# Definition of Wetland, Floodplain, Riparian "Functions" and "Values"

**By Jon Kusler**
Association of State Wetland Managers
jon.kusler@aswm.org

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# Defining Wetland "Functions" and "Values": Overview

State and federal wetland regulatory programs typically include an overall goal to prevent net loss of wetland "functions", and "values". See, examples of functions and values in Appendices A and C. However, there is only partial agreement among regulators and other wetland managers concerning the use of these terms. This paper explores the use of the terms "function" and "value" and makes suggestions for future use of these terms.

## Existing Use of the Terms "Functions" and "Values"

The term wetland "function" is broadly used in statutes, regulations, books and reports to mean the potential of a wetland to produce goods and services of value to society like those identified in Appendix A. However, many scientists use the term "function" in a more restricted sense to mean the natural processes which produce such goods and services. The two definitions of function overlap since the ultimate goal of many efforts to assess processes is to estimate the potential of a wetland or floodplain to provide goods and services.

The term "value" has also often been used broadly in wetland and floodplain contexts in a manner similar to the term "function" to denote goods and services important to society such as flood storage, pollution control and wildlife habitat. The term value, however, has not been confined to natural processes alone and has been used to refer to historical, aesthetic and other cultural goods and services as well. The term "value" has been used more specifically in some contexts to suggest monetary "worth" to society or social significance.

"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.

There is broad agreement among wetland, floodplain and riparian managers concerning the overall categories of goods and services provided by wetlands and floodplains and, to a lesser extent, the natural processes producing such goods and services. See Appendices A and C. However, as indicated above, there is less agreement concerning the formal definition of the terms.

In the last two decades, wetland assessment models such as the Hydrogeomorphic (HGM) models and the Indices of Biotic Integrity (IBI) models have principally focused on assessment of wetland processes including the use of indicators or surrogates to imply wetland processes and, ultimately, goods and services. There have also been some important efforts to develop criteria and procedures for measuring "value" including economic value. See, for example, NY Academy of Sciences: "Ecosystem Valuation: A Sequential Decision Support System & Quality Assessment Issues" by R.Kerry Turner, Sian Morse-Jones, and Brendan Fisher (2010). See also Conservation Gateway, The Nature Conservancy et. al, Nature's Values: Ecosystem Services Provided by Wetlands.

## Importance of Definition of "Function" and "Value"

Section 404 Clean Water Act regulations and many state and local regulations require that regulatory permits not result in net loss of wetland "function". Section 404 permit applicants are to minimize (mitigate) project impacts upon functions and compensate for impacts which cannot be minimized. The definition of "function", therefore, determines, to a considerable extent, what is to be protected, mitigated and compensated.

Protecting wetland, floodplain or riparian area natural processes such as denitrification is not the same as protecting the "goods and services" outputs from such processes such as control or reduction of pollution. The later depend not only upon single natural process but upon multiple natural processes and a broad range of additional factors such vegetation, connectivity of the floodplain or wetland with adjacent waters, existing use, and condition.

See Appendix B for examples of such processes and their relevance to goods and services. Assessment of "processes" is usually undertaken with the assumption that assessment of processes will also indicate potential to provide goods and services. This assumption may hold true if the full range of processes are investigated.

Unfortunately, models focusing solely upon processes such as IBI or HGM models usually do not assess the full range of processes necessary to produce goods and services because of the time and expense of assessment. This often results in oversimplification and inaccurate assessment results. Consider, for example, efforts to evaluate the flood storage functions of a floodplain. Because topographical and hydrologic data-gathering is time consuming and expensive, some assessment efforts attempt to evaluate the impact of vegetation on flood storage and largely ignore other factors. But an examination of the vegetation and the "roughness" coefficient provided by vegetation is only one factor relevant to flood storage potential. The depth of the floodplain waters and the size of the floodplain (surface area) are often primary and more important considerations.

What difference does it make whether "functions" are defined as the natural processes producing goods and services or as the goods and services themselves? The use of the term "function" to mean the natural processes producing goods and services rather than the goods and services themselves makes little difference in terms of what ultimately gets assessed, mitigated and compensated if the natural processes investigated are sufficiently broad so that they also act as an accurate predictor of goods and services. Unfortunately this is not true for many assessment models because the models fail to consider many relevant processes and are based upon broad and only partially validated assumptions with regard to the relationships between individual processes and goods and services.

