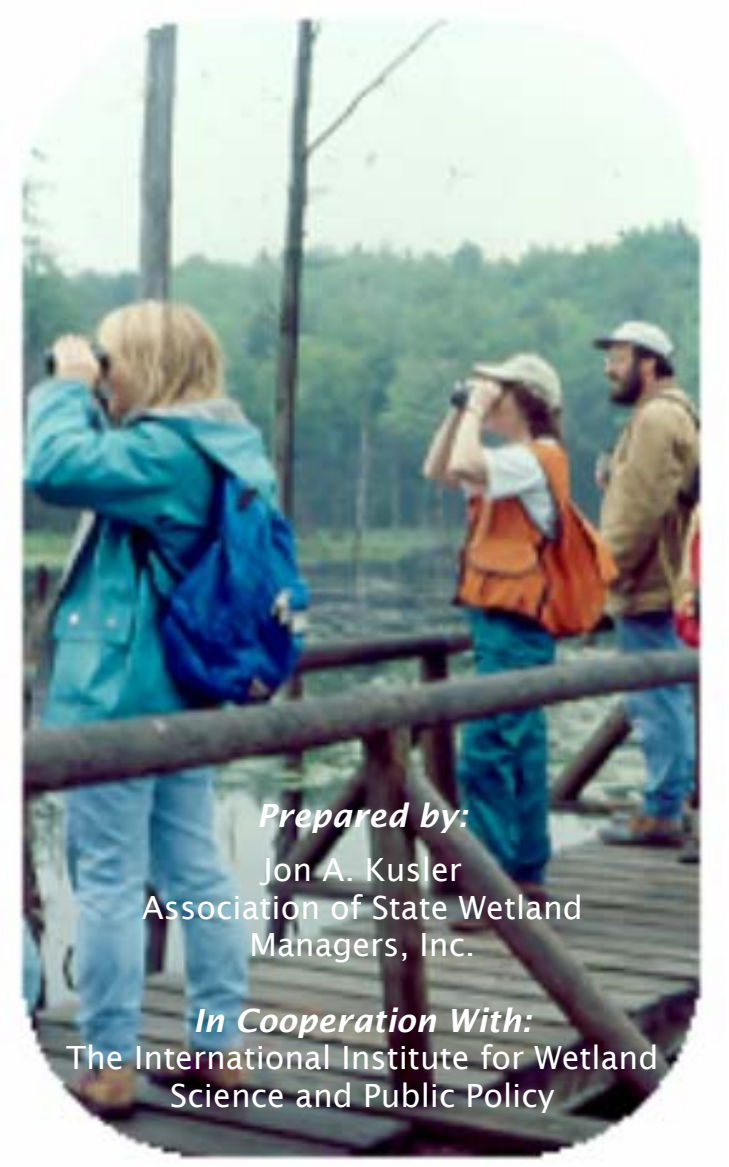
COMMON QUESTIONS:

DEFINITION OF THE TERMS WETLAND "FUNCTION" AND "VALUE"



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In Cooperation With:

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PREFACE

The following guide addresses frequently asked questions with regard to the definition of wetland "functions"" and "values." It is designed for local government officials, land trusts and watershed councils, landowners and other interested in the protection, restoration, creation, or enhancement of wetlands. The guide draws upon a series of research projects carried out by the Association of State Wetland Managers, Inc. (ASWM) including the preparation of a report: Kusler, J. 2004. Assessing Functions and Values, Association of State Wetland Managers, Berne, New York. See http://www.aswm.org/propub/functionsvalues.pdf

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COMMON QUESTIONS:
DEFINITION OF WETLAND "FUNCTIONS" AND "VALUES"

Are the definitions for "functions" and "values" important?

A. The definitions for wetland "function" and "value" are of great significance in regulatory contexts because a no net loss of "function" or "function" and "value" regulatory standard is typically applied in federal, state and local regulations.

These terms are also important in wetland planning, acquisition, active management, and other purposes. Definitions for "functions" and "values" determine the sorts of information that need to be gathered and analyzed in wetland assessment. They determine, to a considerable extent, protection and management priorities. Definitions also determine the compensation "mitigation" ratios required if damage or destruction are allowed.

Unfortunately the terms "function" and "value" have been broadly used without clear definitions and without recognizing the policy implications of various terms. Changes have also been made in the use and application of these terms without (apparently) much concern for the impact on decision-making.

