site, Section 401 of the Clean Water Act, which requires state water quality certification of federal permits, the Coastal Zone Management Act, the Environmental Policy Act and the 1996 Farm Bill.

States have also adopted a broad range of regulatory programs with wetland assessment implications. Most states have established floodplain management and regulatory programs that require a state agency and/or local governments to map and regulate floodplains. A number of states (e.g., Oregon, Pennsylvania, Maryland) have established watershed planning and management programs. Seven states have established shoreline or shoreland zoning programs. Virtually all coastal states have adopted coastal zone planning and, in some instances, regulatory programs. A number of states have established various "critical area" planning and regulatory programs, which include wetlands. Some require intensive state agency or local planning for such areas (e.g., Lake Tahoe Basin, Hackensack Meadowlands). At least fourteen states have adopted statutes authorizing the establishment of mitigation banks. No statute sets forth particular assessment criteria, but most refer to use of banks to replace or restore functions.

SUMMARY: BETTER MEETING REGULATORY NEEDS

Scientists designing wetland assessment techniques for regulators should, in the future:

1. Recognize that regulators have a broad range of critical information needs which must be met with limited time, staff, expertise, and finances. To meet statutory, constitutional and other legal requirements that control private property, assessment methods must provide regulators with sufficient information to:

- **Comply with any assessment procedures** (if any) **established in regulatory statutes**, **administrative regulations and ordinances** (local regulators).
- **Apply the wetland definitions, goals and criteria** set forth in regulatory statutes, administrative regulations and ordinances.
- **Make jurisdictional determinations** (e.g., is a wetland? If so, is it a regulated type of wetland? If so, is the proposed activity, a regulated activity? Is the site of the proposed activity public or private land (this often determines the regulations which apply at the state and local levels).
- **Map and/or carry out on-the-ground delineations.** Some but not all regulations require mapping.

- **Determine whether a proposed project may have "significant" environmental impacts** (an Environmental Assessment).
- **Prepare an Environmental Impact Statement** is such a statement is required (federal agencies).
- **Determine whether there are "practical alternatives"** to the proposed activity.
- **Determine the functions (and values) of the wetland and any proposed "compensation" wetland** sufficient to apply regulatory criteria pertaining to functions and values such as a no net loss of functions and values goal (if the statute contains one), adetermination whether a permit is in the "public interest" (Section 404); and compliance with water quality standards.
- **Determine whether mitigation and compensation measures are adequate.** This may include not only functions information but "values", threats to compensation sites, the difficult likely to be encountered in undertaking compensation of this type of wetland in this setting, and other factors.
- **Apply other regulatory criteria** such as possible flooding threats and the impact of permit issuance on flood and erosion threats to other property.
- **Monitor wetlands and gather other time-series information sufficient to detect violations and provide the basis for enforcement actions.**
- **Defend regulations against "takings"** and other Constitutional challenges (nuisance prevention and health and safety information are often most powerful. Regulators must provide sufficient information to sustain regulations against Constitutional Due Process, discrimination, unreasonableness and takings challenges by private landowners.
- **Avoid liability problems in permitting** (e.g., issuance of permits that increase flood or erosion problems on other properties). Regulators need documented, time-series information for monitoring and enforcement.

2. Recognize that regulators need flexibility in the selection of assessment techniques and procedures, depending upon the issues and problems identified at specific sites such as:

- Downstream flood potential (e.g., HEC models)
- Unstable streams (e.g., Rosgen)
- Blockage of flood flows (e.g., HEC models)
- Endangered plants or animals (e.g., detailed site inspections, WETHINGS)
- Possible toxics at the site (e.g., detailed site inspections including soil borings)
- Near to water supply wells, potential drawdown issues (e.g., ground water pump tests)

3. Recognize that regulators must often evaluate the impacts of proposed activities and the adequacy of impact reduction techniques on not only wetlands but adjacent waters, riparian zones, and floodplains.

4. Recognize that regulators often need to evaluate the impact of an activity on only a portion of a wetland, not a whole wetland.

5. Recognize that consultants will often carry out much of the analysis and that assessment methods must be understandable by consultants.

APPENDIX H:
WHY RAPID ASSESSMENT METHODS ARE NOT BEING USED BY REGULATORS

Most of the focus on assessment in the wetland scientific community over the last two decades has been on the development of rapid assessment methods for wetland "functions", "values", or wetland "condition". Our discussions with wetland decision-makers suggest a variety of reasons why rapid assessment methods are not being used. These reasons needed to be considered in the design of any new techniques.

- **Analysis of wetland functions and values becomes unnecessary when there are clear grounds for denial of a permit without such an analysis.** This is particularly true when a regulatory agency uses a hierarchical, sequential evaluation process that screens permit applications through a variety of tests, and rejects some permits before functional analysis is needed. Some reasons for outright rejection include presence of alternative sites for proposed activities, lack of water dependency, natural hazards (blockage of floodway), incompatibility of proposed uses with other regulations (e.g., an industry in a residential zone), failure of landowner to establish land ownership (wetland on public lake bed rather than private shore land), or incompatibility with a single, prominent function/value, such as habitat for an endangered species.

- **The impact of a project may be so small (e.g., 1,000 square feet of fill for a driveway) that a systematic assessment of wetland functions/values is not considered financially or technically justified.**

- **A wetland conservancy zone approach is used (common at the local level), which prohibits outright most activities in wetlands, based on overall wetland functions and values, natural hazards and other factors.** This obviates the need for case-by-case evaluation of functions and values in individual wetlands. With such an approach, case-by-case evaluation may only be needed for a small number of special exceptions or variances.

- **Rapid assessment techniques are often too complicated.** Regulators and others will not use techniques they cannot understand or which exceed their expertise. This has become an increasingly problem with HGM, IBI, and other models which are complicated or require special expertise for their use (e.g., expertise in diatoms, insects).

- **Rapid assessment methods are too time-consuming and expensive, despite their name.** Regulatory agencies often lack the time and money to carry out model development or systematic analyses of functions and values, which takes days according to these methods. Agencies have also not considered it reasonable to shift this burden to landowners for small-scale projects, which account for perhaps 90 percent of all permit applications in some areas. Regulatory agencies typically spend much of their resources determining whether a proposed activity is located in a wetland subject to the agency's jurisdiction (not all wetlands are regulated under most programs), the precise boundaries of the wetland at the proposed permit application site, whether the proposed activity is consistent with other regulations, and whether the site is in public or private ownership, among other fact-finding.

- **Rapid assessment methods have not provided the right kind of information, with enough detail and accuracy, for managers to apply in regulatory permitting contexts.** For example, general assessment models do not provide specific enough information on plants and animals to identify endangered species or the impacts of a proposed activity on fisheries, waterfowl. Many assessment techniques are too general to determine the adequacy of impact reduction or compensation measures, or to apply a no net loss goal.

- **Rapid assessment methods focus exclusively on wetlands, while many projects impact adjacent waters, riparian areas, floodplains and uplands.** Many regulatory programs (e.g., the Section 404 program, local zoning) control not only wetlands, but also adjacent waters and uplands. This has limited the use of rapid assessment techniques because a regulatory agency needs to evaluate all of a project's impacts and determine the adequacy of all mitigation and compensation measures, not just a small portion.

- **Rapid assessment techniques have not been designed to evaluate portions of wetlands or impact compensation measures for these portions.** This is important because many projects affect only a portion of a wetland.

- **Rapid assessment approaches are often inaccurate.** While simplifications and assumptions are necessary, rapid approaches often rely upon limited data gathering or untested or partially tested indicators or surrogates to predict wetland functions and values, or to suggest compensation ratios. This often produces inaccurate results.

- **Rapid assessment techniques fail to consider all relevant factors.** For example, the HGM method contains sophisticated procedures for evaluating wetland processes, including relative condition. Use of these procedures, if fully tested, can provide an improved scientific basis for evaluating permits and establishing compensation needs. But, HGM then uses a simplified formula to calculate mitigation ratios, which omits many of the factors that wetland managers consider relevant. See Box 3. Fortunately, this problem could easily be addressed and does not affect the fundamental soundness of the HGM approach. But, it has not yet been addressed, and this has hindered the application of this approach in regulatory programs.