## Dictionary Definitions Not Much Help

Part of the confusion in the use of "function" and "value" has been the multiple dictionary meanings of the terms "function" and "value". Both terms may be used as both nouns and verbs (See Webster, 2nd Edition). For example, a wetland can be said to be characterized by certain on-site "functions" (noun) such as atmospheric gas exchange. A wetland also "functions" (verb) to retard and store flood waters. Similarly, a wetland may be characterized as possessing a

certain "value" (noun) such as an economic value of $10,000 for forestry production. But, members of society may also "value" (verb) a wetland for birding, pollution control, or other purposes.

To further complicate matters, a "function" (noun) such as the storage of flood waters can be (and often has been) characterized as a "value" because it is valuable to society. Conversely, a wetland "value" such as flood water retention may perform certain off-site flood loss reduction "functions" for downstream landowners and society. Confusing enough?

It is not surprising that legislators, the public, agency staff, scientists, and others have used the terms function and value somewhat interchangeably in statutes, regulations, ordinances, articles, books, and newspapers.

It is also not surprising that scientists in developing methods for assessing "functions" or "values" have wished to more precisely define functions For example, the HGM procedural guide (Smith et al., 1995) defines functions as the "normal or characteristic activities that take place in wetland ecosystems or simply the things that wetlands do." Unfortunately, this definition is also ambiguously broad although it is clear from the report as a whole that the authors use the term functions to mean natural processes.

Use of the term function to refer only to natural processes leaves a void in terminology for the combinations of natural processes and other wetland characteristics (size, topography) which make a wetland valuable to society. What are these to be called? The term “function” and “value” are both in common use. A New Hampshire wetland assessment method used the term "functional value" to describe such composite characteristics. Wisconsin uses the term “functional value” in its wetland/water quality regulations. Tennessee uses the term resource value in its water quality regulations. Wyoming Water Quality Standards define “wetland value” to mean “those socially significant attributes of wetlands such as uniqueness, heritage, recreation, aesthetics” and a variety of economic values. The HGM assessment method suggests the term "valuable function" for the goods and services provided by wetland functions (Smith et al., 1995).

## “Function” and “Objective” Fact Finding

One goal of reference-based wetland assessment models over the last decade such as HGM and IBI models has been to reduce subjectivity and the use of professional judgment and replace them with actual measurements in assessment. The methods have done this by omitting consideration of “value” and focusing upon natural processes alone. In addition, models have incorporated the use of “reference” to provide bench marks for evaluating proposed impact reduction and compensation measures.

Federal Section 404 regulators must determine whether a proposed permit application is in the “public interest”. See Appendix B. These methods do reduce subjectivity with regard to assessing some factors relevant to determination of the “public interest”. But they may ignore other factors such as the importance of location in meeting no net loss goals. Providing a thousand acre feet of flood storage in an urban setting may involve the same wetland natural processes as providing a thousand acre feet in a rural setting. But there are large differences in

social significance. Protecting wetland flood storage in an urban setting may prevent flooding for hundreds of houses. In contrast, protecting wetland flood storage in the rural setting may protect few if any buildings at present although it may reduce potential future flood damages.

Whatever definition is used for “function” and “value” at least partial separation of "objective" fact-finding from more subjective determination of societies' preferences is useful. Physical features of wetlands including natural processes and project impacts can be categorized, studied, described, measured and modeled by scientists, engineers and other experts with a fair amount of objectivity. This is also true for proposed compensation measures such as creation and restoration. Separation of objective data-gathering from assessment of more subjective factors in analyzing wetlands can facilitate a "meeting of the minds" between resource agencies, the regulatory agency, and a landowner or his or her consultant. Agreeing on "facts" can be an important step in reaching a later agreement on application of policy.

But the objective "facts" that can be measured in the field are not confined to physical, chemical and biological “processes”. Objective facts relevant to regulatory permitting and detailed planning and analysis include wetland size and width, depth of flooding and a wide range of social or cultural characteristics including impacts of proposed changes in floodplains upon landowners, public infrastructure, and the general public. These facts can be, to a greater or lesser degree, objectively measured and described much like natural processes. They are important to the evaluation of the impact of a proposed activity upon both wetland and floodplain goods and services set forth in statutes and other regulations and the adequacy of various measures to reduce and compensate for impacts to these goods and services. For example, a wetland providing flood storage area may decrease flood heights and resulting damage to existing or potential residential houses by 1 foot, 2 feet, 3 feet, etc. with quite different implications to landowners concerning flood and erosion damages. The critical issue from a manager’s perspective is not only what is happening hydrologically and hydraulically but how this will affect the flooding of downstream, adjacent and upstream landowners.