Most regulatory efforts applying a no net loss standard continue to consider both "functions" and "values" (i.e., there must be no net loss of function and value). Some efforts also consider acreage (i.e. no net loss of function, value and acreage). However, in the last decade there has been more emphasis upon function in Section 404 regulatory efforts with less attention to value and acreage. This is because (it is argued) that the goal should be to prevent loss and/or replace the "functions" wetlands serve and not acreage or "value". It has also been justified on the grounds that value is difficult to measure.

Whether value as well as function is considered makes a significant difference in what gets protected and how. For example, if a regulatory agency only considers natural process, a proposed project may be approved if the project proponent agrees to provide compensatory mitigation to "replace" the lost functions anywhere in a state, region or watershed. But if socio-economic "values" are to be reflected, then who benefits and who pays becomes relevant and lost functions may need to be compensated near or at the site of the original destruction.

How has the term "function" been used historically?

A. As already indicated, many wetland regulatory programs, such as the Section 404 program, require that activities seeking a regulatory permit be in the public interest and result in no net loss of wetland "function". A little historical perspective on the term "function" in the Section 404 context may be useful.

Prior to 1995, the terms function and value were often used somewhat interchangeably in the literature and regulations. See Box 1 for a description of some of the "functions" or "values" of wetlands applying a broad concept of function. In 1989 the Conservation Foundation Report, Protecting America's Wetlands: An Action Agenda 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 other services provided by wetlands, including cultural and aesthetic values (See Figure 1, Wetland Functions) in that document. This report led the U.S. Environmental Protection Agency and the U.S. Army Corps of Engineers (Corps) to adopt a 1990 Memorandum of Understanding (MOU) pertaining to mitigation, which incorporated the no net loss of "function" and "values" standard into Corps regulatory permitting pursuant to Section 404 of the Clean Water Act. Pursuant to the MOU there is to be no loss of both "function" and "value" but neither term is defined.

Prior to the Conservation Foundation Report and the MOU, the Corps in the Section 404 program attempted to apply a broad concept of "function" and "value". The Corps along with other federal agencies developed the Wetland Evaluation Technique (WET) in the early 1980's to aid the Corps in processing regulatory permits. The WET method considered efficiency or "capacity", "opportunity", and "social significance" in assessing both functions and values.

In 1995, an unofficial change occurred. In that year the Corps Waterways Experiment Station published the 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." While not more specifically defining "function" the Guide then, focused (see Table 2 in Smith et al., 1995) on the analysis of natural processes relevant to the ecological suitability of wetlands. The goal was, in part, to separate the investigation of project impacts on wetland processes from the analysis of the value of such changes. A second goal was to help assess wetland condition to determine restoration needs and mitigation ratios.

Since 1995, the term "function" has most often been used in scientific circles and in some regulatory contexts (both Section 404 and other programs) primarily to refer to natural processes. However, the term "function" also continues to be used in many statutes, regulations, policies and reports to refer to "goods and services", "functional values", and "values" of the sort described below and in Box 1.

A shift from a broad concept of "function" and value to a narrow concept of function simplifies assessment of wetlands but at the cost of ignoring factors important to the "public interest".

What wetland features or characteristics are relevant to the definition of "functions" and "values"?

A. Four sets of wetland characteristics are important in describing, assessing, regulating, and otherwise managing wetlands. All four are relevant to the definition of functions and values. Ambiguity in use of the terms "function" and "value" is due (at least in part) to complex roles wetlands play in meeting society's needs and little agreement how to assess these roles and how these four sets of factors should be reflected in wetland decision-making.

The first set of wetland characteristics are the **natural processes occurring within wetlands** such as denitrification, biomass production, and flow retardation. As indicated above, the 1995 HGM report referred to such natural processes as "functions". These characteristics can be at least partially measured and objectively described with some precision by assessment methods such as HGM and IBI models if funds and time are available.

Unfortunately tens of thousands of natural processes occur within even a single wetland. In assessment of a specific wetland prior to destruction or damage, it is necessary for regulators for budgetary, staffing, and other practical reasons to focus upon a limited number of natural processes and not the full range of processes. In general, wetland assessment methods used by regulators have focused upon habitat-related processes. Wetland habitat is, of course, very important but habitat is only one of the socially significant roles of wetlands. Flood storage and flood conveyance, erosion control, water quality protection, and recreation may be equally or more important in a specific context.