- **Rapid assessment methods have been developed for use by a single, expert regulator and a single, expert regulatory agency.** But wetland assessment is often undertaken by the landowner or his or her consultant or several regulatory agencies. Rapid assessment methods are often not designed to be comprehensible to landowners or consultants because there is an assumption that the methods will be used by experts in agencies. Consequently, they inadequately tap multiple sources of expertise and information. Most do not contain consensus-building mechanisms.

- **Ranking procedures originally developed for acquisition and highway corridor analysis programs are only partially applicable in typical regulatory contexts.** For example, the practice of ranking wetlands by function/value can be useful in determining the highest priority acquisition sites or the lowest impact transportation corridor. However, this practice misses the real issue in regulatory permitting, which is whether a proposed activity should be located on a wetland or an upland site. Knowing that one wetland has a higher ranking than another in meeting certain goals may help red flag functions or values, and help determine the magnitude of interest in a public interest review. But, it does little to indicate the public interest in locating an activity in a wetland, an upland or aquatic system site.

- **Assessment methods that produce numerical results often mix apples and oranges when function/values are added together.** They typically allow for the subjective combination of factors. Assessment methods that allow factors to be mathematically combined have been, to a considerable extent, susceptible to an enormous amount of manipulation. Regulators quickly lose confidence in an approach when they see results being manipulated by other agencies or consultants.

- **Rapid assessments methods do not consider future conditions and do not reflect the dynamic nature of wetlands.** This means that they have little predictive capability in urban contexts where hydrology, hydraulics and resulting wetland functions and values are rapidly changing.

- **Efforts to develop assessment methods have not defined key terms such as *value, function* and *process*, consistent with critical decision-making needs.** Managers need to define key terms consistent with statutory, administrative regulation, and administrative needs.

- **Limited guidance materials and training have been provided to wetland managers for most assessment methods, discouraging their use.** Rapid assessment methods vary in terms of goals, issues considered, simplifying assumptions, accuracy, staffing and expertise needs, budgets and time required, and adequacy in meeting legal needs, among other features. Many of these features are not readily apparent in the guidance documents and there is typically little information in the literature on the uses and limitations of techniques. Consequently, it is not surprising that regulatory agencies have found it difficult to decide which technique to use.

APPENDIX I:
THE NEEDS OF NONREGULATORS

The assessment needs of various non-regulatory wetland decision-makers vary, depending upon the context and management technique. Common denominator needs for both regulatory and non-regulatory management efforts often include:

- Mapping of wetlands to determine overall wetland types and boundaries (broadly needed);
- Determination of functions/values (scales, types of functions/values, accuracy vary). This is broadly needed;
- Determination of public/private property ownership boundaries (needs vary but often broadly needed);
- Determination of natural hazards (needs vary but often needed for development-related activities);
- Determination of the condition of wetlands (common need but needs vary); and
- Determination of the adequacy of impact reduction and compensation measures for various activities (common need for any sort of development activity but needs vary).

But there are also important differences. For example, wetland assessment efforts for non-regulatory purposes (e.g., public land management, acquisition, planning) generally do **not** need to:

- Be conducted under as tight time deadlines as with regulations;
- Meet constitutional challenges from private landowners claiming an uncompensated taking of their properties;
- Focus as much on changes in wetlands because continued open space uses, such as forestry or wildlife, are often contemplated that involve limited changes rather than fills or drainage;
- Consider as broad a range of wetland functions/values since other, nonregulatory programs often focus on a limited suit of functions (e.g., fisheries); and
- As extensively involve private landowners and their consultants in information gathering and analysis.

More specific differences between regulatory and non-regulatory assessment needs will now be considered in greater depth.

WETLAND ACQUISITION/MANAGEMENT PROGRAMS

Information gathering and analysis needs for wetland acquisition are often considerably different from those for regulations. For example, implementation of acquisition efforts often requires a comparative evaluation of wetland sites within a defined area to help those undertaking the acquisition decide where to spend limited funds. Comparable ranking is not needed in most regulatory contexts. The issue facing regulators is usually whether to locate an activity in a wetland versus an upland site, not in one wetland or another. It is understandable, therefore, that early wetland assessment methods, which were developed for use in acquisition programs and ranked wetlands, have proven to be only partially applicable to regulations.

Wetland acquisition is being carried out by units at all levels of government, nonprofit environmental organizations and land trusts. The federal government undertakes wetland acquisition through the FWS, the NRCS, the National Park Service and the Federal Emergency Management Agency. Goals include: wildlife protection and restoration, establishment of parks, implementation of farm programs and flood loss mitigation (e.g., acquisition after the 1993 Mississippi River flood).

State wildlife, park and recreation agencies undertake acquisition at the state level. Local governments acquire wetlands as part of greenways, recreation areas, and park and wildlife areas. Acquisition by land trusts, such as Nature Conservancy, Trust for Public Lands and the National Audubon Society, is technically "private," but much of the land is ultimately transferred to states and local governments.

Acquisition needs depend, somewhat, on specific acquisition goals. As one would expect, the assessment needs of a program designed to protect and restore ducks need to focus on identification of wetlands with suitable open water, nesting areas and food supply for waterfowl. Assessment needs of fisheries programs have focused on wetlands of highest priority as fish habitat.

Differences between acquisition needs and regulatory program needs include:

- The acquisition agency often needs an up-front, area-wide survey of potential acquisition sites. Case-by-case information for a single site (e.g. the Section 404 program) is not enough to set acquisition priorities. The acquisition agency generally wants to identify all the sites available within a defined area that meet specific goals and criteria. Often, some sort of rating and ranking of sites is needed to help target use of scare acquisition dollars.

- An acquisition agency often needs more specific information about a particular function or value than regulators who need information on a broad range of functions and values. Acquisition agencies may (depending upon the agency mandate) focus on:

    - Waterfowl, fisheries, etc.
    - Endangered species
    - Biodiversity
    - Suitability for interpretation
    - Suitability for recreation
    - Suitability for research and education

- An acquisition agency is often more concerned than regulatory efforts about the permanence of wetland functions and values. It makes little sense to spend scarce money buying a wetland that will not be in existence in ten years.

- Acquisition efforts often need to consider, more than regulators, threats to potential acquisition sites and the adequacy of protection measures. Scarce money is not placed on areas that may be destroyed by other activities.

- Acquisition efforts often need "willing seller" information. This is not needed for regulation.

- Acquisition efforts need cost of land acquisition. Acquisition priorities are often dictated as much by cost as resource features. Cost of land acquisition is less relevant to regulation.

- Acquisition efforts often need information on land management needs and potential of sites. This is not needed for regulation. For example, and acquisition agency with limited funds may wish to avoid acquisition of a site requiring yearly exotic plant control.

- Acquisition efforts often need to assess potential liability for public use of potential acquisition sites. For example, will a site have open water with potential danger to children? Liability for public land management is a considerable concern to state and local governments and nonprofits that acquire and manage properties.

- Acquisition efforts often need to know what sites match the wetland characteristics and criteria set forth in various grant-in-aid programs. Often, funding is available from a specific program for a specific type of acquisition (acquisition of agricultural wetlands, but not others (e.g., urban).

PUBLIC LAND USE PLANNING AND MANAGEMENT PROGRAMS

Approximately one-third of the nation's land is in federal ownership. Most of this land is managed by the U.S. Forest Service, Bureau of Land Management, National Park Service, FWS and the Corps (dams, reservoirs, other water control structures.) States and local governments also own and manage a great deal of land in some states. Approximately 26 percent of the nation's wetlands are located on these public lands, including many of the coastal, estuarine, lake and river fringe wetlands.

In the last two decades, a broad range of statutes, regulations and executive orders requiring land management agencies to protect and restore wetlands as part of land and water management efforts have been adopted. These include, at the federal level, the Water Resources Act of 1991, which requires the Corps to achieve no net loss of wetland function and acreage for new water projects; the Floodplain and Wetland Executive Orders, which apply to virtually all federal activities; a variety of state and local laws, such as the Illinois wetland protection statute that requires that state agencies achieve no net loss of wetlands in their activities.

Federal Section 404 permits are also required for most alteration of wetlands on public lands.