Separation of objective fact-finding of “functions” from more subjective analysis of “values” or broader “social significance” is desirable as long as the validity of both assessing natural processes and the relevance of the functions produced by these processes to the needs of people are recognized.

## Value Judgments and the Assessment of Function

Process-oriented wetland assessment models such as HGM and IBI models do not evaluate “value”. Nevertheless, value judgments creep into the evaluation processes in a number of ways which are rarely acknowledged. In some instances, professional judgment has been shifted from more obvious to less obvious portions of an assessment process. Value is reflected in process-oriented assessment models in a number of more specific ways:

First, process-oriented models often make a variety of assumptions and simplifications in deciding what processes or elements of processes are to be evaluated and which are not. And, these assumptions and simplifications involve value judgments as to what is most important. As noted previously, regulations for the Clean Water Act Section 404 program (See Appendix B) and similar state programs require regulators to decide whether a proposed activity is in the

"public interest". Regulations require regulatory staff to consider a broad list of factors. See the list of public interest factors in Appendix B. Due to limitations on time and budgets, staff cannot examine all factors with the same amount detail. Deciding what public interest factors are to be examined in detail and which are to be examined more superficially in a particular instance introduces value judgments into in permit by permit decision-making.

Second, many aspects of "mitigation" on an individual permit also involve, in part, value judgments as well as fact-finding pertaining to issues such as: Have impacts of the proposed activity been minimized? Are there practical alternatives? Is off site mitigation to be allowed? Is out of kind mitigation to be allowed?

Third, value judgments creep into the process of selecting "reference" sites in process-oriented assessments. For example, the selection of what wetland characteristics (e.g., vegetation, algae) are to be used in defining reference and what sites are to be considered "reference" sites involve value judgments.

It is inevitable that some measure of value will enter wetland assessment efforts. It is important that the entry points for value judgments be identified not with the goal of eradicating all consideration of value but the goal of reducing subjectivity while giving value its due.

## Conclusions, Recommendations

What are useful future directions for use of the terms "functions" and "values"?

**--It is desirable to clarify in a specific context how the terms "functions", "goods and services", and "values" are used.**

**--It makes sense to use the term "function" in scientific assessment contexts to mean "natural processes".** There is widespread agreement in the wetland scientific community that the term wetland "function" should be applied to wetland natural processes such as denitrification and it makes good sense to continue to use the term "function" in scientific and most other contexts to refer to these natural processes.

**--It makes sense to use the term "goods and services" rather than functions to describe the result of wetland processes in regulatory and other management contexts.** See Appendix A. This is, in general, consistent with existing usage of the term goods and services and the term "function" in many contexts. However, it should be recognized that the term function is used in many existing regulations and policies to mean the result of natural processes and not simply functions and there is nothing conceptually wrong with such usage although this usage may be best phased out over time for clarity and consistency purposes.

It should also be recognized that wetland goods and services are created, in part, by wetland characteristics important to society which are not natural processes per se such as wetland depth and configuration of a wetland which, in combination, create flood storage, results in goods and services. Goods and services also include cultural attributes such as archaeological, historical, archeological, or economic features which are not due to natural processes.

Some overlapping use of the term function to include wetland "goods and services" as well as the processes which create such goods and services is not optimal. But, it is consistent with popular understanding and usages of the term "function. It is consistent with the multiple dictionary definitions of function. It is consistent with wetland regulatory statutes and regulations which define function to include goods and services. In addition, efforts to change the definition of function are likely to meet political resistance. And, there is no alternative term which adequately encompasses the wetland characteristics inherent in the concept of a wetland function.

**--The term wetland "value" may best be used to refer to situations in which wetland goods and services have been or are to be assessed from the perspective of providing monetary or other social welfare benefits to society.** This use of the term value is consistent with general use of the term wetland value--the worth, desirability, and utility of wetlands. Value depends not only on functions but opportunity and social significance. Value includes but is not limited to monetary worth. It includes health and safety and psychological well being. The term "value" is sometimes used in the literature as synonymous with wetland "function" to describe the goods and services wetlands provide. However, use of the term value goes beyond goods and services and involves at least some measure of evaluation of the relationship of these services to the needs of society.