With measurement of natural "functions" alone, (referring to national processes) there is not necessarily an acknowledged link to society. For example, knowing that dense vegetation in a heavily forested wetland slows the passage of water does not, in itself indicate the role of the wetland in protecting or not protecting downstream residences from a 100-year flood. More information is needed concerning the relationship of the functions to society's needs.

Once a regulator decides to examine some functions and not others without making explicit the needs of society which are to be served (e.g. flood storage versus habitat) hidden policy judgments creep into assessment. What wetland and associated ecosystem functions are to be measured, protected, or restored in a given instance? Equally important, what weight is to be given to various factors and how is this to be done?

The second set of wetland characteristics relevant to definition of function and value and to assessment of wetlands are the **off-site natural resource characteristics critical to the onsite functioning of wetlands** such as regional hydrology, ecosystem context, connectivity of the wetland to other wetlands and water, rarity in the landscape, presence or absence of buffers, and other landscape-level natural resource relationships. These offsite natural resource characteristics may also be measured with a fair amount of objectivity but with greater difficulty than wetland onsite features. Some of the wetland assessment models such as HGM to some extent consider offsite characteristics (e.g., landscape setting).

The third set of wetland characteristics relevant to definition of function and value relate to the **cultural context** of wetlands in the landscape (roads, dams, houses, etc.). These cultural features often affect onsite and offsite natural resource functions. For example, urbanization in lands surrounding a wetland may greatly increase runoff and wetland hydrology. Cultural features also determine society's needs for particular functions such as control of pollution to protect a water supply intake. Cultural characteristics determine the "opportunity" which a wetland may have to provide flood storage, pollution control, ecotourism, ground water and other services to specific segments of society. Some cultural characteristics, like onsite and offsite natural resource characteristics, may also be measured with a fair amount of objectivity.

A fourth set of characteristics pertain to the **attitudes of society to the roles or outputs of wetlands**. Who wants what? For example, who values flood storage or habitat and how much? How strongly do they feel?

How do the terms "function" and "value" reflect these four sets of characteristics?

The term "function" fits quite well with the first set of characteristics and, to some extent, the second set. The term "function" can be used to describe onsite and offsite natural processes. However, many wetland characteristics other than natural processes such as wetland depth and size also determine wetland outputs.

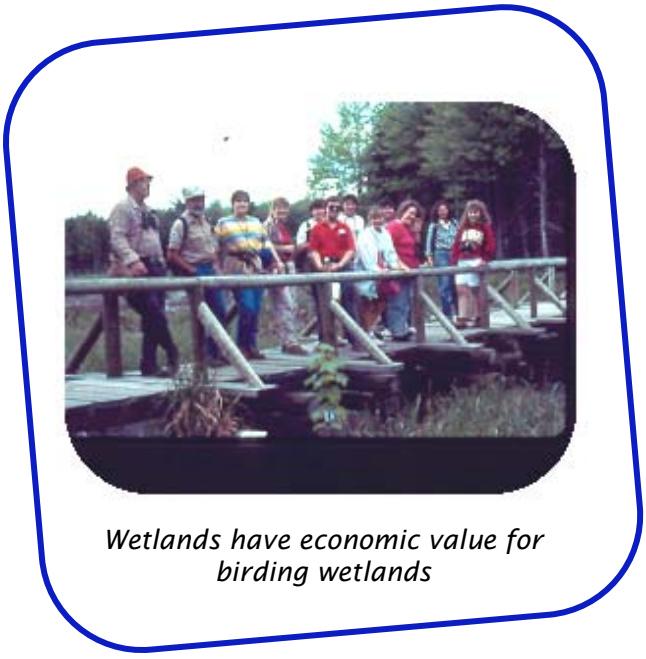
The term function is not a good fit for cultural features nor is it a good fit for societal attitudes. What should cultural features and societal attitudes be called?

What are wetland "values"?

