PART 1

RAPID ASSESSMENT METHOD

Hydrogeomorphic (HGM) Assessment Guidebook

for Tidal Wetlands of the Oregon Coast

Coos Watershed Association

OREGON DEPARTMENT OF STATE LANDS

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

OWEB Oregon Watershed Enhancement Board

Oregon Plan for Salmon & Watersheds

Hydrogeomorphic (HGM) Assessment Guidebook for Tidal Wetlands of the Oregon Coast, Part 1: Rapid Assessment Method

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the Coos Watershed Association...

...is a 501(c)(3) non-profit organization whose mission is "to provide a framework to coordinate and implement proven management practices, and test promising new management practices, designed to support environmental integrity and economic stability for communities of the Coos watershed." The Association, founded in 1994, works through a unanimous consensus process to support the goals of the Oregon Plan for Salmon and Watersheds. Our 20 member Executive Council includes representatives from agricultural, small woodland, waterfront industries, fisheries, aquaculture, local government, environmental industrial timberland, and state and Federal land managers.

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Part 1: Rapid Assessment Method

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Summary

This is the first of a five part assessment guide for tidal wetlands of the Oregon Coast. This document presents a method for assigning scores to a tidal wetland based on twelve functions‡ that are (potentially) performed naturally by wetlands. This method also assesses: 1) the potential values‡ of these functions, 2) the indicators‡ of a wetland's biological and geomorphic condition, and 3) the potential risks‡ to a wetland's integrity‡. Intended for use by trained natural resource professionals, this method can generate usable results from a single day-long visit to a wetland.

Development of this rapid assessment method (RAM) complied generally with guidelines for developing regional hydrogeomorphic (HGM)‡ methods as issued by the U.S. Army Corps of Engineers in coordination with other agencies. During this method's development, multiple regional subclasses of the "Tidal Fringe" wetland class were defined, and the candidate indicators of functions were proposed and peer-reviewed in a workshop of regional scientists. Reference data for these indicators were then collected from 120 reference wetlands from the California border north to, but not including, the Columbia River estuary. The reference data were subsequently analyzed to help calibrate the scoring models‡. Perhaps unique among wetland rapid assessment methods, an accompanying spreadsheet applies regression models to specific sites‡ to set more realistic expectations for some variables‡, and to partially distinguish human impacts to wetland integrity‡ from natural influences. The method also introduces the idea of a "certainty index" for indicator and function scores.

This RAM guide allows users to identify which of several functions most distinguish a particular tidal wetland from others of its subclass. Although it is sensitive to differences among different subclasses of tidal wetlands, the method does not allow users to compare different tidal wetland subclasses directly (e.g., high vs. low marsh‡), nor to compare non-tidal wetlands with tidal wetlands (e.g., undiked vs. completely-diked sites). The method is applicable to several resource management needs, including—

- designing and evaluating tidal wetland restoration projects in a consistent, standardized manner
- prioritizing tidal wetlands based on their condition (level of degradation or integrity)—either potential (i.e., risk) or actual
- providing a standardized and transparent procedure for assessing the capacity of a particular wetland to perform several valuable functions (such as when alterations that would require a federal and/or state wetland permit are proposed)

As far as possible, this method should be used in concert with watershed-scale assessments of wetland functions and with more-intensive procedures that monitor individual wetlands over the long term.

Restoration project designers who prefer not to use this RAM may nonetheless find the reference data accompanying the RAM guide useful. **This method is intended to serve as an operational draft and may be revised at future times in response to user feedback and evolving scientific understanding of tidal wetlands.** As of the publication date, this document, the supporting files of field and GIS data, and the spreadsheet needed to compute scores for the rapid assessment method, may be downloaded from: www.oregonstate.edu/~adamusp/HGMtidal . Users should regularly check for updates at this internet location and at the Oregon Department of State Lands (DSL) website: www.oregonstatelands.us .

‡ Terms defined in Glossary are indicated by a ‡ at first usage in text.

For more information about this method and opportunities to be trained in its use, please contact:

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1 Introduction

Purpose and Need

What is a RAM?
A Rapid Assessment Method assigns numbers to specific field observations and then organizes those numbers to quantitatively evaluate particular functions and values.

Tidal wetlands are widely recognized for the services and values they provide to society (Teal 1962, Costanza et al. 1997; also see "Potential functions of tidal marshes of the Oregon coast, and their associated values," page 9). In Oregon, tidal wetlands are valued for their capacity to passively modify runoff before it reaches productive coastal waters, as well as for their key role in supporting salmon and other marine resources (Seliskar & Gallagher 1983, Thom 1982, Good 2000). Yet, not all tidal wetlands are equal: they differ in their intrinsic capacity to provide these vital services and values. They also differ in the degree to which their capacity to function properly has been altered by human activities. Understanding and representing fairly these differences is important to the people whose land includes or borders tidal wetlands, as well as to those who benefit from the values and services these wetlands support. Understanding these differences is also important to agencies responsible for managing human activities in tidal wetlands, as well as to agencies and groups interested in restoring or enhancing their ecological functions. Even among tidal marshes‡ that are relatively pristine, not every marsh performs every function to the same degree or consistently through time. Recognizing this, agencies are increasingly attempting to tailor their wetland management and regulatory decisions to characteristics of individual wetland sites and watersheds. This fine-tuning of wetland management is being done in the context of the overriding national and state policy objectives of achieving "no net loss" (or net gain) of the important functions of America's and the states' wetlands.

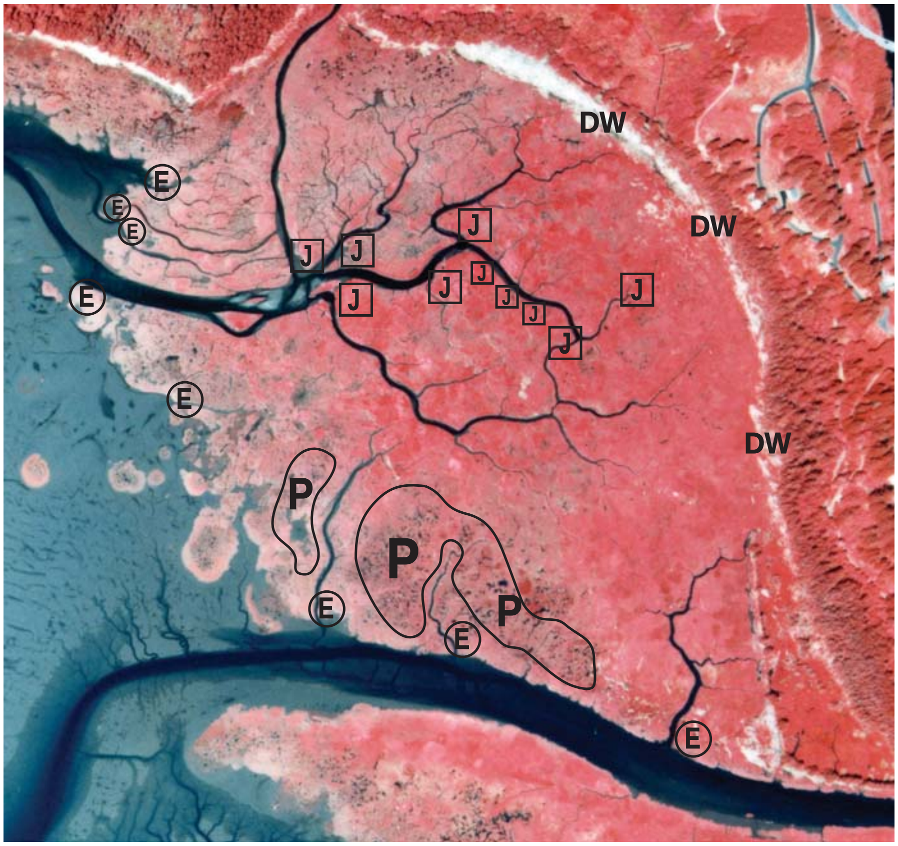


Figure 1. *Aerial infrared photograph of a Nehalem tidal marsh showing geomorphic indicators. The 10 "junctions"(J) measured along the longest interval channel; the 8 "exits"(E) of channels along the external edge‡; complexes of dozens of marsh pannes‡ (P); and a driftwood (DW) line along the upland edge.*

To address the need for distinguishing differences among tidal wetlands, a series of five products has been prepared. Together these products comprise a “Hydrogeomorphic (HGM) Assessment Guidebook” for tidal wetlands of the Oregon Coast—

1. *Rapid Assessment Method for Tidal Wetlands of the Oregon Coast*	A method that may be applied during a single visit to assess indicators of the functions and condition of a particular tidal wetland relative to others of its subclass. Print document with accompanying spreadsheet program CD-ROM.
2. *Science Review and Data Analysis Results for Tidal Wetlands of the Oregon Coast*	A detailed synopsis of literature and data upon which the rapid assessment method is partially based, with emphasis on research from the Pacific Northwest, including statistical analyses of new field data collected for calibrating the rapid assessment method indicated above. Print document.
3. *Wetland Profiles of Oregon’s Coastal Watersheds and Estuaries*	Tabular and narrative summaries and interpretations, by watershed and estuary, of the distribution, properties, and geomorphic settings of wetlands (not just tidal wetlands) as derived from GIS analyses of available spatial data layers. Print document.
4. *Software and Database for Selected Tidal Wetlands of the Oregon Coast*	A CD-ROM containing: a) a spreadsheet that automatically calculates scores for functions and condition, b) a database of raw data collected from 120 tidal wetlands of the Oregon coast, and c) photographs of representative sites on public lands.
5. *Revised Maps of Tidal Wetlands of the Oregon Coast*	A DVD containing refinements of the National Wetlands Inventory maps, specifically: a) increased detail in boundaries of intertidal emergent and intertidal forested wetlands based on enlarged May 2002 color infrared aerial photographs (1:24,000 original scale), field observations, and other data sources; b) labeling of these wetlands to conform with a hydrogeomorphic classification[‡]; c) labeling of some non-tidal wetlands as “Restoration Consideration Area” if they might have geotechnical potential for restoration of tidal circulation; and d) improved depiction of tidal creeks within some wetlands. The DVD also includes spatial data on other themes pertinent to assessing condition and function of Oregon tidal wetlands. Some of this information may also be available at: www.coastalatlas.net or www.coastalatlas.net/metadata/TidalWetlandsofOregonsCoastalWatersheds.Scranton.2004.htm .

The particular rapid assessment method provided by this part of the guidebook is applicable mainly to tidal **marshes**–herbaceous emergent wetlands whose salinity may range from fresh (less than 0.5ppt salt) to saline (up to 35ppt salt, rarely above). It also encompasses shrub‡ and forested wetlands that are occasionally inundated‡ by tides, as well as narrow tidal channels‡ that exist within tidal wetlands. Vegetated wetlands classified as "Palustrine" on National Wetland Inventory maps (Cowardin *et al.* 1979; www.nwi.fws.gov) are included if they are inundated at least monthly. Eelgrass beds are not included, nor are coastal backdune wetlands, even though their underlying water table may sometimes be influenced by tidal variation. Also excluded are other wetlands that are not inundated at least annually by tides, such as most marshes located behind tidegated‡ dikes. Tidal wetlands of the Columbia River estuary are not covered by this method because logistical considerations prevented collecting data from that region as necessary for calibrating the scoring models.

The method is intended partly for use in assessing–in a consistent, standardized manner–the quality of work in projects involving tidal marsh restoration and creation in Oregon. Assessments of the success or failure of restoration and creation projects are needed to justify the financial investment in these projects and to identify ways of improving the success of similar future projects.

Moreover, there is a need for tools to assess tidal wetland condition (i.e., naturalness of a wetland as defined by its water quality, animals, and/or plants) in order to track possible degradation of tidal marshes resulting from gradual urbanization and the cumulative effects of other factors in their watersheds and region. Under Section 401 of the federal Clean Water Act, states and tribes are just as responsible for maintaining the quality and beneficial uses of jurisdictional wetlands as they are for maintaining the quality and designated uses of streams, rivers, lakes, and estuaries.