For example, a wetland may provide flood storage services by storing flood waters in a specific context. Evaluation of the magnitude of theses service as related to the needs of society involves the determination of value.

**--It is desirable to at least partially separate objective fact-finding of function from determination of value.** Whatever definition is used for function, **s**eparate evaluation of process-oriented "functions" from more subjective analysis of "values" of wetlands and wetland goods and services is desirable as long as the validity of both assessing natural processes and the relevance of the functions produced by these processes to the needs of people are both recognized.

**--A preliminary assessment of "value" may help identify and assess functions.** A problem federal regulators in the Clean Water Act Section 404 program encounter in conducting a "public interest" review and state regulators encounter in carrying out similar reviews is that it is often impractical to evaluate all natural processes relevant to a proposed permit at a particular site. Wetlands are typically too complicated and dynamic for evaluation of all natural processes at a site, particularly wetland hydrology. Large amounts of data are typically needed to describe all of the characteristics, functions, and combinations of natural processes taking place within a single wetland much less all of the wetlands within a local government or state. Choices must be made in the wetland characteristics which are to be assessed including the functions selected for analysis and the amount of data gathering. Regulators have found that a rapid, preliminary assessment of "value" even if subjective can help guide design of more detailed assessment of "functions". Such a preliminary assessment of value may include consideration of the following:

1. Who will be affected by the project or activity?
2. How many will be affected?
3. How will people be impacted?
4. What weight does society attach to theses interests?

## APPENDIX A
## EXAMPLES OF WETLAND "FUNCTIONS", "GOODS AND SERVICES", "VALUES"

The following list has been drawn from statutes, ordinances, regulations, and the literature. It is a list and brief description of services wetlands provide to society. These services are variously referred to as wetland "goods and services", "functions "functional values", and "values".

**Provide flood storage.** Many wetlands temporarily store flood waters and reduce flood heights and velocities for downstream lands.

**Provide flood conveyance.** Many wetlands act as flood conveyance areas, reducing flood heights and velocities at upstream, adjacent, and downstream sites.

**Reduce wave damage.** Some vegetated wetlands (e.g., mangroves) reduce the force of waves and resulting wave and erosion damage to back lying properties and structures.

**Reduce erosion.** Many vegetated wetland areas help moderate erosion by reducing water velocities, binding soil and contributing to the vertical and lateral stability of stream channels (i.e., associated with dynamic equilibrium)**.**

**Reduce sediment loadings in lakes, reservoirs, streams, estuaries, coastal systems.** Many wetlands reduce the sediment flowing into lakes, streams, and estuaries by intercepting and trapping sediment.

**Provide groundwater recharge.** Some wetlands provide groundwater recharge although most are discharge areas much of the year.

**Provide groundwater discharge.** Some wetlands help maintain the base flow of streams and help to reduce ground water levels (which would otherwise flood basements) by providing groundwater discharge.

**Produce natural crops.** Many floodplains and wetlands produce cranberry, blueberry, saltmarsh hay, aquaculture, wild rice, forestry, and other natural crops.

**Prevent and treat pollution:**

1. **Prevent pollution from entering water bodies.** Virtually all types of vegetated wetlands intercept sediments, nutrients, debris, chemicals, etc. from upland sources before they reach down gradient rivers, streams, lakes, estuaries, oceans, and ground waters.
2. **Treat (remove) pollution in a water body.** Wetlands located in lakes, streams, estuaries, depressions, and at other locations may remove pollutants from waters.

**Provide habitat for fish and shellfish.*** Wetlands adjacent to lakes, streams, estuaries, and oceans can provide food chain support, spawning areas, rearing areas, and shelter for fish. Many estuarine wetlands provide shellfish habitat.

**Provide habitat for amphibians, reptiles, mammals, and insect species.*** Many wetlands provide habitat for a broad range of mammals, reptiles, amphibians, and birds and corridors for migration or movement.

**Provide habitat for song birds and other nongame birds.*** A broad range of wetlands provide habitat for nongame birds important for ecotourism.

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

**Provide habitat for rare, endangered and threatened species.*** Virtually all types of wetlands provide food chain support, feeding, nesting, and substrates for endangered and threatened animals and plants.