A. Prior to 1995, the term wetland "value" was often used synonymously with wetland "function" (in its broadest rather than scientific sense). For example, a wetland was said to have a flood storage function or a flood storage value. The term "value", however, was used somewhat differently than function to indicate cultural features and societal connotation and worth. A wetland could be important (of value) to society in terms of:

- Health and safety,
- Historical, cultural significance,
- Education, research, scientific significance,
- Aesthetic significance,
- Economic significance, or
- For other reasons.

For example, wave buffering may be characterized as a wetland value in a leveed community where wave buffering may be important. Value has a cultural/societal element.



Wetlands have economic value for birding wetlands

Can attitudes of society to various wetland functions, values, or functional values be measured?

A. To some extent, yes, but with difficulty.

Economic analysis is one way of measuring the value of an output. For example, health and safety value (x number of people saved from flooding) can be subjected to economic analysis and assigned economic value. Assigning economic numbers to other types of "value" such as aesthetic and cultural are more difficult although some economic models attempt to measure them by visitor days, enhancement in adjacent land values, and other techniques. Part of the problem is that "value" (i.e.,

social significance) differs among various groups. For example, a fisherman prefers production of fish in a wetland which requires open water. A birder prefers 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).

Although it is difficult to quantitatively measure value, wetland managers have available a variety of qualitative techniques to gain some understanding of societies' attitudes toward various wetland outputs. See discussion below.

Is it possible to quantitatively describe functions and values?

A. It is possible to quantify some functions (e.g., the slowing of runoff by vegetation, flood storage), and economic values. For example, it is possible to quantitatively determine the flood conveyance and flood storage of a specific wetland for a particular frequency of flood (e.g. 100-year) using hydraulic and hydrologic models. It is possible to link this to flood damage to existing and reasonably anticipated structures in a floodplain. It is then possible to determine potential economic losses with loss of the storage and general public attitude toward protection or destruction through public hearings and other approaches described below.

Are there any easy ways of telling whether a wetland may be characterized by particular functions or values?

A. There are no easy, **accurate** ways. Knowing the overall type of wetland and its context can help "suggest" particular functions, and values in some instances. For example, riverine wetlands are most important for flood conveyance; estuarine, riverine and lakeshore wetlands are often important for wave retardation and shellfish production; many depressional wetlands are important for waterfowl production.

More than 40 rapid assessment techniques have been developed since 1990 alone to measure functions or functions and values. Some have been used in particular circumstances. However, none provide an accurate, rapid approach for assessing functions, and values.

Do wetland assessment techniques assess "function", "value" or some combination?

A. Many of the wetland assessment models developed in recent years such as HGM and IBI models focus on natural process (particular plant and animal species) alone. They attempt to measure wetland condition of various "functions" against a suite of "reference" wetlands of a particular type. Least altered wetlands are rated highest with such an approach.

But, as indicated by field studies by the Washington Department of Ecology, the least altered wetland may rate the highest from the perspective of endangered species, biodiversity, and "ecosystem health" but they do not necessarily rate highest in terms of some of the hydrologic goods and services such as flood storage and conveyance, erosion control, or pollution control.

Other assessment approaches such as WET and the many "sons of WET" including many GIS based assessment approaches attempt to consider opportunity and social significance as well as natural function.

Are economic models available for assessing wetland values?

A. Yes, a variety of economic assessment models have been applied to wetlands. However, assessing economic value of a specific wetland is difficult because the benefits of a wetland often accrue to the public as a whole rather than a single individual (e.g. fish spawning) and these benefits are partially intangible (scenic beauty). It is often difficult to accurately estimate the goods and services provided by a particular wetland (e.g., pollution control) and then to determine the value of these goods and services to society since they depend upon present and future context.

Consider, for example, an effort to assign a dollar value to flood storage and flood conveyance services of a specific wetland. It may be possible through the use of hydrologic models to determine the acre feet of water stored in this wetland in a 100-year flood or to determine the cubic feet per second of water conveyed by the wetland. These figures can be translated into differences in flood heights for adjacent and downstream lands. However, value of this storage or conveyance will depend, in large measure, upon present and future activities in the floodplain. Dollar value will be very great if flood elevation increases will overtop downstream levees, destroying many houses. It may be small if increased flood heights only affect a floodplain forest.

And, economic value pertaining to flood damages determined through use of an economic model alone will not necessarily reflect preferences of the public to be safe from flash flooding. The preferences of human beings only partly reflect economic considerations.

Is it possible to assess the "opportunities" which wetlands have to meet the needs of society?