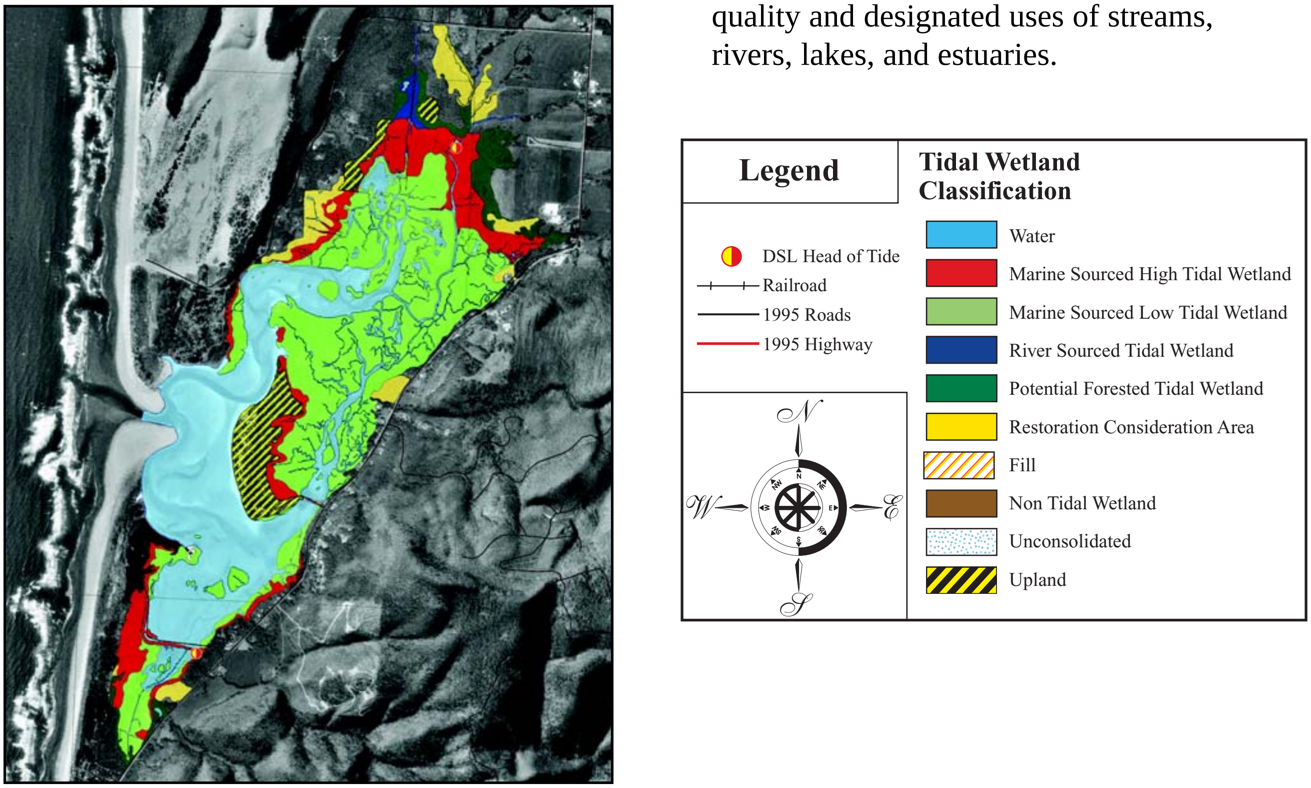


Figure 2. *Example of geodatabase map prepared as part of this HGM project. Such maps were prepared for all estuaries of the Oregon Coast and are available on the accompanying DVD.*

The need to assess wetland **functions**–not just wetland condition or integrity–is mentioned explicitly in numerous laws and policies of state and federal agencies, e.g., December 2002 Regulatory Guidance Letter pertaining to Section 404 of the Federal Clean Water Act, Oregon Removal-Fill Law, and Oregon Watershed Assessment Manual. The capacity of some functions correlates positively with the condition or naturalness of the particular wetland site. Thus, the requirement to assess functions is viewed as generally compatible with the requirement for assessing aquatic life uses (or "wetland integrity") in waters so designated. However, "function capacity[‡]" and "naturalness" should not automatically be assumed to be synonymous. Exceptions to their general correlation are numerous and important. Moreover, the strength of correlation depends strongly on how "naturalness" and "function capacity" are defined and measured. Some ecological goals potentially applicable to Oregon's tidal marshes are shown in "Components of healthy tidal marshes," page 10.

It is hoped that routine use of this guidebook and complementary methods will help Oregon assess the ecological condition for freshwater wetlands (Morlan 2000) and estuarine systems (Good 2000), as highlighted in Oregon's *State of the Environment Report 2000*—

- change in area, diversity, and distribution of wetland types
- changes in hydrologic characteristics
- changes in water quality
- changes in native wetland plant and animal assemblages (e.g., changes due to invasive species)
- degree of connectivity with other aquatic resources and upland[‡] habitats

Increasingly, protocols are being published that describe–often in great detail–a particular researcher's or group's opinion on how best to sample tidal marshes (see Appendix A of Part 2). Some such protocols are designed specifically for monitoring restoration sites. However, many fail to demonstrate specifically *how* the collected data can be manipulated so as to characterize the levels of functions a wetland is performing relative to other wetlands of its type. Consequently, they fail to demonstrate on a site-specific basis how the collected data relate to specific services, values, beneficial uses, and endpoints important to society. Indeed, some data collection protocols claim to be measuring wetland "function" (singular), as if somehow the diverse and sometimes conflicting functions a wetland performs could be unified into one cosmic measure.

This guidebook is not primarily intended to extend our knowledge of tidal wetlands (although some new findings are presented in Parts 2 and 3), but rather to compile, organize, and cross-reference existing knowledge in a manner that focuses it effectively in tools for assessing tidal wetlands of the Oregon Coast. In a national report on wetland mitigation, the National Research Council (2001) highlighted a need for the augmentation of "best professional judgment approaches" with procedures that—

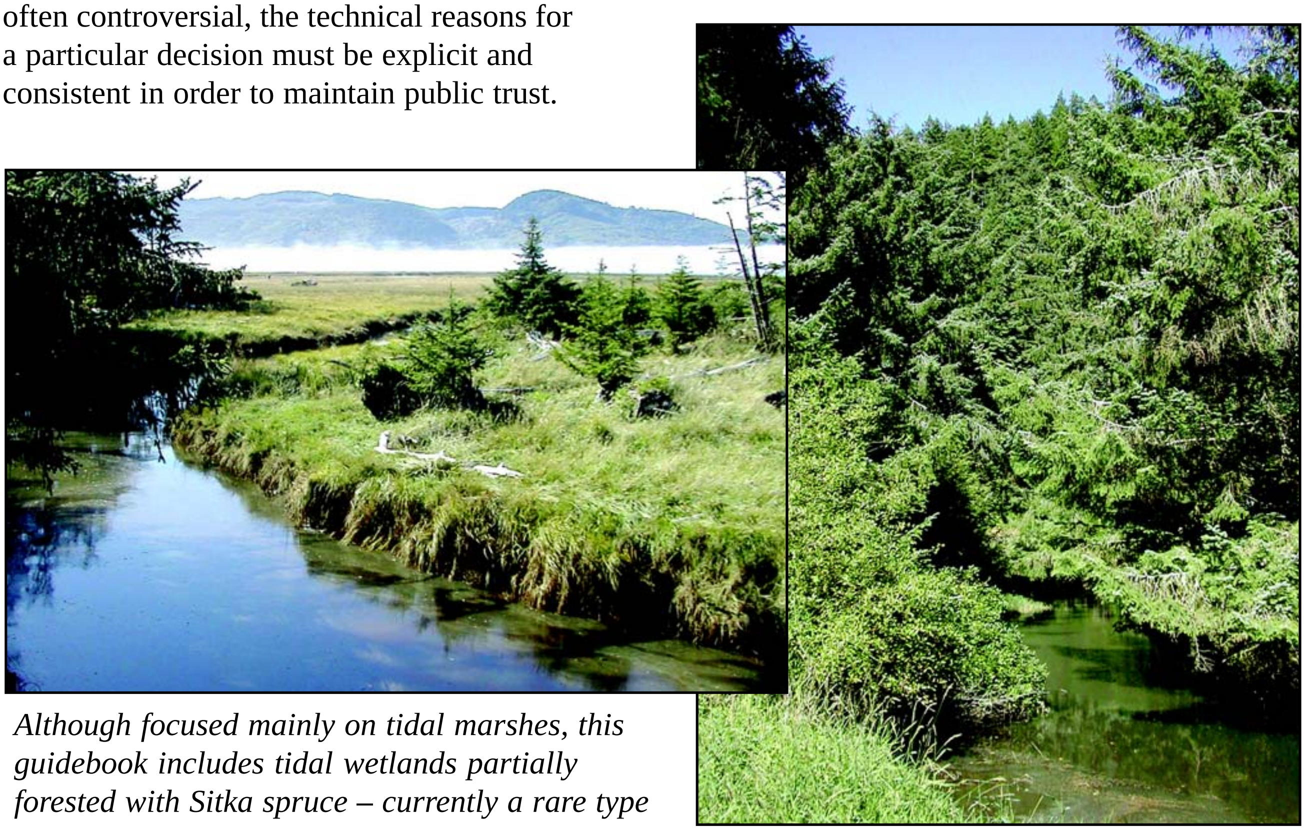
- effectively monitor the attainment of goals of wetland mitigation projects
- assess a full suite of recognized functions
- incorporate effects of wetland position in the landscape
- scale the assessment data to data from a series of reference sites[‡]
- are sensitive and integrative to changes in performance over a dynamic range of space and time
- reliably indicate important wetland processes, or at least, structural indicators of those processes
- generate parametric and dimensioned units, rather than non-parametric rank

This method attempts to address all of the above while still filling the practical need for completing a preliminary site assessment based on a single visit to a wetland site. A single-visit assessment method is needed because the Oregon Department of State Lands (DSL) and the U.S. Army Corps of Engineers, in cooperation with the U.S. Environmental Protection Agency, are required to make hundreds of decisions each year regarding applications to alter Oregon wetlands. Each decision must be made within a limited time period, sometimes with little flexibility to collect data at other seasons. Oftentimes, the severely-limited availability of personnel, time, and funds do not allow the monitoring agencies or parties responsible for these projects to collect more intensive, robust, and process-oriented field data (such as recommended by Zedler & Lindig-Cisneros 2000, Neckles et al. 2002, and others, and as implied by the last of the bulleted items above).

In addition, because wetland decisions are often controversial, the technical reasons for a particular decision must be explicit and consistent in order to maintain public trust.

The method presented in this guidebook is intended to make assessments more explicit and consistent, as well as incorporate the most current and relevant scientific knowledge. Ideally, the method should be used as part of a more comprehensive wetland monitoring strategy.

A need also exists for site-specific assessment methods that address the **values** of functions, not just the capacity of those functions. "Values" are the economic, ecological, and social expressions of a function as a result of context-related **opportunity** to provide the function and the likely **significance** of the function to local and regional users or resources. Values include, but aren't limited to, features that some rapid assessment methods call "red flags," "services," or "value added" features. The method presented in this guide attempts to carefully distinguish values from their functions because any function may have multiple, sometimes conflicting values, and



Although focused mainly on tidal marshes, this guidebook includes tidal wetlands partially forested with Sitka spruce – currently a rare type on the Oregon Coast.

because assessment of values is considerably more subjective and context-dependent than assessment of functions. The consideration of values by this guidebook's method (this document), as well as the data compilations in the third document in this series, represent a response to one of the most frequent criticisms of wetland assessment methods: that they do not sufficiently address the importance of wetlands at landscape, watershed, and regional scales.

This guidebook is intended to be used by wetland specialists for government agencies, natural resource organizations, and consulting companies–people who are skilled in conducting jurisdictional delineations of wetlands. Some basic skills in plant identification are required to address one of this method's 12 functions (Botanical Condition). Users also should be able to recognize features that characterize soils as hydric and delineate drainage area boundaries from a topographic map‡.

Potential functions of tidal marshes of the Oregon coast and their associated values

function	potentially associated values
Produce Aboveground Organic Matter	forage for livestock; supporting biodiversity
Export Aboveground Plant & Animal Production	supporting commercial fisheries & biodiversity
Maintain Element Cycling Rates and Pollutant Processing; Stabilize Sediment	minimizing costs for dredging & shore stabilization, purifying water, supporting commercial fisheries & biodiversity
Maintain Habitat for Native Invertebrates	supporting commercial fisheries & biodiversity
Maintain Habitat for Anadromous Fish	supporting commercial fisheries & biodiversity
Maintain Habitat for Visiting Marine Fish	supporting commercial fisheries & biodiversity
Maintain Habitat for Other Visiting and Resident Fish	supporting commercial fisheries & biodiversity
Maintain Habitat for Nekton-feeding Wildlife	supporting biodiversity & ecotourism
Maintain Habitat for Ducks and Geese	supporting biodiversity & ecotourism
Maintain Habitat for Shorebirds	supporting biodiversity & ecotourism
Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators	supporting biodiversity & ecotourism
Maintain Natural Botanical Conditions	supporting biodiversity & ecotourism

Notes:

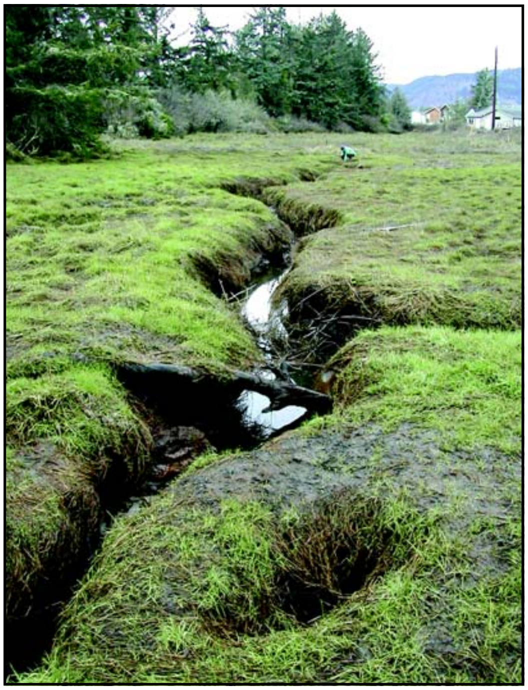
1. Definitions of these functions and discussions of their values are provided in Part 2 of this guidebook.
2. This is not a complete list of functions and values of tidal marshes, but rather a list of functions whose relative capacity may reasonably be assessed across a set of marshes using a set of characteristics (indicators) that can be assessed rapidly with limited technical skills and equipment. The only function not addressed herein, but described in the *National Guidebook for Application of Hydrogeomorphic Assessment to Tidal Fringe Wetlands* (Shafer & Yozzo 1998), is Tidal Surge Attenuation. Also, some functions have been aggregated for the sake of practicality. Accuracy of the assessments is diminished somewhat by aggregating functions, species, or elements, each with slightly different requirements or pathways. If species- or element-specific predictions are needed, users should refer to other assessment methods and models.

Components of healthy tidal marshes

(a.k.a.: "good quality," "intact," "functionally equivalent," "mature," etc.)

A "healthy" tidal marsh …

- …is **inundated at a tidal** frequency, duration, season, magnitude, and extent that is characteristic for the site's elevation and position in the estuary.