**Maintain carbon stores, sequester carbon, and reduce climate change.** Many wetlands and floodplains store carbon in carbon-rich wetland soils, trees and vegetation, reducing climate change. Some continue to sequester carbon from the atmosphere.

**Provide micro-climate modification.** Wetlands and floodplains, particularly those near cities, may reduce temperatures and reduce air pollution levels.

**Provide recreational opportunities and scenic beauty.** Many wetlands provide canoeing, wildlife viewing and other water -based recreational opportunities. Many wetlands also have aesthetic value. Scenic beauty when viewed from a car, a path, a structure, or a boat may enhance real estate values, provide recreation, and provide the basis for ecotourism.

**Provide historical, archaeological, heritage, cultural opportunities.** Some wetlands and floodplains such as the confluence of the Missouri and Mississippi Rivers (Lewis and Clark Expedition) have historical value; others have archaeological value (shell mounds, burial sites).

**Provide educational and interpretive opportunities.** Many wetlands they contain provide education and research opportunities for schools and universities (K-graduate schools) and government agencies

**Provide scientific research opportunities.** Schools, universities, resource agencies, not-for-profit organizations carry out many types of scientific research in wetlands, floodplains, and riparian areas.

*These functions/values can be listed separately or together as "habitat" value. They have been listed separately here because they require somewhat different sorts of assessments.

## APPENDIX B. FACTORS TO BE EXAMINED IN A 404 PUBLIC INTEREST REVIEW

### Section 404 Dredge and Fill Regulations

Regulations adopted by the U.S. Army Corps of Engineers to implement Section 404 of the Clean Water Act set forth a variety of factors which Corps staff are to consider in analyzing proposed permits for dredging or fill activities. The factors listed in the regulation are, to a considerable extent, the end products of natural processes ("goods and services") rather than natural processes per se. Examples of factors which are to be considered which have little to do with natural process include aesthetics, historic properties, land use, navigation, consideration of property owners and, in general, the needs and welfare of the people.

### Factors Considered in a Section 404 "Public Interest Review"

Section 320.4 (a)(l) of the U.S. Army Corps of Engineers Administrative Regulations requires the consideration of the following factors in evaluating a Clean Water Act Section 404 permit. It is to be noted that most are "goods and services", not natural processes per se.

- 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, and, in general, the needs and welfare of the people.

## APPENDIX C: HGM. WETLAND "FUNCTIONS" AS "PROCESSES"

(From Smith et al., 1995. An Approach for Assessing Wetland Functions Using Hydrogeomorphic Classification, Reference Wetlands, and Functional Indices)

| **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.<br>Offsite: Reduce downstream peak discharge and volume and help maintain and improve water quality. |
| Long-Tern Storage of Surface Water: the temporary storage of surface water for long periods. | Onsite: Provide habitat and maintain physical and biogeochemical processes.<br>Offsite: Reduce dissolved and particulate loading and help maintain and improve surface water quality. |
| Storage of Subsurface Water: the storage of subsurface water. | Onsite: Maintain biogeochemical processes.<br>Offsite: Recharge surficial aquifers and maintain baseflow and seasonal flow in streams. |
| Moderation of Groundwater Flow or Discharge: the moderation of groundwater flow or groundwater discharge. | Onsite: Maintain habitat.<br>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<br>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 abiotic and biotic processes. | Onsite: Contributes to nutrient capital or ecosystem.<br>Offsite: Reduced downstream particulate loading helps to maintain or improve surface water quality. |

| **Functions Related to Hydrologic Processes** | **Benefits, Products, and Services Resulting from the Wetland Function** |
|---|---|
| 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 nutrients capital of ecosystem. Contaminants are removed, or rendered innocuous.<br>Offsite: Reduced downstream loading helps to maintain or improve surface water quality. |
| 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.<br>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. | Onsite: Enhances decomposition and mobilization of metals.<br>Offsite: Supports aquatic food webs and downstream biogeochemical processes. |
| **Functions Related to Habitat** | **Benefits, Goods and Services Resulting from the Wetland Function** |
| Maintenance of Plant and Animal Communities: the maintenance of plant and animal community that is characteristic with respect to species composition, abundance, and age structure. | Onsite: Maintain habitat for plants and animals (e.g., endangered species and critical habitats), for rest and agriculture products, and aesthetic, recreational, and educational opportunities.<br>Offsite: Maintain corridors between habitat islands and landscape/regional biodiversity. |