Many land management agencies have developed wetland protection and, in some instances, wetland restoration efforts as part of broader public land planning and management efforts. As part of these efforts, many public land management efforts have carried out mapping of wetlands or used maps prepared by other agencies (e.g., NWI maps). Some agencies have attempted more detailed assessment of wetlands throughout individual units of their lands, usually for specific purposes, such as identification of rare and endangered species, evaluation of waterfowl potential or evaluation of forest production potential.

Land management agencies have also undertaken more detailed assessment of wetland functions and values for specific sites proposed for roads, public buildings, dikes, levees, reservoirs and other works. In such situations, usually involving only a small portion of public lands, the assessment needs of public land management agencies are similar to those of regulators. Land management agencies must, in fact, seek regulatory permits.

Wetland assessment needs for public land management purposes share some commonalties with regulations, but also differ in a number of respects:

- Because most public land management agencies must develop plans for their lands as a whole (typically required by their statutes), they must map and assess wetlands in broad water and land assessment contexts. Case-by-case analysis (e.g., the Section 404 program) is often not enough. For broader ecological analysis, area-wide maps are needed. Not only wetlands need to be assessed, but also many other resource areas such as rivers, riparian areas, buffers and significant uplands. Increasingly GIS systems are used for this analysis.
- Because land is in public ownership, there are fewer legal and constitutional constraints on public land management agencies in managing wetlands on their properties. Public land management agencies do not need land ownership information because lands are already in public ownership. Wetland boundary delineation and assessment may be at a larger scale and less accurate for many public land management purposes. Public land management agencies are also not under the time restraints of regulatory programs to carry out projects that affect wetlands.
- Because the public resource management agency is not typically proposing to place development in wetlands on public lands, there is less need for information on change, natural hazards, mitigation or various compensation requirements, although this information may be needed on a case-by-case basis.
- In many instances a federal public land management agency is subject to National Environmental Policy Act requirements and must undertake an "Environmental Evaluation." If there are significant impacts, an Environmental Impact statement must be prepared for its plans and activities.
- Because the public land management agency is solely responsible for management of the public land, there is less need to involve private landowners and the public in wetland assessment approaches. Wetland assessment manuals can be written for expert, public land management staff.
- Because a public land management agency often has a primary resource management mission (e.g., forest production, recreation, wildlife management), the agency often wishes to emphasize this mission in any assessment effort and needs particularly detailed information pertaining to these goals.

PUBLIC UTILITY, INFRASTRUCTURE PLANNING AND MANAGEMENT PROGRAMS

The wetland assessment needs of public and quasi-public infrastructure agencies (roads, sewers, water supply, airports, waste disposal sites) often more closely coincide with those of regulatory agencies, depending on the activities they are undertaking, because they often require permits from regulatory agencies. Public utility and infrastructure agencies need detailed data, comparable to the information needed for development purposes, to evaluate the suitability of sites for particular purposes (e.g., soil bearing capacity, flooding and other hazards.) Most public utility and infrastructure development is subject to Section 404 and, to a lesser extent, other types of regulatory requirements, including executive orders and environmental impact statement requirements.

On the other hand, these agencies also have needs similar to those public land managers. They manage not only roads, airports and utility lines, but also open spaces adjacent to these areas. Public utility and other infrastructure agencies typically carry out their long-term planning efforts in a hierarchical manner, starting out with general, area-wide resource assessments and progressing to more detailed assessments, including mitigation and compensation planning.

Public utility and other infrastructure projects often need:

- Area-wide wetland maps and up-front surveys for alternative project site locations, much like land management agencies.
- To be able to determine the relative impacts of various project locations or routes, such as a highway corridor on alternative wetlands and other ecosystems. Comparative rating of wetlands is useful because the infrastructure agency often needs to decide whether to alter one wetland or another for a specific highway, transmission line and other infrastructure.

  In contrast, the common permit application for a regulatory agency involves only a portion of a single wetland and comparative information on wetlands is not needed.
- Information sufficient for preparation of detailed environmental impact statements. Public utility and other infrastructure projects are often large. Entire wetlands and whole complexes of wetlands may be affected by a road, dam, airport or power line. Large-scale impacts typically trigger federal and state environmental impact requirements.

  In contrast, full environmental impact statements are rarely required by federal or state law for small, individual wetland permits submitted to a wetland regulatory agency.
- Use of mitigation banks and other types of offsite mitigation. It is often difficult or impossible to compensate onsite for all of the wetland impacts of a large project, such as a road or utility line. Agencies, therefore, need inventories of potential mitigation sites.

The needs of a public utility or infrastructure agency also differ from those of a regulatory agency in that:

- A public utility or infrastructure agency is not confined by a short time frame in assessment of wetland functions and values as is the typical regulatory agency. Large projects often take years to plan, fund and implement, and assessments can be carried out over a longer period.
- A public utility or infrastructure agency is typically not as restricted by budgetary or staff limitations as a regulatory agency. Large sums of public money are spent in constructing highways, reservoirs and other large projects. Environmental assessments, including wetland assessments, are often a small portion of such costs and may be passed on to the public.
- The public utility or infrastructure agency is not concerned with uncompensated taking of private property because agencies pay for any use of private lands for a road, reservoir, etc.
- On the other hand, public utility or infrastructure agencies are often more concerned about common law liability than a regulatory agency for increased flooding, erosion, or other natural hazard damages on adjacent private lands caused by the extensive grading and fills often involved in the alteration of wetlands and related waters. Such agencies may also be liable for negligence if flooding occurs on a road, airport or other public facility and results in killing or injuring people.

NATIONAL ENVIRONMENTAL POLICY ACT ASSESSMENTS

The National Environmental Policy Act of 1969 requires federal agencies to prepare environmental impact statements for actions that substantially affect the environment. The goal of this act is to require agencies to take a hard look at the environmental impacts of their proposed actions and alternatives to the actions.

Federal agencies and state and local governments that use federal money must prepare impact statements for a broad range of planning and management activities. These needs overlap with those described for public land management, infrastructure planning and construction. Many states, such as New York, Washington, California, Wisconsin and Minnesota, have also adopted "baby" NEPA's that require state agencies, local governments and, in some instances, private landowners to prepare impact statements. However, full impact statements are not typically required at any level of government for small projects without significant impacts.

Agencies have typically applied a hierarchical approach to wetland assessment for environmental impact purposes, starting out with generalized EA's for initial, broad scale assessment (which wetlands will be affected? how much?) and red and yellow flagging (are there any special issues or functions likely to be involved?). More detailed analysis and environmental impact statements (EIS's) that take into account proposed mitigation measures are only prepared if a project will have significant impact on the environment.

Agency and landowner needs for assessing the environmental impacts on wetlands and preparing environmental impact statements on specific development projects are somewhat similar to those for regulatory purposes, subject to several qualifications:

- To comply with NEPA and similar state laws, the public agency or private landowner must evaluate the environmental impact of a proposed project on the natural environment as a whole. This means that impacts and the adequacy of measures proposed to mitigate or compensate for them must be determined not only for wetlands, but also other related environments, such as floodplains, riparian areas, aquatic systems and upland areas of biodiversity. In addition, environmental impact assessments must address the issue of "who" is impacted, not simply whether impacts will occur. For example, it is not enough to know that a project will impact flood storage capability. An agency may need to determine who will be impacted by increased flood heights.

- To comply with NEPA and similar state laws, the agency or landowner proposing a project must typically evaluate cumulative impacts. This is also desirable for regulation, but the broader scope of NEPA analysis (wetlands and other areas, broad range of environmental impacts) necessitates a broader view.

- Because detailed impact statements are typically required only for larger projects, agencies and landowners proposing such projects usually carry out more detailed, environmental impact studies than for individual, regulatory permits.

LOCAL AND STATE LAND USE PLANNING PROGRAMS

Land use planning and regulation (zoning, subdivision control, building codes) has been undertaken by tens of thousands of local governments throughout the nation. Some states have also prepared land use plans (e.g., Hawaii) for all or a portion of the state, such as a coastal zone or special planning area like the Adirondacks or Pinelands. The overall goal of these planning efforts is to allocate lands throughout a designated area to their most suitable uses, taking into account natural suitability (functions/values), natural hazards, the availability and costs of public services and infrastructure, existing uses, the need to separate incompatible uses, economic development and tax base needs, among other factors.