A. To some extent, yes. The "opportunity" a wetland has now, or will have in the future, to provide goods and services to segments of population depends on a number of factors which may be qualitatively evaluated in many instances. Opportunity is relevant to a determination of value. Examples of approaches for qualitatively and/or quantitatively evaluating opportunity include:

- Carry out studies, such as HEC flood studies, to determine the importance of a wetland or wetlands in storing or conveying flood waters and the possible impact on upstream or downstream levees, houses and floodplain activities of this storage and conveyance.
- Distribute notices to groups (e.g., bird watching and fishing clubs), publish notices in newspapers and hold public hearings to solicit comments from existing and potential users concerning existing and proposed future uses of particular wetlands and how they may impact groups and individuals.
- Examine land and water use inventories to evaluate the opportunity a wetland has to prevent or ameliorate water or land use problems, such as water pollution or flooding. This can be done manually or through GIS systems. GIS systems have particular promise for this sort of analyses.
- Determine which groups of people use a wetland through field surveys or contacting local sporting or birding organizations.
- Examine access for existing or potential recreational uses.
- Examine demographic data to suggest the relationship of wetlands to existing and potential users. GIS systems may be useful with this as well.

Is it possible to evaluate the social significance of wetland functions and functional values?

A. To some extent, yes. A wetland manager can begin to qualitatively analyze social significance to impacts upon wetlands by answering the following sorts of questions.

- **Who will be affected by changes?** This can help determine whether a wetland impact may be of statewide or national significance. It can also help identify the legal rights involved, such as private landowner riparian rights or public trust rights. The question is relevant to social equity and social justice. For example, an urban wetland may be more important to minorities than a rural wetland.
- **How many people will be impacted?** An overview evaluation of the number of individuals that may suffer impacts is also relevant to the public interest. For example, a wetland that helps protect the New York City water supply may benefit more than eight million people, while fewer people may benefit from protection of another wetland.
- **In what ways will people be impacted?** For example, protection of a wetland that stores flood waters, thereby reducing downstream flash flooding, may have important health and safety implications in a specific setting. Similarly, protection of a wetland that serves as a water supply reservoir may have important health and safety implications. Protection of other wetlands may not.

Having determined who may be affected and how, a wetland agency may then gain feedback concerning public needs and interests by applying a variety of techniques.

Some options include the following:

- **Provide notices of proposed plans, permit applications, other actions to other regulatory agencies and the public; examine feedback.** Providing notices is the most broadly used technique by wetland mangers to assess public opinion. Responses give the agency some idea of the types, numbers and seriousness of interests and concerns.
- **Conduct hearings.** Agencies also broadly use public hearings to gather information and gauge public opinion, particularly on controversial projects.
- **Consult with local groups and organizations to determine 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 community wetlands. The plan was ultimately submitted to the electorate for approval and is now used as the basis for regulatory permitting.
- **Undertake economic analyses for wetland functions and values at specific sites.** Economic valuation is relatively rare because it is time consuming and expensive. But, analyses have been used, particularly by agencies like the Corps in preparing cost/benefit ratios for proposed water projects including restoration projects.
- **Pose the question of value or preferences to local elected officials, executive commissions.** A wetland agency may submit a proposed plan, variance, wetland permit or other action to local governments, soil and water conservation boards, commissions or planning agencies for reaction and comment.
- **Undertake public opinion surveys.** These are relatively rare but have been carried out on some wetland projects (e.g., West Eugene).

These techniques provide qualitative information concerning public opinion. Despite its qualitative nature, this information may, nonetheless, be important in assessing the "public interest" and public attitudes toward alternative projects and strategies.

Why do wetlands have more significant functions and values than many upland areas?

A. Wetlands have more significant functions and values than many uplands because, as transition areas between land and water, they provide many of the functions and values of both uplands (e.g., bird nesting, timber production, bird watching) and aquatic ecosystems (e.g., fish and shellfish spawning, water recreation). They also provide a variety of unique functions as intermediate ecosystems with a broad range of ecological niches even in a single wetland. For example, many different types of plants and animals may inhabit the various "zones" of a particular wetland reflecting differing degrees of saturation and water depths.

Are wetland functions and values the only reason for protecting and managing wetlands?