Deeply-incised channels are characteristic of many Oregon tidal marshes and provide a cool, sheltered microhabitat for foraging fish.

- …exhibits **salinity regimes and experiences freshwater inputs** in spatial and temporal patterns that are seasonally and diurnally appropriate for the site's vertical and horizontal position in the estuary.
- …exhibits **erosional/depositional regimes** and has sediment particle size distributions that are appropriate for the site's position in the estuary and watershed geology/soils.
- …exhibits a **channel cross-section and morphological complexity**, and/or a shoreline slope and complexity, that is appropriate, at multiple scales, for the age of the site and its geologic/hydrologic setting.
- …receives sustained inputs of characteristic quantities, sizes, and decay classes of **large woody debris**.
- …receives **inputs of** nitrogen, phosphorus, and other **naturally-occurring elements** in forms and seasonal patterns that are appropriate for the site's landscape setting, and converts these inputs between inorganic and organic forms (and gaseous forms, for N and C) at rates appropriate for the age of the site and its elevation, substrate, exposure, and salinity.
- …exhibits levels and decomposition rates of **soil organic matter and dissolved oxygen** that are appropriate for the age of the site and its elevation, substrate, exposure, temperature, and salinity.
- …exhibits a resilient assemblage of **native wetland-associated plants** whose species composition, diversity (structural, functional, and taxonomic), percent-cover, productivity, and patch heterogeneity/zonation are appropriate for the age of the site and its elevation, substrate, exposure, and salinity.
- …exhibits a resilient assemblage of **native wetland-associated vertebrates and invertebrates** whose species composition, diversity (both taxonomic and functional), density, tissue contaminant levels, production, and health are appropriate for the age of the site and its elevation, substrate, exposure, and salinity.
- …is **located within characteristic distances** of other tidal marshes and other important estuarine habitats such as native eelgrass beds and freshwater seeps.

Large stable logs provide an elevated surface where relatively salt-sensitive woody plants can germinate and grow in tidal marshes.

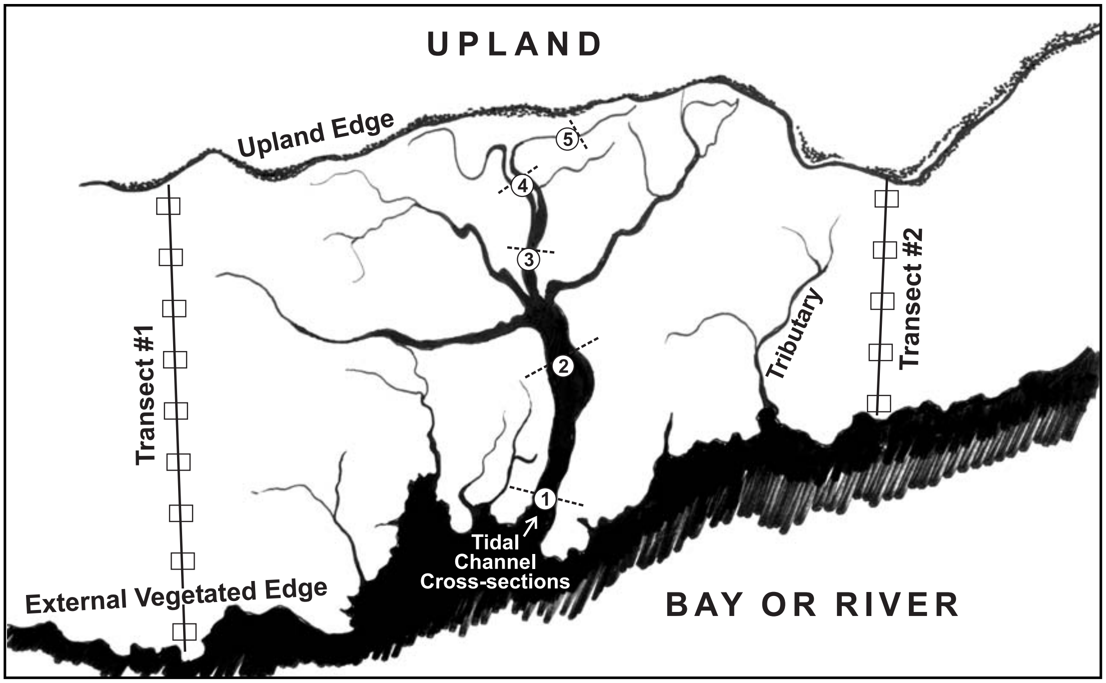


Figure 3. *Idealized depiction of the configuration of transects, quadrats, and channel cross-sections used to survey 120 Oregon tidal marshes.*

Background: the HGM Approach for Assessing Wetland Functions

Oregon is not unique in attempting to develop methods for rapidly assessing the functions or condition of tidal wetlands. In the early 1990s, the federal agency responsible for issuing permits for wetland alteration, the U.S. Army Corps of Engineers, announced a "National Action Plan" (Federal Register 62(119):33607; www.epa.gov/OWOW/wetlands/science/hgm.html) to develop improved methods for representing the functions of all wetlands. The new assessment methods would be developed region-by-region and be organized around hydrogeomorphic (HGM) principles for wetland classification. The methods would feature scoring models that would attempt to represent the relative capacity of a particular wetland to provide each of several functions, as rated on a scale of 0 (low capacity) to 1 (high capacity). The model scales would be calibrated using data collected from regional reference sites. This approach was viewed as a more sophisticated and improved alternative to approaches based simply on wetland location or type, or on the typically-recommended but problematic approach of comparing a particular mitigation wetland with merely a single reference ("control") site, e.g., Mitchell 1981, Neckles et al. 2002.

The national initiative began with publication of a nationwide scheme for HGM classification (Brinson 1993), and broad guidance for developing regional HGM-based assessment methods (Smith 1983, Smith et al. 1995, Smith et al. 2001). Subsequently, "HGM projects" were initiated in over a dozen states, largely with funding from the USEPA. Guidebooks from some of these efforts are now available, including ones for assessing functions of tidal wetlands in other regions (Shafer and Yozzo 1998, Shafer et al. 2002).

In 1997 Oregon's Department of State Lands, after meeting with other agencies and acting upon a key recommendation of a report (*Recommendations for a Nonregulatory*

Wetland Restoration Program for Oregon, Good & Sawyer 1998), proposed that Oregon also begin developing HGM methods and guidebooks appropriate for various regions of Oregon. A statewide HGM framework describing Oregon's wetland types, their functions, and potential indicators of these functions was developed (Adamus 2001b).

From 1998 to 2000, Oregon's first effort to develop HGM methods focused on two types of wetlands common in the Willamette Valley (Adamus and Field 2001, Adamus 2001a). Field data were collected from 109 wetlands belonging to these types and the first regional guidebook for Oregon was published. Subsequently, regulatory staffs of the U.S. Army Corps of Engineers (Portland District), Oregon Department of State Lands (DSL), various other agencies, and consulting firms received training in the Willamette Valley HGM method. In January 2003, DSL adopted rule revisions to the Removal-Fill Law which require that applicants for wetland Removal-Fill permits indicate the HGM subclass‡ to which the impacted and proposed mitigation wetland belong. Oregon's HGM guidebook for the Willamette Valley ecoregion‡ provided peer-reviewed, calibrated models for assessing wetland functions in the Willamette Valley, as well as an extensive reference data set for potential use in developing performance standards for wetland restoration projects there. DSL's administrative rules currently encourage use of these products for assessing wetland functions in the context of permit decisions in the Willamette Valley. However, no such models of wetland functions (or region-wide reference data sets that pertain to wetland functions) were produced for other Oregon regions and wetland types.

Both erosion and deposition are naturally-occurring processes in tidal marshes.

The project that is the focus of this guidebook has attempted to fill that need for tidal wetlands of the Oregon coast. Using the terminology of EPA's national monitoring strategy for wetlands, the method presented herein may be considered a "Tier 2" method[1]. No rapid methods are available for assessing tidal wetlands in neighboring Washington, but California has recently drafted a method, California Rapid Assessment Method, or CRAM (Collins et al. 2004), that includes an assessment component for estuarine wetlands. As presented in this guidebook, Oregon's rapid method for tidal wetlands has some structural similarities to CRAM and similarly was calibrated using a large reference set of field data. It differs from CRAM partly in that it explicitly assesses individual functions as well as wetland condition, and uses a more diverse array of indicators in order to enhance its sensitivity to differences among individual wetlands. Also, the Oregon Watershed Enhancement Board, in concert with the Oregon Department of Land Conservation and Development, has recently supported revision of parts of the Oregon Watershed Assessment Manual that deal with estuaries and tidal wetland restoration (Brophy 2005). That document provides a field-based approach for identifying (but not assessing functions of) wetlands that formerly were tidal and which might have potential for restoration of their tidal circulation. It uses landscape-scale tools to provide broad guidance for estuary-wide decision making, integrating concepts of biogeography, landscape ecology, and land use history to focus on historical and current connectivity between tidal flows, wetlands, and stream networks.

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[1] "Tier 1" involves measurement at broad spatial scales, e.g., use of GIS to describe wetland distribution at a watershed scale. "Tier 2" involves design, testing, and application of methods for rapidly estimating wetland condition and functions at a site-specific scale. "Tier 3" involves detailed, direct measurements of wetland processes and structure, e.g., sampling of wetland invertebrates.

2 The HGM Rapid Assessment Method

In brief, this method has three sequential components—

1) **recording** field observations on standardized data sheets (offered in Appendix A1)
2) **entering** the calculated numeric scores (with a measure of relative certainty) into a specially designed Excel™ spreadsheet
3) **employing** the spreadsheet to derive numbers that represent the relative level of function of the wetland assessed

A variety of equipment was used to access and survey the 120 tidal marshes.

How to Use the HGM Rapid Assessment Method

This method uses separate data forms to assess functions, values, and risks to wetland integrity. Begin by copying the data forms (Appendix A1; use Appendix A2 only if you wish to assess values as well). After filling these out while visiting a wetland, you must enter the data in the *Software and Database for Selected Tidal Wetlands of the Oregon Coast* Excel™ spreadsheet. The spreadsheet automatically calculates scores for individual functions and other attributes. Data entry normally takes no more than one hour per wetland. Using the method is straightforward:

1. **Confirm wetland status.** First, be sure the site you're assessing currently meets federal and state technical criteria for being a wetland **at this time**. Also be sure the wetland you're assessing is a **tidal** wetland. That is, most of the site must be flooded by tides (either fresh or saltwater) at least once a year and must meet jurisdictional criteria for being a wetland.
2. **Delimit the site.** Delimit the "assessment unit‡" (wetland site) boundaries following the guidance in Classifying the Wetland, below. In some instances these boundaries may be more restricted than boundaries determined as part of a regulatory wetland delineation.
3. **Gather existing information.** Assemble existing information most relevant to the wetland site. This may include—
    - map of the site's location in the context of its estuary
    - polygon boundaries of the wetland as shown in the accompanying DVD or on National Wetlands Inventory (NWI) map server: http://wetlandsfws.er.usgs.gov/NWI/index.html
    - county soil survey maps (available at NRCS offices, libraries, and online at: www.or.nrcs.usda.gov/pnw_soil/or_data.html)
    - aerial photographs (available at offices of some state and federal resource agencies, university libraries, and from private vendors)
    - discussions with local residents and resource agency staff
    - data from other investigators and resource agencies
4. **Visit the site.** Visit the site at least once for a 6-hour period. If you can visit it only once and have flexibility in scheduling a date, visit it on or near the day of the month when high tides are highest (spring tide‡). During the visit, observe conditions described on the field forms. Walk as much of the site as is necessary to make the specified observations with reasonable certainty. If one repeat visit is feasible, schedule it for the month's lowest tide. If a third visit is possible but not urgent, schedule it for the highest tide of the year. Assessment by a multidisciplinary team is encouraged but not required. Prior training in the use of this method also is encouraged but not required at this time. For such scheduled training, contact the Department of State Lands or check on the Internet at: http://epp.esr.pdx.edu/calendar.html.
5. **Fill out the data sheets.** While in the field, use your observations and best judgment to fill out the forms completely, e.g., putting an appropriate number in every box marked "score" and "certainty." Be sure to read any explanatory notes in the last column of each form, and refer to the Glossary (Appendix D) if necessary. Supplement your field observations using the resources in #3 as necessary. If you decide to assess the function called "Maintain Natural Botanical Conditions," be sure to follow the protocol described in "Protocol for assessing botanical indicators shown on Data Form A2" (below) and Figure 3 (page 11).
6. **Transfer data to Excel™.** Transfer the data from your field forms to matching parts of the Excel™ spreadsheet (TidalWet_Assess.xls) contained on the CD. For the most recent version of the spreadsheet and this guidebook, visit: www.oregonstate.edu/~adamusp/HGMtidal .
8. **Print the results.** After all data have been entered, print the resulting scores for the site's functions, values, and/or ecological risk. These were calculated automatically by the Excel™ program. If you prefer not to use the spreadsheet, you may calculate some of the summary scores using a pocket calculator, inserting data from your field forms into the formulas (scoring models) shown in

Appendix C, taking careful note of the mathematical order of operations in each formula. One exception is the function, "Maintain Natural Botanical Conditions," which must be calculated using the spreadsheet.

9. **Interpret the results.** Interpret the results, partly by comparing your scores with those for other Oregon tidal wetlands of the same subclass (shown in Part 2).

10. **Annotate the results.** Write a short site description as an addition to your site data sheets, discussing any unusual conditions present at the time of your visit. Note other factors important to functions that might not be apparent from the scores generated by this rapid assessment method. Describe in words the Values component of the assessment, if you chose to do that as well. Note that the Values assessment does not have scoring models associated with it.