Land use planning ideally precedes local zoning, subdivision controls and building codes. Land use planning is undertaken not only for private lands, but also to help guide infrastructure development (roads, sewers, water supply), public land acquisition (recreation, greenways), emergency preparedness and economic development.

The wetland information needed for land use planning depends on the scope of the planning effort and its use. Less detailed, inventory information may suffice for overall, comprehensive planning. More detailed, site-specific information is needed for infrastructure site design and other planning purposes.

Many land-use planning agencies allocate wetlands with special capabilities and/or development limitations such as steep slope and erodible lands and floodways, to conservancy zones. The scale and accuracy of the wetland information needs increase dramatically if a local government decides to apply a case-by-case, performance standard approach similar to that of the Section 404 program, rather than a blank conservancy zone approach. Then, the typical regulatory information needs becomes applicable.

Some differences between local land planning needs and wetland regulatory needs include:

- The information needs of land use planning agencies include all of the information needed to determine natural suitability of not only wetlands but other lands throughout a community. Typically, broad use is made of soils and topographic maps, surface water inventories and other specialized inventories to meet such broad analysis needs.
- Land planning agencies need area-wide wetland maps for local planning and conservancy zoning purposes. However, some wetland programs (e.g. Section 404 program) operate without maps.
- Land planning agencies need to be able to combine natural resource with cultural information, such as demographics and land use. For this reason GIS systems, which permit multiple analyses, are particularly useful.
- Land planning agencies often need to analyze a broad range of possible development scenarios at various locations (e.g. roads, sewers, water supply systems). Comparative ranking of wetlands is, therefore, useful.

LOCAL OR STATE WATERSHED PLANNING AND MANAGEMENT

Many local governments and entities (e.g., levee districts, water districts, soil and water conservation districts), state water and natural resource agencies, and a number of federal agencies (Corps, NRCS, U.S. Bureau of Reclamation, U.S. Geological Survey) are undertaking comprehensive, multi-objective water resources or watershed planning and management efforts. Others are undertaking water-related planning and management efforts for more limited purposes, such as floodplain and stormwater management, pollution control, soil and water conservation, water supply and surface water allocation.

All of these efforts require analysis of wetlands in the context of broader water regimes, although the focus and levels of analyses differ somewhat. For example, floodplain and stormwater programs are typically concerned with large, infrequent flows and flood loss reduction techniques. Water supply programs are concerned with the quantity and quality of water.

The wetland assessment needs of watershed planning and management efforts are similar to those of case-by-case wetland regulation in some respects, but the scope and scale of information needs is broader and more concerned with hydrology and hydraulics. Wetlands are increasingly recognized as important in achieving certain water resources goals, such as flood loss reduction and pollution control. Other differences between water management and wetland regulatory programs include:

- Water and watershed programs typically require up-front wetland and other water information for an entire planning area, including maps that indicate the location and boundaries of wetlands and other waters. Water resource agencies need to know what areas they should/must avoid when siting projects. They also must comply with various statutes and laws, such as the Section 404 permit requirements for structures, fills and drainage.

- Water resource agencies need more specific water regime information for particular project sites (backwater computations) and analysis of water regime/wetland interactions for detailed project design, environmental impact analysis, permitting and compensation. Water and watershed management programs at all levels of government are making increasing use of computerized hydrologic and hydraulic models to determine short and long-term flow regimes and the impacts of various manipulations of water on these regimes, including wetlands.

- Water and watershed agencies need to know how the wetlands and other aquatic ecosystems may respond to various water management schemes, such impoundment levels and low flow releases from reservoirs. For example, it is not enough to know that certain wetlands exist at the site of a proposed water supply reservoir. The water resources agency needs to know what changes would take place in the functions and values as a result of altering water levels, water temperatures, hydroperiod, sediment regimes and other features.

NON-REGULATORY WETLAND RESTORATION/CREATION/ENHANCEMENT PROGRAMS

In recent years, there has been increasing interest in identifying areas suitable for wetland restoration for a variety of purposes. Inventories of potential restoration/creation sites may used to target landowners for financial incentive programs pursuant to the Wetland Reserve Program,

Partners for Wildlife and other Farm Bill programs. Inventories can help communities and state agencies restore degraded waters and landscapes to create parks, recreation and interpretation areas (e.g., Hackensack Meadowlands, Tifft Farms near Buffalo, the Platte River Greenway). Inventories can help public land management and infrastructure agencies develop impact reduction and compensation plans for projects. They can be used to help establish and implement mitigation bank proposals.

A variety of ecological and societal information is relevant to the evaluation of wetlands from a restoration or creation perspective. The potential to restore or create a wetland depends on existing natural resource features and reasonably anticipated anthropogenic changes in hydrology and other threats. The overall hydrologic regime is most important, but other factors determine suitability as well.

Evaluation of onsite and offsite restoration/creation potential has become an important part of regulatory permitting. However, there are also some differences between case-by-case regulatory and non-regulatory restoration needs:

- Up-front, area-wide assessments of possible wetland restoration sites are needed for an entire region to help target Wetland Reserve, Partnerships for Wildlife and other non-regulatory restoration programs. These assessments are also needed to identify possible mitigation bank sites. There is somewhat less need for such area-wide assessments in regulatory programs.

- A comparative ranking of wetlands based on restoration potential is needed to help agencies and nonprofit organizations select priority sites.

- Mapping of possible wetland restoration sites requires the inventory of more than existing wetlands (needed for regulatory purposes). It requires the inventory of drained or partially drained wetlands.

- Assessment of sites needed to determine restoration or creation potential requires information concerning parcel size, threats from adjacent land uses and management needs (e.g., control of exotics).

SUMMARY: BETTER MEETING THE NEEDS OF NONREGULATORY DECISION-MAKERS

Recommendations for better meeting the needs of nonregulatory decision-makers include:

1. Future efforts to develop wetland assessment methods should begin with the recognition that there are commonalities between assessment needs non-regulatory decision-makers but there are also many differences. The needs of various types of nonregulatory decision-makers should be more carefully documented. Assessment models should then be matched with these needs.

2. Nonregulatory decision-makers, like their regulatory counterparts, need wetland maps or alternatively wetland type and boundary information in detailed, digital because they often use GIS systems.

3. Nonregulatory decision-makers often need assessment information which evaluates the relative functions and values of wetlands. This is particularly true for infrastructure agencies needing to evaluate alternative corridors for roads and other utilities and restoration agencies needing to prioritize restoration sites. It is also true for agencies carrying out restoration efforts.

4. Nonregulatory decision-makers also need to relate wetlands to related aquatic ecosystems. They also need to relate wetlands to uplands. For example, assessment procedures are needed to simultaneously address riverine wetlands, streams, floodplains, and riparian areas.

5. Nonregulatory decision-makers increasingly need watershed-based assessment methods as they attempt to manage resources on a watershed basis. GIS systems are particularly attractive for watershed or landscape level analyses.

6. Nonregulatory decision-makers increasingly need monitoring information to evaluate the effectiveness of their programs. Reference sites and reference systems are needed.

APPENDIX J:
AREA-WIDE (WATERSHED OR LANDSCAPE LEVEL) ASSESSMENTS

NEED FOR AREA-WIDE ASSESSMENTS

Traditionally, wetland assessment techniques have focused on areas within wetland boundaries, with limited consideration of adjacent land use, hydrologic and ecological factors or landscape/watershed context. This has undercut the accuracy of assessments.

Analysis of adjacent areas and broader landscapes is needed for several reasons:

1. Proposed projects submitted to a regulatory agency, such as bridges, roads, dredging operations and fills, often impact not only wetlands, but also adjacent waters (lakes, rivers, streams, estuaries), floodplains and sometimes related uplands. Quite often wetland regulatory agencies have jurisdiction over wetlands and these broader areas, and they must evaluate such broader impacts. For example, the federal Section 404 program applies to both wetlands and broader waters. Many state wetland programs also apply to waters. Many also regulate wetland buffers of 50 to several hundred feet. Local regulatory programs (zoning) typically apply to wetlands, floodplains and upland areas.