A. No. Many local, state, and federal wetland protection and management programs are based to a greater or lesser extent upon avoidance of flood hazards, erosion hazards, wave hazards, structural bearing capacity problems and other problems such as failure of septic tank/soil absorption systems in wet soils which characterize most wetlands. Activities placed in wetlands will often suffer natural hazard losses and may increase losses on other lands.

Which wetlands are subject to the most severe natural hazards?

A. Coastal and estuarine wetlands are typically subject to inundation in excess of 10-14 feet by a once in 100-year frequency hurricane or coastal storm. Significant wave heights may be added. Freshwater wetlands along major rivers and streams and the Great Lakes are often inundated by similar depths of water in a major flood. Riverine wetlands are often subject to high velocity and erosive flows located in or near a floodway. Depressional wetlands are often subject to not only several feet of water level fluctuation each year but long term fluctuations of two to eight feet. Filled wetlands of all types in earthquake prone areas are often subject to "liquefaction" during major earthquakes.

Why do many wetland regulatory programs require no net loss of wetland acreage as well as "functions" and "values"?

A. Many programs require consideration of acreage because it is difficult to quantitatively measure "functions" and "values", there are no agreed upon techniques for measuring function and value, assessment approaches contain many assumptions, and assessment approaches are often susceptible to manipulation.

Houses and roads constructed on filled wetlands often suffer subsidence like these in Baytown

Does restoration, enhancement or creation of wetland functions in one location (e.g., a mitigation bank) compensate for destruction at another?

A. Not necessarily, both from scientific and public policy perspectives. Restoration, enhancement, or creation of a function (natural process) at one location will not necessarily compensate for destruction at another because it will affect different ecosystems or portions of ecosystems and groups of individuals. Different people will benefit and pay. Location is of great importance from ecological and societal including legal perspectives. It is also important to the production of goods and service and to values.

For example, destruction of a wetland at one site with replacement many miles away with resulting flooding of adjacent properties at the original site has quite different "public interest" and legal implications than replacement at the original site. One public or private landowner who drains a wetland and increases flooding on another landowner may be legally liable to the damaged landowners. See, for example: 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.) In some instances the government agency permitting an activity which damages other property may also be liable.

In some instances, the government agency permitting an activity which damages other property may also be liable. For example, in Hurst v. United States, 739 F. Supp. 1377 (D.S.D. 1990) the Corps was successfully sued by private landowners for flood and erosion damage that resulted from the Corps' issuance of a Section 10 and 404 permit for construction of jettys in a river. The court held that the Corps had negligently supervised the project and failed to issue a prohibitory order to prevent the activities causing the flood and erosion damage. See also Annot., "Liability of Government Entity for Issuance of Permit for Construction Which Caused or Accelerated Flooding", 62 A.L.R.3d 514 (1975) and many cases cited therein. See, for example, Cootey v. Sun Inv., Inc., 690 P.2d 1324 (Haw.App. 1984) in which a Hawaii court held that a county may be liable for approving a subdivision with inadequate drainage: "(I)n controlling the actions of a subdivider of land, a municipality has a duty not to require or approve installation of drainage facilities which create an unreasonable risk of foreseeable harm to a neighboring landowner, and where a breach of that duty is established, a municipality may be held liable for consequential damages". Id. at 1332. See also City of Columbus v. Smith, 316 S.E.2d 761 (Ga.App. 1984) (City may be held liable for approving construction project resulting in flooding); Pickle v. Board of County Comm'rs of Platte, 764 P.2d 262 (Wyo. 1988) (County had duty of exercising reasonable care in reviewing subdivision plan).

Flooding may be due to wetland

Why do regulatory agencies often require onsite as well as offsite mitigation when they allow damage or destruction of a wetland to occur?

A. A combination of onsite and offsite mitigation may best compensate for damage or destruction of functions and values. Onsite mitigation may focus on flood storage, flood conveyance, erosion control, and water quality protection to avoid the sorts of problems discussed above. Offsite mitigation at some distance from project impact may help restore regional wildlife.

Is it possible to accurately "classify" wetlands once and for all according to development potential based upon functions and values alone?