Protocol for assessing botanical indicators shown on Data Form A2.

Dozens of protocols have been proposed for surveying vegetation, and the choice of any particular one will depend on the objectives of the project. The following protocol features square-meter quadrats‡ placed along marsh transects. It is intended for use specifically for the objectives of this guidebook, and is required so data from future assessments using this guidebook's method may be compared with reference data that were collected using the same protocol during guidebook development. If possible, vegetation data should be collected sometime during May–August.

1. In most instances, establish two parallel transects per wetland (Figure 3). One end of each transect should be at a point containing wetland vegetation that is nearest the adjoining unvegetated bay or river; the other end should be at the approximate upper annual limit of tidal inundation (i.e., "upland"), as usually indicated by the tree line or driftwood line. If the wetland occupies all of an island with no upland, extend each transect the width of the island (if feasible). Transects should be relatively straight, but precise alignment is not essential.

2. Situate the two transects near the widest part of the wetland. Situate them to minimize or avoid crossing major channels and non-wetland spots (dikes, fills) within the wetland. Avoid placing the transects within 2m of each other; much wider spacing (at least 10m) is preferred if logistically possible. Do not try to "aim" the transects to intercept particular plant communities or attempt to make the transects "representative" of the wetland. Random placement, while desirable statistically, often presents logistical headaches and is relatively meaningless given the limited replication (of only two transects).

3. In exactly 20 quadrats (square plots), each 1m x 1m, identify and estimate relative coverage (by percent) of each plant species. Each of the two transects should contain 10 quadrats, spaced equidistantly along the transect beginning at the vegetated transition from unvegetated bay/river. However, if it becomes evident that less than 20% of a quadrat is vegetated, move to the left or right of the transect until a spot is found where this criterion is met. (The botanical protocol in this guidebook is not intended to assess extent of unvegetated area in a wetland; that is addressed only by indicator #28.)

4. In narrow marshes, the use of only two short transects could result in quadrats along each transect being closer than 2m to each other. To avoid this, deploy additional transects perpendicular to the bay or river until at least the 2m spacing is established between quadrats as well as between transects. In rare instances, it may also be necessary to change transect orientation from perpendicular to oblique.

Classifying the Wetland

The national guidebook for HGM assessment of tidal fringe wetlands (Shafer & Yozzo 1998) does not define any subclasses of the national tidal fringe class, nor does its regional version for the Gulf of Mexico (Shafer et al. 2002). Nonetheless, this Oregon guidebook recognizes three hydrogeomorphic subclasses of tidal fringe wetlands—

- Marine-sourced Low Marsh, sometimes called simply "low marsh"
- Marine-sourced High Marsh‡, sometimes called simply "high marsh"
- River-sourced Tidal Wetland

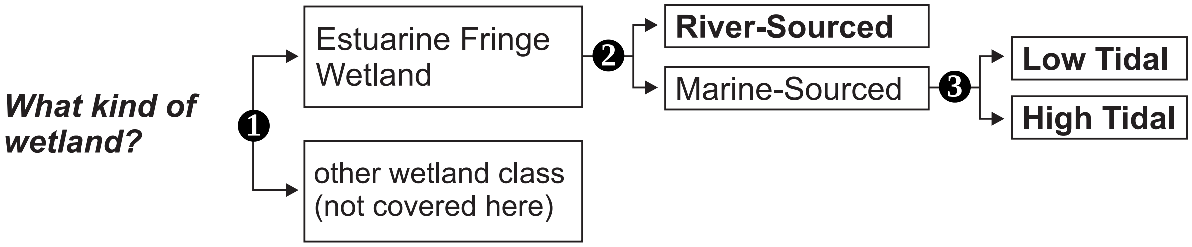
Portions of wetlands flooded at least once annually by spring high tides are considered tidal wetlands in this guidebook.

These are defined using the key below. For most purposes, tidal wetlands should be assigned to an HGM subclass based on their *present* condition, not what is documented, believed, or imagined to have existed historically. The classification of each Oregon tidal wetland polygon with regard to these three subclasses is labeled provisionally on the digital maps accompanying this document. However, the maps provide only a coarse rendition of subclass boundaries and were not comprehensively field-verified.

This guide may be used for assessing both herbaceous (emergent marsh) and wooded (scrub-shrub, forested) tidal wetlands. However, note that throughout this guide, the terms "tidal marsh" and "tidal wetland" are used interchangeably to denote both herbaceous and wooded tidal wetlands; those terms do not include tidal aquatic-bed wetlands, such as eelgrass beds (habitats that aren't covered by this guide). Also note that the nouns "variable" and "indicator" are used interchangeably.

In summary, this method allows you to quickly assign an HGM subclass to many, but not all, tidal wetlands. Although it is impossible to assign a particular wetland to a specific tidal fringe subclass quickly and unequivocally, this method is expected to be flexible enough to accommodate this uncertainty. Assigning a tidal wetland *a priori* to one of the three HGM tidal fringe subclasses is not required by this method, but attempting to do so will help clarify your understanding of the wetland and its functions.

Dichotomous Key to subclasses of tidal wetlands of the Oregon Coast



1. Tidal forces cause the wetland to be flooded with surface water at least once annually, during most years. Excluded are wetlands whose water level or soil saturation may be influenced by tidal fluctuations but which lack a regular (at least annual) surface connection to tidal waters. Plant species that typically characterize upland habitats are absent or nearly so, and some wetland species that are present may be characteristically tolerant of brackish as well as fresh salinity conditions. Channels, if present, are often narrow, winding, or branched, and may be deeply incised as a result of tidal action. Regardless of the wetland's salinity, it is located downriver from the recognized head-of-tide[2] of its associated estuary. Drift logs and growth of trees‡ and moss often mark the upper boundary of annual flooding, particularly in the transition to non-tidal wetland or upland.

YES: *Estuarine Fringe Wetland HGM Class; go to #2.*
NO: *Other wetland classes; this guidebook is not applicable.*

2. Tidal forces cause the wetland to be flooded at least once annually with saline or brackish surface water originating partly or wholly from the ocean. Often located within or along the fringes of a major estuarine embayment or a slough off the embayment. Typically located within zones classified as "Marine" or "Brackish" on maps published by Hamilton (1984), the National Estuarine Inventory (1985, NOAA 1985; http://spo.nos.noaa.gov/projects/cads), and/or as "Estuarine" on National Wetlands Inventory maps (http://wetlandsfws.er.usgs.gov/NWI/index.html). The wetland and/or its immediate receiving waters may have one or more of the following indicators suggestive of marine water: barnacles, seaweed wrack‡, salt marsh‡ plant species (halophytes such as *Salicornia*, *Triglochin*, *Distichlis*, *Plantago maritima*), springtide‡ minimum salinities of >5 ppt, or a preponderance (in adjacent flats) of rounded sediment particles indicative of marine-derived sediments.

YES: *Marine-sourced Fringe Wetland; go to #3.*
NO: ***River-sourced Tidal Fringe Wetland** (RS).*

3. All of the wetland is inundated at high tide‡ at least once during the *majority of days during each month of the year.* This may be indicated by a combination of direct observation of tidal inundation, predominance‡ of plant species characteristic of "low marsh" marine environments in Oregon, absence of woody plants, and/or by reference to data on local tidal range‡ paired with precise measurements of elevation and tidal fluctuations relative to an established geodetic benchmark. Less definitively, a boundary between low and high marsh may be evidenced by a vertical break in the marsh surface or by accumulations of fresh wrack [seaweed, plant litter].

YES: ***Marine-sourced Low Tidal Fringe Wetland** (MSL)‡,* commonly called "low marsh."
NO: ***Marine-sourced High Tidal Fringe Wetland** (MSH)‡,* commonly called "high marsh."

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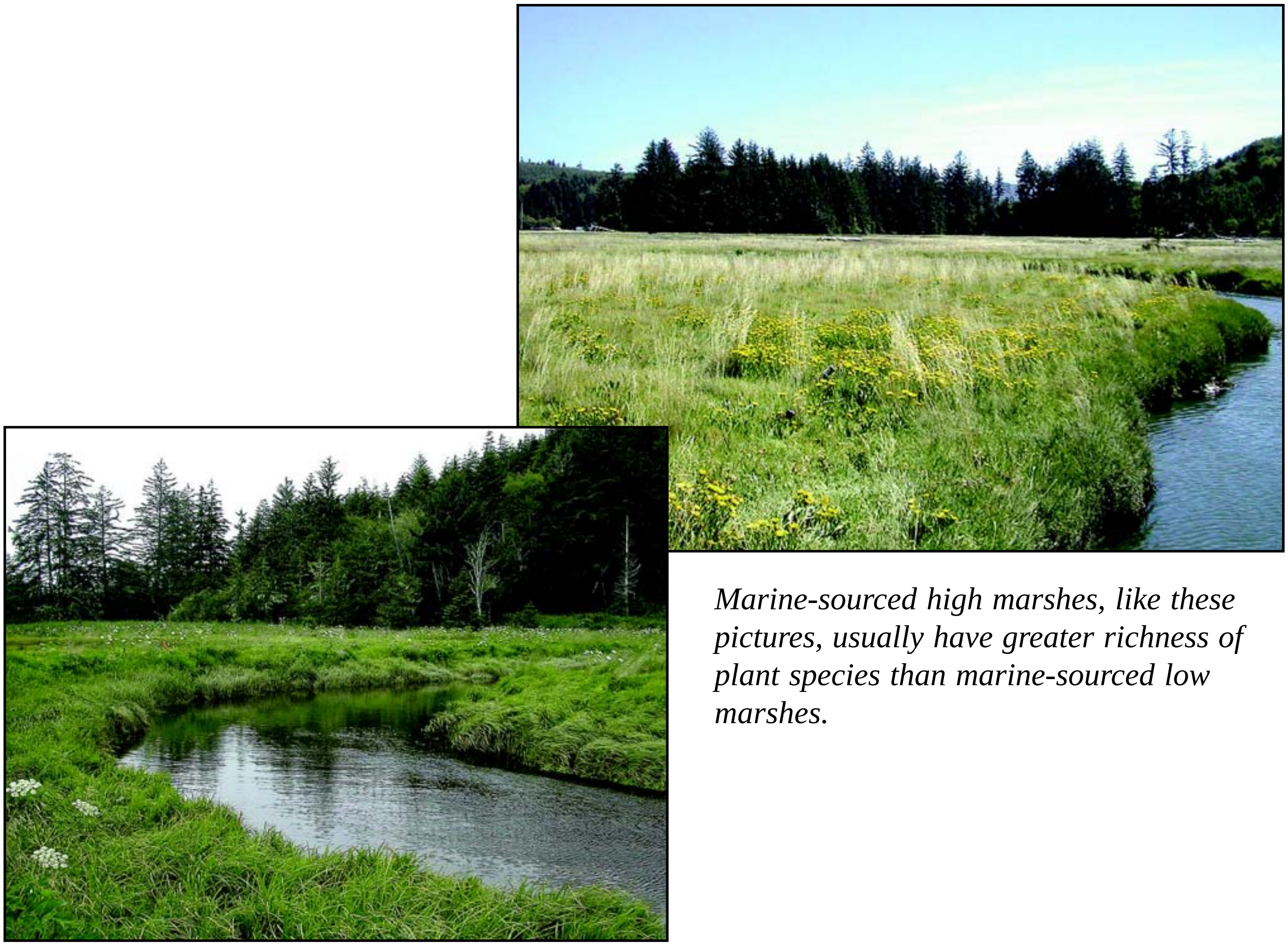
[2] Locations of major heads of tide are shown on the accompanying DVD, or are available from the Department of State Lands.



Marine-sourced high marshes, like these pictures, usually have greater richness of plant species than marine-sourced low marshes.

Marine-sourced low and high marshes on sandy substrates often have assemblages of plant species that differ from those in finer-substrate marshes.

Delimiting the Assessment Units

The area assessed is termed the "assessment unit" (or "wetland site"). Normally you should sketch at least a rough version of the assessment unit on a map or aerial photograph before you visit the site. For larger wetlands, marking of "waypoints" along wetland boundaries using a handheld GPS can expedite mapping and improve its accuracy. For purposes of using this method, it is not necessary to delineate the wetland boundary with the high level of precision customary for jurisdictional determinations.

Where you draw the boundaries of the assessment unit(s) will influence the resulting scores. When assessing activities that affect only **part of a wetland,** you may assess and score separately at least two spatial units. In all cases, one of the units you assess *must* be the entire tidal wetland. This should include both low and high marsh (when both are present), as well as internal tidal channels‡; it should never include any adjoining non-tidal marsh. The other spatial unit, if desired, may be either (a) the portion of the wetland where construction or vegetation management has been proposed, or (b) spatial units within the wetland based on their functionally-distinct HGM subclass (e.g., high vs. low marsh). Using the latter (subclass-based units) may be particularly helpful if one of those subclasses comprises more than 20% of the total wetland polygon. However, be aware that results for (a) and (b) are likely to be less accurate than for the first type of assessment unit because the first type method was based on data collected in whole-wetland units.

River-sourced tidal wetlands often occur as a narrow fringe with sharp transitions among vegetation assemblages.

The "default" boundaries you use for assessing the **entire wetland** should be the polygon boundaries of that wetland shown in the accompanying DVD. However, adjoining or nearly-adjoining polygons should be considered distinct wetlands whenever appearing to be separated from each other by—

- a road or dike (even if it contains bridges, culverts, or tidegates), *or*
- upland, tideflat, rocky shore, or unvegetated water wider than about 100 feet, *or*
- patches of salt-intolerant vegetation wider than 100 feet (e.g., dunegrass, freshwater marsh plants)

Boundaries of the entire assessment unit should never be based *solely* on property lines, fence lines, mapped soil series, vegetation associations, elevation zones, or land use designations.