2. Wetland managers at all levels of government must determine whether landowners have practical alternatives to proposed wetland activities. To determine this, managers must be able to evaluate the environmental impact of proposed activities on wetlands, adjacent waters, floodplains, riparian areas and uplands. For example, it makes no sense (and would violate statutes) for a regulatory agency to attempt to shift a proposed wetland activity to an endangered species upland site.

3. Wetland functions and values, including the restoration potential of a wetland, often depend in part on the functions and values of the related aquatic and upland ecosystem, and on the broader hydrologic context. For example, wetland fisheries often depend on the fisheries potential of adjacent lakes, rivers or streams. (See Boxes 14 and 15.)

4. The landscape determines hydrology. For example, urbanization often substantially increases runoff. This means that a restoration project for a marsh may, in fact, produce a lake due to the increased water levels.

5. Local planners and regulators need information concerning the relative suitability of land and water uses throughout a community for planning and zoning purposes. Similarly, Section 404 regulators need a variety of contextual information to determine the public interest.

Box 17
Importance of Landscape Context

Landscape context has substantial impact on wetland processes and the ability of wetlands to provide goods and services. Some examples include:

- **If a wetland/related resource is adjacent to a lake, river, stream, estuary or ocean.** It will likely have water recreation, fisheries, waterfowl, water quality protection, wave retardation, erosion control and, in some instances, flood conveyance functions/values. It will also, in many instances, be subject to flood and erosion hazards. It may be partly owned by the public or subject to public trust values. Such a wetland will typically be subject to state and local regulations. For these reasons, regulators typically apply tight regulations virtually all wetlands adjacent to lakes, rivers, streams, estuaries or the ocean.
- **If wetland/related resources are rare in the locality, state or region, or a wetland type is rare in a given area.** If either of these is true, a wetland is more likely to be habitat for rare or endangered species or a unique community. It is more likely to be important for water quality maintenance and pollution control, fisheries and waterfowl, among other purposes, and is a good candidate for detailed evaluation.
- **If a wetland/related resource forms part of a drainage way (either a permanent or ephemeral watercourse).** If so, it is likely to be particularly important for conveying flood flows, reducing erosion and sedimentation, protecting water quality and for fisheries and other habitat purposes. It is more likely to be part of a broader wildlife corridor, although other wetlands may also serve this role. A wetland that forms a portion of a drainageway is a good candidate for detailed evaluation.
- **If a wetland is connected with, contiguous to, and/or part of a larger wildlife corridor or area of protected lands.** If so, it is likely to have particular wildlife habitat value. Proposed alternations in such wetlands may impact not only the wetland, but also the larger protected area.
- **If large human populations are located near or contiguous to the wetland.** If so, a wetland may have enhanced opportunity to provide services to society, and its destruction may have immediate social significance.

Box 18
Importance of Landscape Context to Specific Functions/Values

Specific wetland functions/values often depend on overall landscape context. Examples include:

Flood storage: The flood storage function/value of a riverine wetland depends, to a considerable extent, on the flood characteristics of the river or stream and the size and shape of the entire wetland depression, including any berm or rim around the wetland. Protection of the wetland area alone will not protect much of its flood storage value unless the topographic contours of the entire depression are also protected.

Flood conveyance: The flood conveyance function/value of a riverine wetland depends on the flood characteristics of the river or stream and the topographic contours of the riverine wetland and the area on both sides of the river or stream capable of conveying flood flows, and the condition of this area (dense vegetation, denuded, etc.)

Pollution Prevention and Control: The pollution prevention and control functions of wetlands/related resources depends on the overall surface water runoff regime, including pollution sources from upland areas and their travel paths to lakes, streams or estuaries, and the position of a wetland in this runoff regime.

Fisheries: The fisheries function/value of a wetland depends on the characteristics of the wetland and whether the wetland is adjacent and connected to a larger water body where fish may live, feed and breed.

Waterfowl: The waterfowl breeding and feeding function/value of many wetlands depends not only on the onsite characteristics of the wetland (if it has limited open water), but also on whether the wetland is adjacent to a lake, river or stream, and the wetland's location in relationship to other wetlands.

Song Bird Habitat: The bird habitat function/value of a wetland often depends on the onsite characteristics of the wetland and the adjacent buffer and upland areas, since many bird species nest in upland areas and use wetlands for feeding.

Mammal Habitat: The use of wetlands by raccoons, bears, deer and other mammals that do not live in wetlands often depends on adjacent upland habitat and the adequacy of the connections (corridors) between the wetland and upland habitats.

Reptile and Amphibian Habitat: The use of wetlands/related resources by many reptiles and amphibians (e.g., snapping turtles, salamanders, frogs) depends on adjacent upland habitat and the adequacy of connections between the upland and wetland, since many reptiles and amphibians spend only a portion of their life cycles in wetlands/related resources.

Recreational Uses: The recreational use of wetlands/related resources often depends on the proximity of the wetland to open water and the ability of the paddlers or boaters to enter and exit the wetland.

Assessing wetlands at landscape context as well as at the site-specific level can, of course, be time consuming and expensive. However, a common sense approach that takes a qualitative look at the interrelationships between wetlands and broader areas is possible even on individual permits. In addition, a variety of up-front assessment approaches on a regional or watershed basis hold promise for improving and supplementing case-by-case wetland assessment over time. These approaches can help with red flagging and preliminary environmental analysis. They can assist regulators perform more detailed analysis of capacity, opportunity and social significance, and they can help monitoring and enforcement. These approaches can also help establish compensation ratios; make wetland regulations more predictable and equitable; reduce the administrative and financial burdens on private landowners; and integrate wetland regulations with comprehensive land and water planning.

However, the dream of an inexpensive wetland assessment method that will allow accurate and inexpensive, up-front assessment of all wetlands within a local government, state or region and can entirely replace case-by-case information gathering will not be realized in the foreseeable future. Wetlands are too complex and conditions often change quickly. Regulatory information needs are too diverse and complicated. Approaches that combine up-front and case-by-case permitting are needed to improve wetland permitting and other site-specific analyses.

Area-wide wetland assessments have been carried out for some locations as part of advanced identification, special area management, and wetland and watershed management programs. Cost is a particular issue if very detailed data is gathered. The costs of accurately assessing a single wetland/related resource area on a case-specific basis are multiplied one thousand or ten thousand fold when efforts are made to evaluate in detail all wetlands throughout a region. There may be some economies of scale in assessment, but experience to date suggests there are few short cuts to detailed and accurate assessment. Because funds are limited, only generalized data is often generated in area-wide efforts and many simplifying assumptions and tradeoffs are typically made. As a result, area-wide surveys often lack much of the needed information for evaluating specific permits at specific sites without some measure of supplementation on a case-by-case basis.

This does not mean, however, that area-wide assessments are not useful in providing and analyzing specific types of information (e.g., endangered species, floodway, erosion maps) and for red or yellow flagging or preliminary determinations of boundaries, functions/values, hazards and other features. Some information is clearly better than none, providing it is not misrepresented or misused. And, it is possible to generate detailed information pertaining to specific issues, such as endangered species, on an area-wide basis. It is also possible to characterize wetlands on a landscape basis with regard to possible functions, threats and other features. The FWS has done this on an experimental basis, using NWI data.

To be useful, such area-wide products must be in a form and format subject to refinement and confirmation through site-by-site field investigations, if necessary. Unfortunately, this has not often been possible with efforts to rate or otherwise characterize wetlands. The original data used in rating the wetlands is usually not available to the regulator and it is extremely difficult, if not impossible, to disaggregate the overall characterization to allow confirmation and refinement through site visits.

MAPPING AND SURVEYS

Various types of up-front wetland maps and surveys can be combined with the case-by-case evaluations to provide landscape-level perspectives. These include:

Wetland/related resource mapping (boundary delineation) in hard copy and/or digital form. Wetland mapping has been widely undertaken at all levels of government. Wetland types, as well as boundaries, are typically displayed on maps, but there is usually no attempt to evaluate functions and values, hazards or other features. Mapping efforts that have been undertaken for both regulatory and non-regulatory purposes include:

- Wetland maps developed specifically for regulation by some states and local governments (e.g., Wisconsin).
- Wetland maps designed for broad use and sometimes used for regulation, such as NWI maps.