A. No, for several reasons. First, development potential depends upon a broad range of factors (e.g., natural hazards, infrastructure) and not just functions and values. Second, wetlands are complex and dynamic systems and change over time. This includes functions and goods and services. In addition, it is not possible to evaluate long term characteristics by a single observation because water levels and vegetation change throughout the year and over a period of years. Wetland functions, goods and services, and values change over time as watershed hydrology changes and any attempt to evaluate natural processes and characteristics once and for all cannot reflect these changes. Finally, accurate assessment of functions and values at even a single point in time is extremely expensive for the millions of wetlands in the Nation. Detailed assessment of functions and values has not taken place for any state, community or region in the nation.

Will protection of areas within wetland boundaries alone protect wetland functions and values?

A. In many instances, no. Protection of the areas within wetland boundaries is, of course, important. But, it is essential to protect wetland sources of water, buffers, and connections to other wetlands and water bodies to protect functions and values.

Can wetland functions and values be restored, enhanced, or created?

A. Yes, some can be restored, enhance, or created. But, it is difficult to restore, enhance, or create the full range of functions and values. And, quite often enhancing one function or value will decrease another.

Offsite mitigation to compensate

How could agreement best be reached on the definitions of "function" and "value"?

This is a topic worthy of some careful attention by the National Academy of Sciences committee or another national wetland interagency task group including federal, state, and local agencies, academic institutions, not for profit organizations, and landowner interests. It would be useful, first, for this committee or task group to define the contexts in which these terms are presently used—scientific, assessment, planning, regulatory, nonregulatory management, etc. It would be useful, second, for this committee or task group to investigate the policy as well as scientific considerations in defining the terms. This could provide the basis for defining not only "function" and "value" but other terms which might be useful such as "opportunity", and "social significance".

Box 1
Examples of Wetland Values ("Functional Values")
Derived From Reports, Statutes, Regulations

Wetlands and related water and floodplain/riparian areas provide the following sorts of goods and services. They are often referred to as values or functional values. The magnitude of these goods and services depends on the specific context.

Provide flood storage. Some wetlands and floodplains temporarily store floodwaters and reduce flood heights and velocities that affect downstream lands.

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

Reduce wave damage. Some wetlands and floodplains reduce the force of waves and thereby reduce wave and erosion damage to back lying properties and structures.

Provide erosion control. Many wetlands and floodplains help erosion by reducing water velocities and binding the soil.

Reduce sediment loadings in lakes, reservoirs, streams, estuaries and coastal systems. Many wetlands and floodplains 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 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 may remove pollutants from these waters.

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

Provide groundwater recharge. Some 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 reduce ground water levels, which would otherwise flood basements and cause other problems, by providing groundwater discharge.

Provide habitat for fish, produce fish. Wetlands can provide food chain support, spawning and rearing areas and shelter for fish.

Provide habitat for shellfish, produce shellfish. Wetlands may provide shellfish habitat.

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

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

Provide scenic beauty. Many wetlands and floodplains have aesthetic value. Scenic beauty may enhance real estate values and enhance ecotourism.

Provide recreational opportunities. Many wetlands and floodplains provide paddling, 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 value (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. 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.

SUGGESTED READINGS

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Box 2
Critical Terms

A brief summary of terms includes:

"Functions." Wetland natural processes (determined by both onsite and offsite characteristics).

"Opportunity." The physical relationship of a wetland's good and services to the needs of society. For example, a wetland capable of storing 1000 acre feet of water may have considerable opportunity to reduce flood losses if it is located upstream from a residential subdivision. In contrast, a wetland in a wilderness setting may have a capacity to provide flood storage or remove pollutants, but there may be no downstream flood damage reduction potential at the site because there are (as of yet) no downstream structures. Opportunity is not so easy to evaluate, however, because wetlands which lack present opportunity to provide flood loss reduction or pollution control benefits may have considerable future opportunity if development, pollution or other changes occur in the area.

"Value." The social significance of a wetland in meeting societal needs including public attitudes. In terms of analysis, this requires a step beyond description of goods and services.

"Social significance." Refers generally to the importance of wetlands to people. Assessing social significance requires simultaneous consideration of functions, functional values, opportunity, the impacts and benefits to people who may benefit or suffer costs from the change in a wetland, and people's attitudes. To evaluate social significance, an agency needs to determine (at least in a generalized manner) who benefits and suffers costs from changes in the flood storage, pollution control, recreation opportunities. And, the agency needs to know what this means to affected groups.

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