Usually the boundary between tidal marsh and upland is clearly evidenced by a topographic break, driftwood line, and/or shift from predominantly‡ herbaceous to woody vegetation. However, in the upper parts of estuaries the spatial boundary between tidal wetlands (covered by this guidebook) and non-tidal wetlands (not covered by this guidebook) is often extremely difficult to delimit. Such identification relies upon being able to define a line between areas flooded more than once a year and those flooded less than once a year. When flooding appears to occur more than once annually, you will need to determine whether daily tidal fluctuations had any role in that flooding, either directly or by "backing up" a river that otherwise flows unimpeded into its estuary. Salinity alone cannot be used as a criterion, not only because of its extreme temporal variability, but also because many tidally-influenced wetlands register no salinity, especially during times of peak flooding. Similarly, vegetation cannot be used alone because many woody plants (e.g., Sitka spruce, red alder) tolerate tidal flooding provided salinity is not extreme. There are no salt-intolerant (freshwater) plants that occur *only* in tidal situations and would therefore be useful indicators. Although driftwood found in a riverine wetland might have been brought in by tides, it also could have been carried into the wetland solely by river flooding.

Accumulations of driftwood along the edge between tidal wetlands and uplands may mark the upland edge of the assessment unit; driftwood provides cover for small mammals and insects.

The optional process for assigning boundaries to **subunits** within the large wetland polygon can be equally challenging and is sometimes arbitrary. If based on the tidal HGM subclasses, the boundaries will be defined by the line between low marsh areas (inundated by tides at least once daily during the majority of the days in each month of the year), and high marsh areas (flooded by tides less often). Often there is no clear separation line and these HGM subclasses are discontinuous within a wetland. That is, within a larger wetland polygon, "islands" or zones of high marsh or upland may be interspersed amid areas of extensive low marsh, and vice-versa. In the usual case, where no data are available describing tidal frequency at various points (elevations) within a marsh, subunits will need to be based on prevailing plant species. If you've surveyed marsh vegetation using the protocol prescribed on page 16 of this guidebook, the determination of high vs. low marsh can be made generally using the five indices calculated by the spreadsheet accompanying this guidebook: the species wetness index, and the percent-cover and frequency indices for salt-tolerant and salt-intolerant species. However, no thresholds have been determined for using these or other indices to clearly distinguish high marsh from low marsh. Such thresholds would undoubtedly be influenced by factors such as substrate type and local climate. Uncommonly, visible breaks in marsh topography can provide clues for distinguishing high marsh from low marsh. Encrustations of sand or barnacles on older driftwood suggest marine origin and support the likelihood the wetland is marine-sourced.

Although the rapid method provided in this guidebook can be applied at multiple scales (entire wetland, plus subunit within based on proposed activity or HGM subclass), the scores it yields are expected to be much more accurate for the entire wetland. That is because of the considerable subjectivity involved in defining boundaries of any subunits and because field data used to calibrate this method were collected at the scale of the entire wetland, not smaller subunits. Thus, this method is expected to be less reliable when comparing high vs. low marsh subunits within a marsh, or when comparing different vegetation communities or development parcels within a marsh. As noted by authors of the HGM guidebook for tidal wetlands of the Gulf of Mexico (Shafer et al. 2002), “Since many of the model variables focus on geomorphological or landscape characteristics, separation of wetland subclasses based on elevation and salinity did not seem justified.”

Nonetheless, this method is not blind to important distinctions between high and low marsh in scoring individual indicators of marsh function. Where supported by the field data, scales for scoring the botanical indicators took into account HGM subclass of the assessed unit. This was done by using the species wetness index and other indices (all presumed to indicate the HGM subclass) to statistically adjust the botanical scales. Likewise, the scoring scale for channel cross-sectional morphology took into account the relative location of the cross-section within the marsh.

Description of Data Forms

This method includes five data forms corresponding to its three major themes—

Data Form A1. Rapid Indicators of Risks to Integrity and Sustainability of Tidal Wetlands

Data Form A2. Direct Indicators of Wetland Integrity That Require More-intensive Field Work

Data Form B1. Rapid Indicators of Function That May Be Estimated

Data Form B2. Rapid Indicators of Function Requiring Aerial Photographs or Measuring Equipment

Data Form C. Rapid Indicators of the Values of Functions

Data Form D. Vegetation Quadrat Data Form

The first four data forms each have four columns regarding each indicator—

1) identifier number and code for the indicator
2) description of the indicator with numeric values
3) score boxes for the indicator and certainty estimate, sometimes with intermediate scale to translate raw numeric values
4) guidance for interpreting the indicator

The fifth data form has three columns for each value—

1) description of characteristics exemplifying the *highest* value of that function
2) your score
3) description of characteristics exemplifying the *lowest* value of that function

The bottom of each row in the Guidance column contains abbreviations indicating the functions or other attribute that row's indicator is associated with. The function codes are:

Function abbreviations used in this document	description
Afish	Maintain Habitat for Anadromous Fish
AProd	Produce Aboveground Organic Matter
BotC	Maintain Natural Botanical Conditions
Dux	Maintain Habitat for Ducks and Geese
Inv	Maintain Habitat for Native Invertebrates
LbirdM	Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators
Mfish	Maintain Habitat for Visiting Marine Fish
NFW	Maintain Habitat for Nekton-feeding Birds
RA	Assessment of Risks to Wetland Integrity & Sustainability
Rfish	Maintain Habitat for Other Visiting and Resident Fish
Sbird	Maintain Habitat for Shorebirds
WI	Wetland Integrity
WQ	Maintain Element Cycling Rates and Pollutant Processing; Stabilize Sediment
Xpt	Export Aboveground Plant & Animal Production

Forested upland areas help protect tidal wetlands from extreme temperatures, erratic runoff regimes, and invasive plants.

Brackets around these codes in the last column of data forms A1, A2, B1, B2 denote that the indicator is not associated with the function directly, but is associated indirectly with another function through which it is assessed. Part 2 of this guidebook defines and documents each of these functions, and gives the reasons each indicator in Data Forms A1, A2, B1, and B2 was used, i.e., documents its linkage to one or more functions.

Each indicator row has a box in which, optionally, you may enter a numeric estimate (as a decimal from 0 to 1) for scoring **certainty**. Factors to consider when assigning a certainty score might include ones shown in "Considerations in assigning a certainly score to your site-specific assessment," below. This guidance for scoring certainty is provided to minimize the role of user personality, and maximize the consideration of more objective factors, in scoring the certainty for a specified indicator. The certainty scores do not reflect overall scientific uncertainty underlying the use of each indicator, but rather the certainty of the user applying this method to a specific wetland site. The certainty scores should not be combined mathematically with scores for functions, risk, condition, or value. The uncertainty scores are intended to give an overall sense of the relative strength of the other reported scores. They also should be used to help prioritize collection of additional data as needed to strengthen the results of a particular assessment.

Considerations in assigning a certainty score to your site-specific assessment

consideration	low certainty (= 0)	high certainty (= 1.0)
How much of the site were you able to view?	little, from a distance	all of the site, covering all of it on foot
How many visits were you able to make—and for how long?	one visit, less than 1 hour	visits at 2+ seasons (high & low runoff), at monthly highest and lowest tides, 6 hours each
What is your experience & skill with this indicator?	minimal	have been trained and/or have assessed many tidal wetlands
How observable is this indicator?	subjective, varies greatly in time, or nearly invisible (e.g., contamination)	objectively measurable (e.g., tributary lengths) or reliable measured data are available from other sources

Tidal wetlands largely surrounded by development are often ditched or have atypical water runoff regimes.

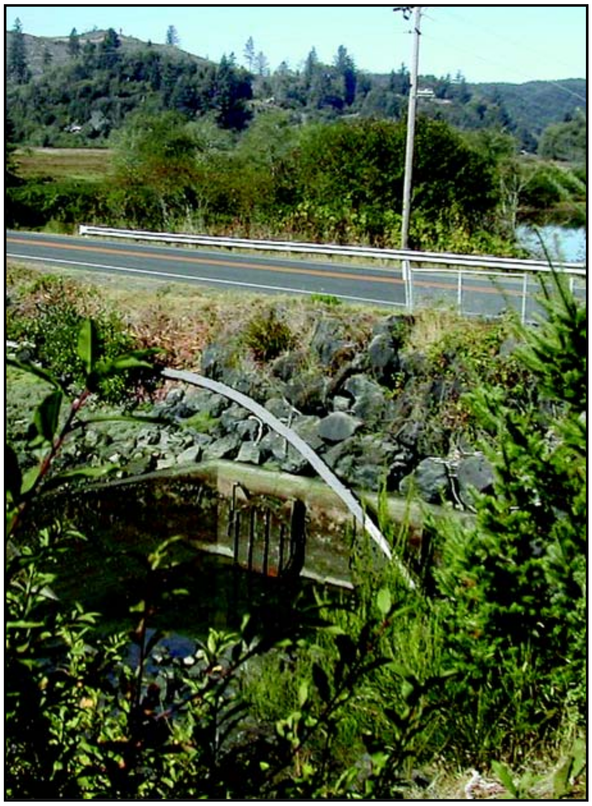
3 Correctly Interpreting and Applying Results of this Method

The overarching goal of wetland assessment is to determine the overall integrity and functions of specific wetlands. This HGM Rapid Assessment Method quantifies indicators of wetland funtions that are intended to be used in conjunction with expert judgement and other factors (noted below). With care, these specific numerical values can be used to better track or predict changes over time in a specific wetland (such as in scoping restoration or mitigation alternatives) or to quantitatively compare specific features of similar wetlands.

In some situations, the functions may be used to identify specific wetland characteristics to be highgraded in efforts to manage or restore the wetland. Such action should be undertaken with great caution, however: among other considerations, it should involve suites of functions since the functions used here are representative and because functions work together in ways that are not well understood.

Guidance

This guidebook's HGM-based method does not change any current procedures for determining jurisdictional status of wetlands: the method is intended mainly for assessing the functions and values of individual wetlands after jurisdictional status has been determined. Application of this method to wetlands is not (at time of publication) required by law or policy. Contact the Oregon Department of State Lands and U.S. Army Corps of Engineers for current regulatory requirements. Although this method is sensitive to differences among different subclasses of tidal wetlands, it does not allow users to compare different tidal wetland subclasses directly (e.g., high vs. low marsh), nor compare non-tidal wetlands with tidal wetlands (e.g., undiked vs. completely-diked sites) or with any other habitat (e.g., tidal tideflats).



Closed tidegate at low tide at a wetland road crossing.

It must be recognized that scientific understanding of wetlands is far less than optimal for supporting the indicators and models used in methods such as the one in this guidebook. That is equally the case with the most popular alternative: the application of informal "common sense" or "BPJ" (best professional judgment). Moreover, standardized assessment methods are not immune to attempts by determined users to produce a desired result. Nonetheless, the *potential* for biased manipulation of methods to achieve a desired result is not by itself a valid reason for failing to use formal methods in wetland decision-making. Less formal, non-standardized methods are equally or more susceptible to manipulation of results, and manipulation may be less transparent. If bias is suspected, additional documentation and/or an independent assessment should be required.

The consistency of results produced by this method among various independent users–with various levels of expertise, local knowledge, and training–has not been tested. Although every effort has been made in the selection and wording of indicators to create a rapid method that should provide acceptably consistent results among unbiased users, all methods that rely on casual observation of nonparametric indicators, rather than direct measurement of natural phenomena, tend to be imprecise. (In other words, while we did our best to pick sound indicators, anything easy to measure will likely not be very precise.) There exists no widely accepted standard of "adequate" consistency, and this should depend partly on the application objective. Perhaps this issue is better stated as: "Is a new method *more* consistent and accountable than the current method?"–the current method often being solely the application of unstandardized personal judgments by diverse specialists.

The function indicators and scoring models presented in this guidebook are based on the author's experience and interpretation of scientific literature, as well as on the opinions of experts who attended DSL-sponsored workshops during development of the method. The models (largely constructed of independent variables) do not measure actual processes or describe the statistical probability of a function occurring. They are not deterministic equations, dynamic simulation models, statistical probability models, or other mathematical representations of processes taking place. The scoring models *are* numeric representations of systematic qualitative constructs and are intended to assist a specific decision-making context. Thus, the scoring models are conceptually quite similar to models economists use to illustrate the economy that are based on leading economic indicators.

As is true of all other rapid assessment methods applicable to this region, this guidebook's scoring models and their indicators have not been validated. The time and cost of making the measurements necessary to fully determine the model's accuracy would be exorbitant. Nonetheless, the lack of indicator validation, as well as uncertainty regarding repeatability of results, are not by themselves sufficient reasons to avoid using this method; the alternative–relying entirely on unstructured judgments of wetland technicians–is not demonstrably better. When properly applied, the models and their indicators are believed to adequately describe relative levels of function among sites, as well as make some wetland decision-making processes more standardized, accountable, and technically complete. Results of any future scientific studies of functions of the region's tidal wetlands should be reviewed carefully and often for ideas for indicators that may improve upon ones now used.

It is recognized that this guidebook's method will often need to be used at seasons or times of day when conditions are less than ideal for the required observations. Moreover, it is recognized that the "snapshot" kind of portrayal of a site obtained during a single visit is unlikely to adequately assess the long-term natural disturbance regimes that ensure the viability of many sites and their functions. Many indicators change to some degree depending on the time of day, month, and year. These temporal changes potentially confound the interpretation of data from multiple sites visited at different times, and ultimately complicate the use of the data for describing reference standard conditions. Indicators that describe plant species composition and percent cover are especially likely to vary within the sampling window (June through September), and indicators such as salinity will vary greatly within a site during a tidal cycle.