Wetland mapping has proven useful in regulatory programs to both landowners and regulatory agencies to suggest overall wetland boundaries. However, maps have not generally been sufficient, even at scales of up to 1 in. = 200 ft., to determine precise wetland boundaries without further field surveys.

Wetland boundary maps have proven most useful for regulatory purposes if they are used on a presumptive basis with more detailed, field delineation carried out as needed. However, boundary maps become costly with increasing scale. There must be a tradeoff between initial scale and case-by-case fieldwork. Maps for urban areas also may become quickly outdated due to the dynamic nature of wetlands and changing hydrologic conditions.

Wetland/related resource boundary mapping, with evaluation of one or several functions/values or other characteristics. Wetland mapping with, in addition, evaluation of one or several functions/values or other features has been undertaken in a variety of contexts and can also be useful in case-by-case permitting. Examples of such maps include:

- Area-wide identification of wetland restoration sites (e.g., Everglades)
- Inventories of wetlands of potential special recreational value (e.g., SCORPS)
- Inventories of wetlands of particular significance to waterfowl (e.g., North American Waterfowl Management Plan)
- Wetland property ownership maps (e.g., Florida, Virginia)

These mapping efforts, like more general wetland mapping, can help wetland management agencies identify general wetland boundaries. This type of mapping has also proven particularly useful for red and yellow flagging, although it has typically been limited in terms of types of information provided, accuracy and detail.

Broader area-wide natural resource inventories. A variety of broader natural resource inventories and map products can help wetland management agencies define, in advance, wetland hazards, existing uses, archaeological and historical sites and provide other needed information. Examples include:

- Natural hazard maps (e.g., FEMA flood maps, erosion maps)
- Pollution inventories
- FWS and State Heritage Program endangered species maps and lists of sites
- State Heritage Program natural area maps
- Archaeological site maps and lists
- Land use maps

These maps and other information are useful in providing certain types of up-front information, and assisting in the evaluation of project impact and the adequacy of mitigation measures.

ADVANCED RESOURCE PLANNING FOR WETLANDS

A second type of up-front information gathering and analysis that can help implement wetland management programs is more specific, advanced resource planning for wetlands. These planning efforts have been undertaken by only a small number of governments generally involve mapping of wetland boundaries, evaluation of overall functions/values and, in some instances, natural hazards and other features. Social significance and opportunity have been considered in some of these efforts (e.g., Advanced I.D. efforts). Generally, these mapping and assessment efforts focus primarily on functions and values.

Examples include:

- Local wetlands and watershed plans (e.g., West Eugene, Oregon)
- EPA, NOAA, Corps and other Special Area Wetland Management Plans (e.g., Hackensack Meadowlands)
- EPA Advanced Identification Projects. (e.g., Hackensack Meadowlands)

Most of these efforts have been undertaken by local governments with the help of the EPA, NOAA and other agencies. Many efforts have compared wetlands based on functions and values. Various function/values assessment methods have been used in these efforts, such as a modified form of WET or WET 2. Quite a number of these efforts have also used GIS systems to facilitate analysis.

These efforts have been of some use in regulatory contexts, but have generally lacked the detail and accuracy needed for site-specific project review. In addition, consideration of functions/values alone without consideration of factors, such as natural hazards, has limited the usefulness of these efforts in determining the suitability of wetlands for particular uses.

Efforts that attempt to provide aggregate evaluation of wetland functions/values on an area-wide basis with a high, middle, low or ordinal rating have overall proven disappointing for regulatory purposes, although they have been useful for some red and yellow flagging and planning purposes.

Multi-objective resource management planning or land use planning with wetlands/related resource as one component. A large number of local governments (4,000 plus and the number may be much higher), regional planning agencies and public resource management agencies have undertaken broader land use planning or combined land/water use planning with wetlands as one component. The goals of these efforts are to allocate lands throughout the planning area to

their most suitable uses. Wetland boundary maps are often used in these efforts. Other types of natural resource and cultural/economic data are also typically overlaid on wetland maps. These broader planning and assessment efforts include, but are not limited to:

- Coastal Zone Plans
- Shoreline and Shoreland Plans
- Scenic and Wild River Plans
- Floodplain Management and Greenway Plans
- Environmental Corridor Plans
- Water Quality Protection Plans
- Critical Area Plans
- Local Land Use Plans
- Watershed Plans

In these efforts, local governments have generally made no effort to assess in detail the functions and values of particular wetlands. The overall suitability of wetlands for development in comparison to other lands in a community is, however, considered. Larger wetlands, particularly those adjacent to water bodies are typically placed in conservancy zones, based on natural hazards, public/private property ownership, costs of public services, compatibility with other uses and overall functions/values, among other factors.

Such multi-objective resource management efforts have proven useful for overall conservancy zoning and subdivision control. However, the wetland maps used in these efforts have often been small-scale and not sufficient for regulatory analyses without supplemental information gathering.

WETLAND REGULATORY CLASSIFICATION OR CATEGORIZATION

Several states (e.g., New York) and a number of communities (e.g., Anchorage) have attempted to classify wetlands for regulatory purposes based on at least superficial assessment of the functions/values of individual wetlands. These classification efforts are intended to indicate protection and development potential. These efforts have proven to be of limited value for site-specific management because they are based on too little information and attempt to simply wetlands too much. Attempts to classify wetlands for regulatory purposes have also proven to be misleading if they are based on too little information or consider too few factors. For example, efforts to classify wetlands for development purposes, that consider only functions/values, may overstate development potential because they do not consider natural hazards. The determination that wetlands as a whole, or most categories of wetlands, are suitable for development must be based on a combination of information concerning hazards, public ownership, public rights in waters and functions/values, among other features.

COMPUTER-ASSISTED ASSESSMENT AND GIS SYSTEMS

Geographic information systems (GIS) are being used with increasing frequency to assist wetland managers assess wetlands in a variety of ways:

- Tracking regulatory permits
- Tracking wetland gains and losses
- Tracking wetland restoration, creation and enforcement projects

- Analyzing, storing and making available biological and other data from wetland reference systems and sites
- Indicating wetland boundaries (e.g., digital maps)
- Providing data that will facilitate wetland analysis, such as floodway, flood fringe, and coastal high hazard maps (FEMA data bases), digital air photos (USGS), water resources information (USGS) and endangered species sites
- Providing existing land use and property ownership information, including infrastructure (roads, bridges)
- Providing land use planning and regulatory information, such as zoning boundaries
- Identifying potential restoration sites based on soils, present and anticipated hydrology, existing land uses, watershed problems and biology
- Identifying flood prone and other development that may be impacted by wetland project proposals
- Identifying human populations that wetland projects may impact

Over the last decade, interest has grown at all levels of government in the use of GIS models to evaluate certain wetland characteristics on an area-wide basis and to carry out certain types of case-by-case site review, such as determination of the impacts of fills on flood conveyance with HEC-2 backwater computations. For example in the summer of 1996, more than 80 papers were presented at a national workshop, organized by the Association of State Wetland Managers, on the use of GIS systems and on-line services in wetland and floodplain management. There were a total of 250 participants.

GIS includes a variety of information analysis approaches, which code and analyze information spatially (geographical reference). Wetlands are usually only one type of information contained in a system. With a geo-referenced approach, analysis is almost always done by computer, but information can also be manually geo-referenced through overlays (e.g., “McHarg” resource overlays). The computer facilitates storage and simultaneous analysis of information pertaining to a particular geographical point or area, such as topographic, vegetative, soils and other types of data, and the analysis of the relationships among these data. Computerized water resource models (e.g., flood storage, flood conveyance, water quality) can also analyze geo-referenced information through the application of mathematically-based water resources flow models.

At one time, interest in GIS was confined to a small number of users with mainframe computers and large sums of money. But, interest in GIS systems has grown exponentially as inexpensive personnel computers with large, rapid computing capacity and large data storage capacity have become available. Relatively inexpensive software (e.g., ArcInfo, MapInfo) with powerful GIS capability and the availability of natural resource information in digital form, such as NWI maps and FEMA flood maps, have also helped. New technologies, such as Global Positioning Systems (GPS) and low-level digital imagery hold promise for addressing some of the problems with GIS systems and providing some of the detailed data that have been lacking.