Some indicators tend to correlate strongly with the size of the marsh. Because function indices that use these indicators may later be multiplied by marsh area, the correlation of these indicators with marsh area needs to be "factored out" or marsh area will implicitly be double-counted. We have attempted to accomplish this by applying particular statistical procedures to the data, and reflecting this in the manner in which the rapid method is configured in the spreadsheet and in this document. These adjustment procedures and their applications are described further in Part 2 (*Science Review and Data Analysis Results for Tidal Wetlands of the Oregon Coast*).

Formerly diked wetlands whose tidal circulation is restored often pond water for longer periods each tidal cycle because their substrate has subsided to a lower elevation.

As noted elsewhere, the number of functions that wetlands perform far exceeds those described in this guidebook (see Adamus 2001b for further discussion of this), so the guidebook focuses on a few that are easiest to assess in the short time periods required by the wetland permitting process.

The numeric scores should not be used alone with expert judgment because the scores *reflect only a subset of factors vital to decisions about wetlands.* In addition to expert judgment and the functions and values from this method, factors that must be weighed in many wetland decisions, but which are addressed only partly or not at all by this method, include—

- availability of alternatives for the proposed development (potential for impact avoidance)
- availability and cost of appropriate nearby sites for compensatory mitigation
- intrinsic sensitivity of the site to natural and human-related disturbance
- cost of any measures required to maintain a wetland over time
- navigability of the site, or if the site is itself legally considered non-navigable, its perceptible influence on aquatic life (or other "uses" designated by the state) in nearby navigable waters
- relative contribution of the site's flora and fauna to regional biodiversity
- special legal status of any of the site's species
- actual or potential ability of the site to produce timber, crops, fur, or other marketable products
- recreational, open space, aesthetic, or educational use of the site
- status of the site as a natural hazard area
- status of the site as a hazard or potential hazard due to known accumulations of chemical wastes
- existence of a conservation easement, deed restriction, local zoning designation, or other legal instrument that limits or allows particular uses of the site and/or its contributing watershed
- percent of total site acreage potentially affected by a proposed alteration, and location of impacts within the site

- the magnitude of the proposed alteration, after accounting for the likely reliability of its impact minimization strategies
- technical “replaceability” or “manageability” of the site’s functions
- likelihood of compensatory mitigation being physically and biologically successful
- potential for the alteration to create a public nuisance (directly, or through loss of wetland functions) either on-site or (especially) off-site
- potential for the alteration to impose unreasonable burdens on local infrastructure
- potential for cumulative impacts (e.g., consideration of local loss rate of this subclass of wetland)
- rules and policies of agencies involved in reviewing permit applications

Despite the limitations noted here, this method is believed to be one of only a few that expresses the best available science in the format of a semi-quantitative rapid assessment method. Draft versions of the method were reviewed by several wetland scientists and were tested by many users. The method is the only rapid method applicable to Oregon that directly incorporates reference data collected from Oregon tidal marshes. It provides a structured means for considering many factors believed important to the condition and functions of tidal marshes, and can serve as a tool for educating resource managers having limited experience with some tidal marsh functions.

Applying the Results of the HGM Method

Scores generated by this method, as well as the data from its accompanying reference databases, have several potential applications for both regulatory and non-regulatory programs. The questions they can help address include, but are not limited to—

- What effect might restoring or enhancing the natural structure in a degraded marsh (by improving circulation, adding wood to its channels, etc.) have on the marsh's functions?
- Which of several tidal marshes has likely suffered the most degradation of its functions, and therefore might benefit the most from restoration or enhancement?
- Which of several tidal marshes has likely suffered the least degradation of its functions, and therefore might be the best choice for conservation or to use as a reference site?
- Should a permit application for alteration of a tidal marsh be denied altogether, or will a proposed tidal marsh mitigation project located elsewhere adequately compensate for loss of its functions?
- What is a realistic "target" or performance standard for plant species richness in a restored low marsh on sandy substrate on the outer coast?
- To inform the design of a tidal channel being created as part of a marsh restoration project, what channel dimensions have been found to be typical of natural marshes in similar situations on the Oregon Coast?
- What proportion of the tidal marshes in a particular watershed or estuary is at high risk of long-term degradation?
- In terms of capacity to perform each of the 12 identified functions, how does this tidal marsh rank when compared with 120 others that were already sampled on the Oregon Coast?
- Over many years' time, which functions are probably increasing or decreasing as a result of structural changes made to a given tidal marsh and its surroundings?

Agencies and consultants have already begun using test versions of this method to examine some of these questions.

Evaluating the HGM Method

The Oregon Department of State Lands welcomes feedback on how well the process and application of this HGM Rapid Assessment Method fulfills wetland management needs. Specific comments and input should be directed to:

Janet Morlan, *Wetlands Program Manager*
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Appendix A. Data Forms

Data Form A1. Rapid Indicators of Risks to Tidal Wetland Integrity and Sustainability

This form primarily assesses “stressors,” indicators of the risk a tidal wetland may face from various types of degradation usually associated with human activities. These stressors have the potential in some situations to diminish wetland integrity. Specifically, they can reduce the ability of a wetland to maintain a balanced, integrated, adaptive community of organisms with a species composition, diversity, and functional organization that compares well to unaltered habitat of the Oregon Coast. A wetland may be considered to have high integrity when all of its characteristic processes and parts are intact and functioning within their natural ranges of variation. After entering the appropriate score in each box of this field form, enter your scores into the accompanying spreadsheet, assign weights to the indicators if desired, and compute the score for Risk. When assessing these stressors, do not take into account their potential for being reversed. The “sustainability” of wetland sites is assumed to be lowest when they are at greatest risk. When combined with other information, risk assessments such as this are useful not only for assessing wetland integrity and function, but also for helping prioritize sites for restoration based on a site’s likelihood of having been ecologically degraded. Other factors, such as the wetland’s intrinsic sensitivity, scarcity, geomorphic resilience, and land ownerships, should also be considered when prioritizing restoration.

Wetland Site Name: ______________________________________ Date:____________ Time Begin:________ Time End: _______
Assessor: ____ Total Marsh Transect Length (combined): _______m
Estimated Position of the assessed unit in the estuary:
near ocean (lower one-third): ______ mid: ______ near major head-of-tide (upper one-third): ______
Estimated HGM areas in the assessed unit:
Marine-sourced **High** Marsh: _______% Marine-sourced **Low** Marsh: ______% **River-sourced** Tidal Wetland: _______%

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>1.
BuffAlt</td>
<td>
Relative buffer between the wetland and upland areas.
Calculate: A * (B + C). [For example, for A, B, C below, calculate 2 x (1 + 3) = 8.] Screen the resulting calculation with the scale on the right [ex: 8 = 0.3], then enter the score in the box. Optionally, also enter an estimate of certainty (0 to 1).

A) Within 100 ft of the wetland’s edge with adjoining upland, the % of the upland that contains pavement, buildings, or other bare substrate:
<table>
<tr><th>% upland as described</th><th>scale</th></tr>
<tr><td><5 %</td><td>1</td></tr>
<tr><td>5-14 %</td><td>2</td></tr>
<tr><td>15 – 24 %</td><td>3</td></tr>
<tr><td>25-49 %</td><td>4</td></tr>
<tr><td>>50 %</td><td>5</td></tr>
<tr><td>wetland occupies nearly all of an island, and none of the island is developed</td><td>0</td></tr>
</table>
B) Within 100 ft of the wetland’s edge, the predominant elevation of the portion of the upland that is most-disturbed (paved, landscaped, overgrazed, or bare):
<table>
<tr><th>predominant elevation</th><th>scale</th></tr>
<tr><td>< 20 ft higher than wetland</td><td>1</td></tr>
<tr><td>20-50 ft higher</td><td>2</td></tr>
<tr><td>>50 ft higher</td><td>3</td></tr>
</table>
C) Within 100 ft of the wetland’s edge, the substrate predominating in the portion of the upland that is most-disturbed (paved, landscaped, overgrazed, or bare):
<table>
<tr><th>predominant substrate</th><th>scale</th></tr>
<tr><td>loam, silt, clay</td><td>1</td></tr>
<tr><td>fine, sandy soil</td><td>2</td></tr>
<tr><td>coarse sand (minimal organin layer), fill, pavement, or rock</td><td>3</td></tr>
</table>
Screen the resulting calculation with the scale on the right, then in the box enter the score and optionally an estimate of certainty (0 to 1).
</td>
<td>
0 = 0.01
1-2 = 0.1
3-6 = 0.2
7-9 = 0.3
10-12 = 0.4
13-15 = 0.5
16-18 = 0.6
19-21 = 0.7
22-24 = 0.8
25-27 = 0.9
>27 = 1.0

score #1:

certainty #1:
</td>
<td>
<i>Within 100 ft</i> = the percent within the entire area that is upland and within 100 ft. of the wetland-upland edge. Do not include the tidal wetland itself, but non-tidal wetlands may be included as part of that zone.

Measure the 100 ft horizontally from the wetland’s upper limit of annual tidal flooding (highest tide).

Extend the 100 ft limit to 300 ft if a perennial freshwater tributary flows through the wetland, i.e., 100 ft on either side of the tributary channel, up to 300 ft away.

Used for: RA.*
* see page 23 or Appendix A for abbreviations
</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>2.
ChemIn</td>
<td>Maximum risk of the wetland being exposed to chemical pollutants (excluding nutrients).
Calculate: T * (L + E). [For example, 0 x (1 + 1) = 0] where:
<table>
<tr><th>T <i>Toxicity</i></th><th>scale</th></tr>
<tr><td>no pollutant sources likely in nearby runoff, groundwater, or surface water; no history of recent spills reaching the wetland</td><td>0</td></tr>
<tr><td>some pollutants</td><td>1</td></tr>
</table>
<table>
<tr><th>L Maximum <i>Load</i> (of contaminants)</th><th>scale</th></tr>
<tr><td>diffuse (distant source), or infrequent (severe storms only)</td><td>1</td></tr>
<tr><td>concentrated (nearby source) or frequent</td><td>2</td></tr>
</table>
<table>
<tr><th>E Maximum <i>Extent</i> (of contaminants)</th><th>scale</th></tr>
<tr><td>limited (only a small % of the wetland is likely to be exposed to the chemical)</td><td>1</td></tr>
<tr><td>most of wetland could be exposed</td><td>2</td></tr>
</table>
Compare the result with the scale at the right to determine the score.</td>
<td>0 = 0.01
2 = 0.33
3 = 0.66
4 = 1.00
score #2:
certainty #2:</td>
<td><i>Toxicity</i> = pollutants include substances potentially harmful to plants or animals and present well above any natural background level.

<i>Load</i> = runoff load of contaminants will depend partly on size, slope, and soil type of the contributing area; consider annual maximum for a normal year.

<i>Extent</i> = “limited” would apply if surface water travels only in a single internal channel, or if the only contaminant source is at a localized spot along the upland edge.

“Certainty” should normally be scored very low for this indicator. If measured data are available, you may use it to inform components (T) and (L).

Used for: RA, Inv, Afish, Mfish, Rfish, [NFW, Sbird, LbirdM].</td>
</tr>
<tr>
<td>3.
NutrIn</td>
<td>Maximum risk of nutrient overload in the wetland.
Calculate: S * (L + E) For example, 1 x (1 + 2) = 3 where:
<table>
<tr><th>S <i>Source Type</i></th><th>scale</th></tr>
<tr><td>no abnormal sources</td><td>0</td></tr>
<tr><td>minor potential or known source of nitrogen or phosphorus</td><td>1</td></tr>
<tr><td>major potential or known source of nitrogen or phosphorus</td><td>2</td></tr>
</table>
<table>
<tr><th>L Maximum <i>Load</i> (of nutrients)</th><th>scale</th></tr>
<tr><td>diffuse or diluted (distant source), or infrequent</td><td>1</td></tr>
<tr><td>concentrated (nearby source) or frequent</td><td>2</td></tr>
</table>
<table>
<tr><th>E Maximum <i>Extent</i></th><th>scale</th></tr>
<tr><td>only a small % of the wetland is likely to receive inputs due to its relative elevation & other factors</td><td>1</td></tr>
<tr><td>not localized</td><td>2</td></tr>
</table>
Compare the result with the scale at the right to determine the score.</td>
<td>0 = 0.01
2 = 0.33
3 = 0.66
4 = 1.00
score #3:
certainty #3:</td>
<td><i>Minor</i> source type = widely-scattered houses, lawns, low-density grazing, parking lots, extensive stands of alder, recently burned or logged areas, and/or occasional large boat traffic.
<i>Major</i> source type = neighborhoods (not on sewer lines), extensive concentrated grazing, waste treatment plant effluent, many malfunctioning septic systems, and/or boatyards, harbors.

<i>Load</i>, <i>Extent</i>: see above.

If measured data are available, you may use it to inform components (S) and (E).

Used for: RA, AProd, Dux, [WQ, Xpt, Inv, Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>4.
SedShed</td>
<td>Incoming fine-sediment overload.
As a result of human activities outside the wetland, sediment loads reaching the wetland are currently (select one):
<table>
<tr><th>sediment loads</th><th>score</th></tr>
<tr><td>mostly normal for the wetland’s subclass and location in the estuary</td><td>0.01</td></tr>
<tr><td>somewhat above normal for the wetland’s subclass and location in the estuary, due to accelerated erosion upslope, upriver, or alongshore</td><td>0.50</td></tr>
<tr><td>much above normal for the wetland’s subclass and location in the estuary, due to accelerated erosion upslope, upriver, or alongshore</td><td>1.00</td></tr>
</table>
</td>
<td>score #4:

certainty #4:</td>
<td>Ignore the wetland’s ability to trap whatever sediment arrives—consider only its exposure to elevated sediment loads.

Potential sources include: eroding banks, logged or burned areas, mining (especially gravel, placer), roads, frequent dredging, livestock, ATVs. Consider proximity, extent, slope, substrate type, and number of years to recover.

“Normal” for a wetland near the estuary mouth may be a greater load than for a wetland near head-of-tide, because load increases downstream even in pristine estuaries.

Used for: RA, Inv, [Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td>
</tr>
<tr>
<td>5.
SoilX</td>
<td>Onsite soil disturbance.
How much of the assessment unit (only the part that is still wetland) has been affected by ongoing or past erosion/ compaction caused directly by human activities.
<table>
<tr><th></th><th>none</th><th>1- 10%</th><th>10-50%</th><th>>50%</th></tr>
<tr><td>ongoing</td><td>0</td><td>2</td><td>3</td><td>4</td></tr>
<tr><td>historical but still apparent</td><td>0</td><td>1</td><td>2</td><td>3</td></tr>
</table>
Select one number from each row. Then sum the two chosen numbers and apply the scale on the right to derive the score.</td>
<td>0 = 0.01
1 = 0.1
2 = 0.2
3 = 0.3
4 = 0.4
5 = 0.6
6 = 0.8
7 = 1.0

score #5:

certainty #5:</td>
<td>Potential disturbances within the wetland include: livestock, ATVs, restoration activities, subsidence associated with diking, ditches, fills, log storage. Consider extent and severity.

Infer past log storage from historical aerial photographs, local contacts, presence nearby of old pilings, and partially-buried cut logs. Infer livestock from presence of fences, or local knowledge.

Used for: RA, AProd, WQ, [Xpt, Inv, Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>6.
DikeDry</td>
<td>Degree the area that is still wetland (and including its internal channels) becomes drier (i.e., muted tidal flooding) as a result of ditches or the installation of dikes, tidegates, culverts, and other artificial constrictions.
<table>
<tr><th></th><th>score</th></tr>
<tr><td>no such alterations, and no changes observed</td><td>0.01</td></tr>
<tr><td>flooding from tide or runoff occurs less often as a result of the alterations—nonetheless, nearly all areas within the wetland that previously were flooded by daily tides continue to flood daily</td><td>0.33</td></tr>
<tr><td>some areas that previously were flooded by daily tides or upland runoff no longer flood daily, but are still tidal wetland; during monthly low tides, there is much less water in the wetland than previously</td><td>0.66</td></tr>
<tr><td>daily tidal circulation has been eliminated from all but a small part of the wetland; severe reduction in frequency, duration, and depth of daily and monthly high/low tide</td><td>1.00</td></tr>
</table>
Note: For many diked wetlands, the appropriate score will be 0.66.</td>
<td>score #6:
certainty #6:</td>
<td>Where historical data are lacking, consider “drier” relative to nearby unaltered wetlands of about the same elevation & size. Wetlands receiving little upland runoff or groundwater seepage are especially vulnerable to this condition when they are diked. Mainly include constrictions within or along the upland or water edge of the wetland. In rare instances decreased onsite flooding may be attributed to presence of upriver dams, water diversions, or dredging (deepening) of estuary mouths. Ignore drying due to geologic uplift or to sediment-related increases in elevation of marsh surface, but include drying if due to sediment blockage of surface water inputs. As time allows, use procedures described by Brophy (2005) for locating tidegates.
Used for: RA.</td>
</tr>
<tr>
<td>7.
DikeWet</td>
<td>Degree this wetland and/or its channels becomes wetter (more ponding) as a result of installation of dikes, tidegates, culverts, ditches, and other artificial constrictions or excavations, including substrate compaction and subsidence associated with these.
<table>
<tr><th></th><th>score</th></tr>
<tr><td>no such alterations, and no changes observed</td><td>0.01</td></tr>
<tr><td>some areas within the wetland now flood more often, longer, or more extensively as a result of alterations, but only at monthly high (spring) tide and/or during heavy precipitation</td><td>0.33</td></tr>
<tr><td>some areas within the wetland now flood more often, longer, or more extensively and this is noticeable each day; and/or upland runoff is noticeably impounded within the wetland at various times as a result of the alterations</td><td>0.66</td></tr>
<tr><td>much of the site remains flooded long after daily high tide; and/or major increase in flooding as a result of sediment subsidence following diking</td><td>1.00</td></tr>
</table>
Note: For many diked wetlands, the appropriate score will be 0.66.</td>
<td>score #7:
certainty #7:</td>
<td>Do not include dike breaching or removal that made the site wetter (such as that evidenced by dead trees). Where historical data are lacking, consider “wetter” relative to nearby unaltered wetlands of about the same elevation. Diked wetlands are especially vulnerable to this condition if they have perennial tributaries, direct stormwater inputs, or seeps/wetlands along their upland edge. In rare instances increased onsite flooding may be attributed to increased runoff from pavement, inputs from offsite ditches, or recent clearcutting in the watershed. As time allows, use procedures described by Brophy (2005) for locating tidegates.
Used for: RA.</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>8.
FootVis</td>
<td>Extent and frequency of wetland visitation.
Calculate: A + (B*2) + (C*3). [For example, 10 + (20x2) + (70x3) = 260] where:

_____(A) % of wetland & upland* visited only rarely (<10 days /yr) by people on foot
_____(B) % of wetland & upland* with intermediate visitation frequency
_____(C) % of wetland & upland* visited daily or almost so (>360 days/yr)

* includes upland within 100 ft.

<table>
<tr><th>the resulting number</th><th>score</th></tr>
<tr><td><110 (infrequent & localized visitation)</td><td>0.01</td></tr>
<tr><td>110-139</td><td>0.33</td></tr>
<tr><td>140-199</td><td>0.66</td></tr>
<tr><td>200+ (frequent & extensive visitation)</td><td>1.00</td></tr>
</table>
</td>
<td>score #8:

certainty #8:</td>
<td>A, B, and C must sum to 100%.

Assume an average visitor “casts a disturbance shadow” of radius 100 ft.

Infer greater visitation frequency if closer to roads & buildings (especially population centers), public land, mostly high marsh, and/or signs of use, e.g., foot trails.

Used for: RA, NFW, Dux, Sbird.</td>
</tr>
<tr>
<td>9.
Boats</td>
<td>How frequent and close is boat traffic (all types)?

<table>
<tr><th></th><th><100 ft away</th><th>100-1000 ft away</th><th>>1000 ft away</th></tr>
<tr><td>seldom (<2x/day)</td><td>0.6</td><td>0.4</td><td>0.01</td></tr>
<tr><td>frequent</td><td>0.8</td><td>0.6</td><td>0.2</td></tr>
<tr><td>nearly constant</td><td>1.0</td><td>0.8</td><td>0.4</td></tr>
</table>

Select the largest number that is applicable and enter it in the Score box.</td>
<td>score #9:

certainty #9:</td>
<td>Used for: RA, NFW.</td>
</tr>
<tr>
<td>10.
HomeDis</td>
<td>Proximity (ft) to the nearest inhabited structure.

<table>
<tr><th>proximity</th><th>score</th></tr>
<tr><td><200’</td><td>1.00</td></tr>
<tr><td>200’-999’</td><td>0.75</td></tr>
<tr><td>1000’-1999’</td><td>0.50</td></tr>
<tr><td>2000’-5000’</td><td>0.25</td></tr>
<tr><td>>5000’</td><td>0.01</td></tr>
</table>
</td>
<td>score #10:

certainty #10:</td>
<td>Estimate the distance from the wetland-upland edge closest to the structure. The structure must be:
(a) inhabited for at least 2 months per year, <i>and</i>
(b) not continuously separated from wetland by water wider than 10 ft., e.g., not on an opposite shore. Aerial photographs or topo maps are useful.

Used for: RA, LbirdM.</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>11.
RoadX</td>
<td>Proximity (ft) to the nearest paved area:
<table>
<tr><th></th><th><10 ft</th><th>10-100’</th><th>100-1000’</th></tr>
<tr><td>primary roads</td><td>1.0</td><td>0.6</td><td>0.2</td></tr>
<tr><td>secondary roads</td><td>0.6</td><td>0.3</td><td>0.01</td></tr>
</table>
Enter the maximum appropriate number directly into the score box to the right.</td>
<td>score #11:
certainty #11:</td>
<td>Consider parking lots (>20 vehicle capacity) to be primary roads. Primary roads usually have >1 vehicles/minute during the daytime. If a primary road borders only a tiny fraction of a wetland’s upland edge, treat it as a secondary road.
Used for: RA, LbirdM.</td>
</tr>
<tr>
<td>12.
Invas</td>
<td>Presence or potential for invasive exotic invertebrates.
<table>
<tr><th></th><th>score</th></tr>
<tr><td>no invasive exotic invertebrates have been reported from this estuary (see guidance at far right), and there are no oyster cultivation facilities or <i>large-ship traffic</i> routes in similar parts of the same estuary</td><td>0.01</td></tr>
<tr><td>no invasive exotic invertebrates have been reported from this estuary (see column at far right), but there are oyster cultivation facilities and/or large ships traffic in the estuary</td><td>0.50</td></tr>
<tr><td>populations of invasive exotic invertebrates are known to have become established in this estuary</td><td>1.00</td></tr>
</table></td>
<td>score #12:
certainty #12:</td>
<td>Green crabs or other invasive invertebrate species have been documented in Tillamook, Netarts, Salmon, Siletz, Yaquina, Alsea, Umpqua, Coos, and Coquille estuaries. Oyster facilities are present in some of these plus in the Nehalem and Siuslaw estuaries.
<i>Large ship traffic</i> = deep-draft vessels, especially those that discharge foreign ballast water.
Used for: RA, Inv, [Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>13. Instabil</td>
<td>
Possible instability of the wetland.

Calculate the following using the numeric values below:
A + B + C + D + E = scale
Then use the scale to the right and enter a score in the box.

A) Living trees or shrubs > 10 ft. tall and flooded by tide at least once per year:
<table>
<tr><th>description</th><th>value</th></tr>
<tr><td>many</td><td>1</td></tr>
<tr><td>few</td><td>2</td></tr>
<tr><td>none</td><td>3</td></tr>
</table>
B) Percent of wetland that is high marsh (not flooded daily during most of the month, but still flooded occasionally by tide):
<table>
<tr><th>description</th><th>value</th></tr>
<tr><td>>50%</td><td>0</td></tr>
<tr><td>10-50%</td><td>1</td></tr>
<tr><td>1-10%</td><td>2</td></tr>
<tr><td><1%</td><td>3</td></tr>
</table>
C) Change in area of wetland and adjoining tideflat as indicated from historical data, maps, or images:
<table>
<tr><th>description</th><th>value</th></tr>
<tr><td>increase from sedimentation,
or no noticeable change, or no data</td><td>1</td></tr>
<tr><td>loss of marsh area from erosion or windblown sand
(<i>not</i> from filling, diking, drainage)</td><td>3</td></tr>
</table>
D) Tidal circulation:
<table>
<tr><th>description</th><th>value</th></tr>
<tr><td><i>no evidence</i> tidal flooding restricted during past 100 years</td><td>0</td></tr>
<tr><td><i>full daily</i> tidal flooding resumed <i>more than</i> 10 years ago</td><td>1</td></tr>
<tr><td><i>full daily</i> tidal flooding resumed <i>less than</i> 10 years ago</td><td>2</td></tr>
<tr><td><i>partial</i> tidal flooding resumed <i>more than</i> 10 years ago</td><td>3</td></tr>
<tr><td><i>partial</i> tidal flooding resumed <i>less than</i> 10 years ago</td><td>4</td></tr>
</table>
E) Predominant substrate:
<table>
<tr><th>description</th><th>value</th></tr>
<tr><td>loam, silt, clay</td><td>1</td></tr>
<tr><td>sandy soil</td><td>2</td></tr>
<tr><td>sand dunes, fill, dredged material, rock</td><td>3</td></tr>
</table>
</td>
<td>
3 = 0.01
4 = 0.1
5 = 0.2
6 = 0.3
7 = 0.4
8 = 0.5
9 = 0.6
10 = 0.7
11 = 0.8
12 = 0.9
>12 = 1.0

score #13:

certainty #13:
</td>
<td>
(C) Do not include direct losses from filling or diking, or increases due to restoration – include only those from sedimentation or erosion. If area loss can be documented at any time since 1850, assign a “0” regardless of possible subsequent increased area. Be careful when comparing historical maps or aerial photographs, as apparent changes may actually be due to differences in the daily or monthly tidal cycle when the image was recorded.

(D) Restoration may have been intentional or from natural erosion of dikes. Partial tidal flooding includes marshes with “muted” tidal amplitude due to culvert restrictions or modified tidegates. Presence of dike remnants does not always mean tidal flooding is partial.