Some of the strengths of GIS systems and computerized water resources flow models for wetland assessment include the ability to:

- Store and quickly process large amounts of data
- Combine, for analytical purposes, natural resource data with census, tax, economic and other data

- Quickly analyze multiple scenarios (e.g., evaluate the impacts of various project designs)
- Print analyses in a variety of formats (maps, charts, tables, 3-dimensional models, etc.)

Quite a wide variety of GIS-based wetland evaluation systems are operational or under design in states like Maryland, Wisconsin and North Carolina. More specific wetland applications are described in Box 16.

Box 19
Application of GIS and LIS Systems
In Landscape Scale Wetland Assessments

GIS and land information systems (LIS) can assist wetland assessment in several ways (this list is not exhaustive):

Parcel analyses. Up-front wetland planning and permit processing efforts can benefit from the parcel analysis capabilities of LIS, which have already been implemented by many local governments and are being developed by others. LIS systems are a type of geoinformation system that use the ownership "parcel" to encode and analyze data. Types of information useful to wetland regulation and often available from these systems include:

- Parcel ownership
- Existing use of parcel
- Property values
- Taxes
- Zoning classification and other regulations
- Public facilities (sewer, water, roads)
- Demographic data (how many people nearby)
- Flood and wetland maps, other special resource features
- Broader topographic, soils and other natural resources data (in some instances)

Parcel-level LIS approaches are often not specific enough to delineate wetland boundaries because information is encoded by parcel rather than natural resource boundary. But, they provide broader parcel information useful in red flagging and determining opportunity and social significance.

Red and yellow flagging. GIS or LIS systems with wetland components can also be used for broad inventory and red and yellow flagging purposes, even if the system lacks data at the scale and degree of accuracy needed for site-specific regulatory analysis. Use will depend, of course, on the information available in the system. For example, a GIS or LIS with wetland types (e.g., digital NWI data) and overall acreage can be used to determine whether particular types of wetlands are rare in a locality. It may be used to determine the proximity of wetlands to other wetlands and waters. The system might also be used to red flag flood hazards, if flood maps have been encoded into the system.

Determining opportunity and social significance. GIS and LIS systems can be used to determine the relationship of wetlands to pollution sources, flood flows, public lands and population centers, as well as various wetland users.

Determining possible cumulative impacts, the implications of various development scenarios. One of the strengths of GIS and LIS systems is their ability to analyze alternative development scenarios for a geographical area. For example, in processing a permit application for a one-acre fill in a 10-acre wetland, it might be useful to assume a one-acre fill in all similar wetlands in the region and to determine the hydrologic implications. Or it might be useful to determine changes in existing hydrologic regime due to projected urbanization of a watershed for a wetland restoration project. A computer hydrologic model could help with both.

Hydrologic analyses. Computer models have become an essential tool in flood routing, determination of flood conveyance areas, determination of erosion and deposition, water pollution analysis and the types of water resources investigation that lend themselves to numerical modeling. Computerized hydrologic models (commonly now combined with broader GIS systems) are being increasingly used for floodplain management planning, stormwater management, water supply planning, water quality planning and other water resources planning to not only determine existing conditions, but also to predict long-term changes such as changes in hydrology due to urbanization of watersheds. It is possible to project "build out" scenarios (e.g., various densities and types of development), as well as the implications of management schemes, such as flow diversions and operation of dams.

With the strengths outlined in Box 16, one might expect widespread use of GIS and computerized information systems in wetland management. GIS systems have been used for wetland decision-making tory purposes. For example, the Maryland Department of Natural Resources and the New York State Adirondack Park Agency have used GIS to help provide a portion of the information needed for planning and analyzing proposed wetland permits for a number of years. Illinois and New York have developed extensive GIS systems with wetlands as one component.

However, use in wetland regulatory contexts has been limited for a variety of reasons:

"Garbage in, garbage out." The output of GIS and other computer modeling systems can be no better than the data put into the system. Computers cannot generate raw natural resource data (e.g., detailed topographic, water level or species information). They can only process it. In many instances the maps imported to GIS systems are out of date and contain inaccuracies due to changing conditions. And the costs and time of evaluating an individual wetland may be multiplied thousands of times if efforts are made to evaluate all wetlands in a region and the data then inputted to a GIS system.

Problems with geo-referencing data. GIS systems require the precise location of information in relationship to selected geographical references because data must be provided to the computer in a geo-coded form. Precise geo-referencing is difficult because wetland information is often at a variety of scales (e.g., NWI, soils and land ownership maps), and may be only available on unrectified map bases that often lack specific coordinates. Data is also typically subject to a great deal of inaccuracy. Human beings visually comparing maps and other types of information can make adjustments for such limitations; computers cannot. For example, a regulator attempting to evaluate a proposed project at a specific site can often, with a little ingenuity, locate this site on topographic and soils maps and air photos of varying scales, and adjust problems to scale. Judgments can be made with regard to inaccuracies. A computer cannot make these adjustments.

Problems with aggregated information. There are financial limits to data encoding, computer storage and analytical capabilities, despite the large capacity of modern computers. For this reason, computer specialists often attempt to encode information pertaining to a whole area (e.g., a polygon) rather than a point. This also limits disaggregation and later fine-grained analysis because information, once aggregated, typically cannot be disaggregated.

Problems updating wetland information required by the dynamic nature of wetlands and anthropogenic changes. It is often as expensive and time-consuming to encode new, updated wetland information as it was to encode the original information. This is a serious limitation on the use of GIS because wetland characteristics, particularly in urban areas, may change dramatically in a few years.

Expense. Despite advances in technology, wetland GIS has often proven expensive and only a modest number of wetland-based systems have become operational. This is changing because hardware and software prices are now relatively low. On the other hand, developing adequate referencing for information and encoding and checking for accuracy often requires a great deal of staff time, despite some measure of automation (e.g., use of rastor scanners).

Lack of staff expertise. Most regulatory staff does not have adequate training and expertise to use GIS, despite the widespread availability of computers for other purposes. GIS is a technical subject, although relatively untrained personnel can carry out simplified computer runs and some basic programs are available to review results, such as ArcView. This is increasingly less of a problem.

Despite limitations, computerized information systems have considerable future potential for assisting wetland managers. They should be cooperatively developed at federal, state, and local levels to help meet wetland analysis and other needs. However, even if improved, GIS will only be able to supply some of the information needed for permitting and it will need to be supplemented by case-by-case data gathering on individual permits for the foreseeable future.

SUMMARY: LANDSCAPE-LEVEL ASSESSMENTS IN THE FUTURE

1. Landscape level wetland assessments are increasingly needed to supplement case-by-case analysis approaches for regulators, restoration agencies, public land managements, and other wetland decision-makers. Wetland assessment must consider broader hydrological and ecological context.

2. Landscape approaches which were not practical a few years ago are becoming practical due to advances in computer hardware and software including GIS software capabilities and information on the internet. GIS systems have strengths in not only looking a natural processes but opportunity and social significance.

3. A broad range of approaches are available for partially adding “landscape context” to wetland decision-making such as mapping of wetland and related ecosystems with added functional analysis of one or more features. However, all approaches are typically limited by the expense, time, and expertise required for detailed information gathering.

4. Future landscape level assessment will typically need to combine up front information gathering on a watershed or landscape basis with continued case-by-case information gathering.

APPENDIX K: SUGGESTIONS FOR A PRELIMINARY ASSESSMENT PROCESS

INTRODUCTION

Many of the assessment approaches that have been developed over the last decade involve preliminary assessment procedures to identify red flags with regard to the proposed activity and/or wetland (e.g. HGM, WET, ORAM). However, preliminary analysis is limited and the model then typically leads the user into the use of that method alone. There is no independent review to held the user decide what assessment method might be most appropriate in the specific circumstances.

Agencies at all levels of government are beginning to recognize the need for free-standing, preliminary assessment procedures to help them decide whether a detailed assessment is needed and, if so, which assessment methods should be applied. Such a procedure is also needed to help agencies meet EA requirements of the National Environmental Policy Act or comparable state or local acts.

What should be some of the characteristics of such a preliminary process? We suggest that a workable process should:

- Help determine, on a preliminary and qualitative basis, whether significant wetland processes, functions and values might be impacted at a site. It so, data gathering and analysis can be quickly focused on the specific functions/values that may be impacted.

- Depend primarily on existing information, professional judgment and perhaps a single field visit.

- Provide all reviewers with a clear picture of the proposed project.

- Recognize that landowners/consultants, local governments, state and federal agencies, and the public must often collaborate on information gathering and analysis, particularly for larger projects. There is simply not enough money and time for any entity to go it alone. Collaborative information gathering can build consensus among regulatory and commenting agencies concerning relevant facts (e.g., Is a site subject to severe flooding? Is an endangered species present?), and distribute the cost. Collaboration also helps build consensus on wetland-related impacts and the adequacy of impact reduction and compensation measures. Consensus-building is particularly important when multiple agencies review a permit.

- Include a variety of “sorting” procedures (e.g., red and yellow flags), with various feedback loops to determine, early on, the issues and problems at the site and whether more detailed studies are needed. This corresponds with the requirements of the National Environmental Policy Act, which states that before preparing an environmental impact statement an agency must first take a hard look at potential impacts to see if they might be significant.

- Sequence information gathering to get the easy information first. For example, if a proposed fill is in a floodway and would violate floodway regulations, if a septic tank system is proposed for a saturated area where such system will not work, or if the site is an endangered species habitat, a simple “no” may be rational and legally defensible.

- Help the regulatory agency evaluate the proposed impact and the adequacy of reduction and compensation measures, including the adequacy of proposed monitoring procedures.

- For regulatory contexts, include at least a superficial evaluation of the impact of permit denial or conditioning on the landowner to determine whether possible "takings" challenges or other legal problems may result. If so, more detailed information gathering may be needed for the permit application. Data gathering may best focus more on health and safety issues (e.g., flooding) and other nuisance issues, which are given great weight by the courts.

It is, of course, not easy to develop a rapid and inexpensive process that satisfies all of these goals. We have put together a suggested "collaborative assessment process" as a starting point for such an effort. This process involves the overall steps and considerations outlined in Box 20. (See J. Kusler, Integrating Wetland Assessment into Regulatory Permitting for more detail.)

The draft preliminary process we have put together is designed to answer several questions: May there be a significant impact from the proposed activity on wetlands and the environment? If so, what sorts of impacts may occur to specific functions or values? If there is clearly a significant impact, immediate denial of the permit will often be justified. If there clearly would not be a significant impact, immediate issuance of a permit may be justified. If the impacts are not clear, the permit is then subject to more detailed information gathering, pursuant to one or more of the many assessment techniques available.

The determination of a significant impact is based on consideration of wetland class and condition, the type of activity, whether policy issues are involved, the landscape context, a broad consideration of opportunity and those who may be impacted by the decision.

The selection of a more detailed assessment technique or techniques (if needed), including topic, scale and degree of accuracy, will take into account the functions and values that may be impacted, the importance of the policy issues involved, the severity of the impacts and other factors.

We suggest this model as a straw man. Criticisms? Suggestions?

Box 20
Factors to Be Considered in a Preliminary Environmental Analysis of a Regulatory Permit Application

A regulatory agency would consider the following factors (listed as questions) in carrying out a preliminary analysis of a regulatory permit application. The goals of the analysis would be to decide whether a proposed activity may have significant environmental impact. The preliminary analysis will help the agency decide what issues, processes and values may need special attention. Preliminary analysis would be based on the project application, at least one field visit to the site, an examination of available maps and data, and professional judgment. Evaluations would be qualitative. The agency would make written comments only where the analysis suggests relevant factors. If there is an obvious red flag, the application may be denied outright. If there is a yellow flag or other cautionary issues, the permit will be subjected to more detailed analysis.

In carrying out a preliminary analysis, the regulatory agency will ask:

1. Does This Permit Application Deserve Special Attention for Policy or Legal Reasons?

- Will this decision undermine a general regulatory policy or goal or be precedent setting?
- Is there some feature of the proposed activity that immediately suggests it will have significant environmental impact, given the type and size of the proposed activity, the type of wetland and the size of the impact, the number of individuals who may be impacted, the type of impacts or other factors?
- Will this permit decision be subject to possible court challenge by other agencies, environmental organizations or the landowner?

If any of these factors are found, the regulatory agency will approach further information gathering and analysis with particular care.

The regulatory agency will next consider:

2. Is There a Red Flag that Justifies an Early "No"?

- Does the landowner have practical alternatives to the proposed activity?
- Does the activity comply with federal, state or local regulations or have necessary approvals been obtained (e.g., 401 certification, CZM consistency review).
- There is evidence of a severe natural hazard, such as a proposed activity in a FEMA or Corps of Engineers mapped floodway?
- There is evidence that the proposed activity will increase flood hazards, erosion or hazards on other lands that violate adjacent landowner rights, threaten public safety or cause nuisances?
- Will there be adequate onsite waste disposal? (For example, septic tank/soil absorption systems do not work in high ground water contexts.)
- Has the landowner demonstrated adequate ownership interest in the site of the proposed activity?
- Is there is a documented endangered species or other protected species at the site?
- Has the wetland been given special status under regulations, such as the Estuarine Sanctuaries Act, National Scenic and Wild Rivers Act, etc.?
- Will the proposed activity cause significant pollution because it is near a municipal well head (source water supply), involves an unacceptable discharge (e.g., toxic wastes) into a lake, river or stream, violates wetland water quality standards?

The regulatory agency will deny the permit application if it finds that one or more red flags.

3. Are There One or More Yellow Flags that Justify More Detailed Studies?

- Are there possible ownership problems?
- Are there possible natural hazards?
- Are there possible problems with onsite waste disposal and pollution?
- Are there possible significant functions/values, including endangered species?
- Are there possible conflicts between proposed activities and regulations?
- Are there possible taking or other legal challenges if a permit is denied?

The regulatory agency will provide a more detailed review if it encounters any yellow flags.

4. May There be Significant Impact on Functions/Values, Apart from the Red and Yellow Flags?

The regulatory agency will qualitatively answer the following questions. The analysis of each of the issues will be primarily based on the HGM class, landscape context, the type and magnitude of the project, the location of the proposed activity within the wetland and the condition of the wetland.

A. What are the possible functions/values at the site that may be impacted, based on HGM wetland class and other factors?

- What functions/values are suggested by the wetland class and subclass?
- What functions/values are suggested by the overall landscape context?
- What functions/values are suggested by available flood, soils, topographic, endangered species, and other maps and written reports?
- What functions/values are suggested by the size and condition of the wetland, scarcity of wetlands in the area and the landscape context?
- What functions/values are suggested by the collective knowledge of the regulatory agency? and the regulatory team?
- What functions/values are suggested by responses to public notice and public hearing, if notice and/or hearing are provided?
- What functions/values are suggested by information provided by the landowner in the permit application?

B. What are the magnitudes of the functions/values at the site that may be impacted?

- What magnitudes are suggested by the wetland class and subclass?
- What magnitudes are suggested by the size of the wetland?
- What magnitudes are suggested by scarce are wetlands and the wetland type in the area?
- What magnitudes are suggested by the condition of the wetland?
- What magnitudes are suggested by the landscape context?

C. What are the possible impacts on specific functions/values, including magnitude and types of impacts?

- How much of a wetland will be affected and how will it be affected?
- Will the proposed activity affect fundamental wetland processes?
- How sensitive is the wetland type (e.g., a bog) and how reversible will the changes be?
- What is the condition of the wetland?
- What impact reduction and mitigation measures are proposed?

D. What will be the societal importance of possible impacts?

This will need to be qualitatively evaluated.

- What opportunity does the wetland in its present versus its altered condition, including any mitigation and compensation, have to provide goods and services to society?
- What is the social significance of a wetland present versus altered condition, in terms of who will be affected by the changes, how many will be affected and what will be their attitudes toward such affects?

5. Will There Be Significant Impacts Other Than Impacts on Functions/Values?

The regulatory agency will also consider in this preliminary evaluation other impacts, in addition to those that affect functions/values, such as incompatibility of the proposed activity with adjacent land and water uses and the possible presence of toxics at the site,

APPENDIX L:
SELECTED READING

(Please note: Not all references are cited in the text of the report.)

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