Used for: RA, WQ.
</td>
</tr>
</table>

Data Form A2. Direct Indicators of Wetland Integrity that Require More-Intensive Field Work

If unable to perform these relatively intensive measurements, you may skip this section and proceed with section B1, but wetland integrity and the botanical function will not be scored. To calculate information needed in this section, you must first enter your field data in the accompanying Excel™ spreadsheet. For the plant indicators, you must use the survey protocol specified in **Protocol for assessing botanical indicators** on page 16.

code	indicator	score	guidance
14. RatioC	**Channel proportions.** Walk upstream to each of five survey points along a major internal channel (see right column) and measure the channel *topwidth* and *incision depth*. Then input the measurements on the accompanying spreadsheet (part A2a) and allow it to calculate the Absolute Difference (mean). Compare that number with the left side of the following scale, to determine the score. Enter the score in the column to the right. If the site contains no tidal channel, skip this section. Protocol: The five survey points (Figure 1) should be arrayed from where the main channel exits the wetland (#1) to the most distant but connected feeder channel (#5), and should be representative of the other nearby sections of channel. If no banks are apparent, then measure at the first major break in the channel side slope (often the wetted width at high tide). Vegetation change can also be used to discern the top of the bank. Measure to the geomorphic top, not to where the water level is.	**score #14:** **certainty #14:**	*Topwidth* = the distance from bank-to-bank. Measure to the geomorphic top, not to where the water level is. *Incision depth* = the vertical distance (m) between the channel bottom and the top of a line running between the channel banks. See Part 2 for description of assumptions behind this indicator and its scaling. Used for: WI, WQ.

code	guidance
15. SpPerQd **16. SpDeficit** **17. AllPC90** **18. DomDef** **19. NN20PC** **20. NNdef** **21. AnnDef** **22. TapPCdef** **23. StolPCdef** **24. TuftPCdef**	These botanical indicators are calculated and scaled automatically in part A2 of the accompanying spreadsheet, using field data you enter in part A2b of the spreadsheet. You must first collect the data using the following protocol. Record the plant data on the Appendix E (Vegetation Quadrat Data Form), then transfer to the spreadsheet. 1. In most instances, establish two parallel transects per wetland (Figure 3), preferably sometime between May and September. One end of each transect should be at a point containing wetland vegetation that is nearest the adjoining unvegetated bay or river; the other end should be at the approximate upper annual limit of tidal inundation (i.e., "upland"), as usually indicated by the tree line or driftwood line. If the wetland occupies all of an island with no upland, extend each transect the width of the island (if feasible). Transects should be relatively straight, but precise alignment is not essential. 2. Situate the two transects near the widest part of the wetland. Situate them to avoid or minimize crossing of major channels and non-wetland spots (dikes, fills) within the wetland. Avoid placing the transects within 2m of each other—much wider spacing (at least 10 m) is preferred if logistically possible. Do not try to "aim" the transects to intercept particular plant communities or attempt to make the transects "representative" of the wetland. Random placement, while desirable statistically, often presents logistical headaches and is relatively meaningless given the limited replication (of only two transects). 3. In exactly 20 quadrats (square plots), each with dimensions 1m x 1m, identify and assess relative percent-cover of each plant species. Each of the 2 transects should contain 10 quadrats, spaced equidistantly along the transect beginning at the vegetated transition from unvegetated bay/river. However, if it becomes evident that less than 20% of a quadrat is vegetated, move to the left or right of the transect until a spot is found where this criterion is met. (The botanical protocol in this guidebook is not intended to assess extent of unvegetated area in a wetland. This is addressed only by indicator #28). 4. In narrow marshes, the use of only two short transects could result in quadrats along each transect being closer than 2m to each other. To avoid this, deploy additional transects perpendicular to the bay or river until at least the 2m spacing is established between quadrats as well as between transects. In rare instances, it may also be necessary to change transect orientation from perpendicular to oblique.

Data Form B1. Rapid Indicators of Function That May be Estimated

This form and the successive one (Form B2) include indicators known from technical literature or reasoned ecological principles to be associated with one or more of the 12 key functions of tidal wetlands. Some of the indicators were correlated statistically with one or more indicators of Risk from Form A1. Others were uncorrelated, either due to the imprecision with which they and/or the Risk indicators were estimated, or to their being intrinsically unaffected by human activities. The uncorrelated functions were included because of their importance to assessing the functions, as documented in Part 2 of this guidebook. Note: A higher number for a particular indicator below does not always mean greater function–the number depends on the function and the indicator. Italicized terms are defined in the last column. Abbreviations for functions in the last column are shown in Appendix B.

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>25.
Flood</td>
<td>Imagine the wetland under each tidal condition listed below.

What % of the wetland's area (including its internal tidal channels) is likely to be accessible to young anadromous fish?

As your answer, select one number from each row, then sum the four numbers and use their sum with the scale on the right to generate a score for the box.

<table>
<tr><th>during:</th><th>0% (none)</th><th>1-10%</th><th>10-50%</th><th>50-90%</th><th>>90%</th></tr>
<tr><td>Monthly low tide</td><td>0</td><td>4</td><td>5</td><td>6</td><td>7</td></tr>
<tr><td>Daily low tide</td><td>0</td><td>3</td><td>4</td><td>5</td><td>6</td></tr>
<tr><td>Daily high tide</td><td>0</td><td>2</td><td>3</td><td>4</td><td>5</td></tr>
<tr><td>Monthly high tide</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td></tr>
</table>
</td>
<td>0 = 0.01
1 = 0.1
2 = 0.2
3-4 = 0.3
5-6 = 0.4
7-8 = 0.5
9-10 = 0.6
11-12 = 0.7
13-14 = 0.8
15-16 = 0.9
>15 = 1.0

score #25:

certainty #25:</td>
<td>Assume conditions are averaged over February—June. If the site cannot be visited repeatedly, answer this based on visual estimation of the topography of the wetland relative to the tidal amplitude reported from the closest monitoring station in the estuary (see Tidal range in Oregon estuaries, below) or improved local data (where available).

Salmonid distribution maps are available on the internet at: <u>rainbow.dfw.state.or.us/nrimp/information/fishdistmaps.htm</u>

Used for: Xpt, Afish, Mfish, Rfish, Dux, LbirdM, [NFW].</td>
</tr>
</table>

Tidal range in Oregon estuaries (mostly from Hamilton 1984). Use better local data when available.

estuary	location	daily range (ft.)	monthly range (ft.)	estuary	location	daily range (ft.)	monthly range (ft.)	estuary	location	daily range (ft.)	monthly range (ft.)
Necanicum	Seaside	4.7	5.8	**Siletz**	Taft	5.0	6.1	**Umpqua**	Winchester	5.1	6.9
Nehalem	Brighton	5.9	7.8		Kernville	4.6	6.6		Reedsport	5.1	6.7
	Wheeler	5.9	7.6	**Yaquina**	So. Beach	6.3	8.3	**Coos**	mouth	5.2	7.0
	Nehalem	5.6	7.2		Yaquina	6.2	8.2		Charleston	5.7	7.5
Tillamook	Barview	6.2	8.2	**Alsea**	Waldport	5.8	7.7		Empire	4.9	6.7
	Garibaldi	5.9	7.8		Drift Cr.	5.0	6.2		Coos Bay	5.6	7.3
	Bay City	5.4	7.1	**Siuslaw**	mouth	5.5	7.3	**Coquille**	Bandon	5.2	7.0
	Tillamook	5.2	6.6		Florence	5.4	7.3	**Rogue**	Wedderburn	4.9	6.7
Netarts	Whiskey Cr.	4.8	7.8		Cushman	5.5	7.3	**Chetco**	Brookings	5.1	7.0
Sand Lake	---	5.7	---		Tiernan	5.9	7.7				
Nestucca	mouth	5.8	7.6		Mapleton	6.2	8.0				

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>26.
Shade</td><td>Percent of the entire wetland’s vegetated area that is shaded by trees or topography:
<table>
<tr><th>%</th><th>score</th></tr>
<tr><td><1%</td><td>0.01</td></tr>
<tr><td>1-10%</td><td>0.50</td></tr>
<tr><td>>10%</td><td>1.00</td></tr>
</table></td><td>score #26:
certainty #26:</td><td>To count, it must be shaded for 4+ hours during an average cloudless day.
Include parts of the <i>internal channel</i> network that are inundated most days and are shaded by deep incision, logs, or undercut banks. <i>Internal channels</i> include both tributary channels (flowing from uplands) and blind channels (flooding with the incoming tide).
Used for: AProd, [WQ, Xpt, Inv, Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td></tr>
<tr><td>27.
ShadeLM</td><td>[Skip if no low marsh is present.]
Percent of <i>only</i> the low marsh that is shaded by trees or topography:
<table>
<tr><th>%</th><th>score</th></tr>
<tr><td><1%</td><td>0.01</td></tr>
<tr><td>1-10%</td><td>0.50</td></tr>
<tr><td>>10%</td><td>1.00</td></tr>
</table></td><td>score #27:
certainty #27:</td><td>See above.
As a reminder, “low marsh” is defined as areas flooded by the tide during the majority of days during most months of the year. Low marsh is not limited just to areas that flood every day.
Used for: Afish.</td></tr>
<tr><td>28.
Bare</td><td>Area of bare substrate, including <i>pannes</i>, shallow pools, and tideflats wider than 2m and located <i>within</i> the wetland:
<table>
<tr><th>area</th><th>score</th></tr>
<tr><td>0-4 sq. m</td><td>0.01</td></tr>
<tr><td>4-100 sq.m</td><td>0.25</td></tr>
<tr><td>100-2,500 sq.m</td><td>0.50</td></tr>
<tr><td>2,500-10,000 sq.m</td><td>0.75</td></tr>
<tr><td>>10,000 sq.m</td><td>1.00</td></tr>
</table></td><td>score #28:
certainty #28:</td><td><i>Pannes</i> = shallow mostly-bare depressions in the marsh surface and aren’t currently a part of tidal channels. Assess condition as at low tide.
Used for: AProd, NFW, Dux, Sbird, [WQ, Xpt, Inv, Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>29.
Pannes</td><td>Area only of pannes and shallow <i>isolated</i> pools (not tideflats):
<table>
<tr><th>area</th><th>score</th></tr>
<tr><td>0-4 sq. m</td><td>0.01</td></tr>
<tr><td>4-100 sq.m</td><td>0.25</td></tr>
<tr><td>100-2,500 sq.m</td><td>0.50</td></tr>
<tr><td>2,500-10,000 sq.m</td><td>0.75</td></tr>
<tr><td>>10,000 sq.m</td><td>1.00</td></tr>
</table></td><td>score #29:
certainty #29:</td><td><i>Isolated</i> = lacking a surface connection to other waters during daily low tide
Used for: Inv, Rfish, [Afish, Mfish, Sbird, LbirdM].</td></tr>
<tr><td>30.
TranAng</td><td>Transition angle along most of the wetland <i>external edge:</i>
<table>
<tr><th>transition angle</th><th>score</th></tr>
<tr><td>gradual, or steep but stable</td><td>0.01</td></tr>
<tr><td>steep, with extensive erosion and undercutting</td><td>1.00</td></tr>
</table></td><td>score #30:
certainty #30:</td><td><i>External edge</i> = the edge between the marsh and adjoining bay or tidal river.
Used for: WQ.</td></tr>
<tr><td>31.
UpEdge</td><td>Percent of the wetland’s entire <i>perimeter</i> that is upland, i.e., <i>neither</i> water, non-tidal wetland, nor tideflat:
<table>
<tr><th>%</th><th>score</th></tr>
<tr><td><1</td><td>0.01</td></tr>
<tr><td>1-25</td><td>0.25</td></tr>
<tr><td>25-50</td><td>0.50</td></tr>
<tr><td>50-75</td><td>0.75</td></tr>
<tr><td>>75</td><td>1.00</td></tr>
</table></td><td>score #31:
certainty #31:</td><td><i>Perimeter</i> = the wetland’s edge with upland plus with unvegetated water or tideflat. Do not include internal channels in the calculation of the marsh perimeter. If possible, use computer GIS software to measure the perimeter and edges.
Used for: WQ, LbirdM.</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>32.
LWDchan</td><td>Number of pieces of large woody debris (LWD) in wetland’s tidal channel network:
<table>
<tr><th># LWD in channel</th><th>score</th></tr>
<tr><td>0, or no channels present</td><td>0.01</td></tr>
<tr><td>1-10</td><td>0.50</td></tr>
<tr><td>>10</td><td>1.00</td></tr>
</table></td><td>score #32:
certainty #32:</td><td>To count, the LWD must have a diameter >15 cm and a length >2m.
Used for: Inv, Afish, [Rfish, Mfish, Sbird, LbirdM].</td></tr>
<tr><td>33.
LWDmarsh</td><td>Number of LWD projecting at least 1m above the wetland surface:
<table>
<tr><th># LWD above surface</th><th>score</th></tr>
<tr><td>0</td><td>0.01</td></tr>
<tr><td>1-4</td><td>0.25</td></tr>
<tr><td>5-9</td><td>0.50</td></tr>
<tr><td>10-30</td><td>0.75</td></tr>
<tr><td>>30</td><td>1.00</td></tr>
</table></td><td>score #33:
certainty #33:</td><td>Used for: LbirdM.</td></tr>
<tr><td>34.
LWDline</td><td>Driftwood line as % of wetland’s upland edge length:
<table>
<tr><th>%</th><th>score</th></tr>
<tr><td>0</td><td>0.01</td></tr>
<tr><td>1-9</td><td>0.25</td></tr>
<tr><td>10-29</td><td>0.50</td></tr>
<tr><td>30-59</td><td>0.75</td></tr>
<tr><td>>59</td><td>1.00</td></tr>
</table></td><td>score #34:
certainty #34:</td><td>Driftwood line = LWD arranged naturally in a linear pattern, usually parallel to upland, as a result of tides. (Driftwood lines are often close to the elevation of annual high tide)
Used for: Inv, LbirdM, [Afish, Mfish, Rfish, NFW, Sbird.]</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr>
<td>35.
TribL</td>
<td>Cumulative length (in miles) of fish-accessible non-tidal tributary channels that feed into the wetland:
<table>
<tr><th>length</th><th>score</th></tr>
<tr><td><3mi.</td><td>0.01</td></tr>
<tr><td>3-10mi.</td><td>0.05</td></tr>
<tr><td>>10mi.</td><td>1.00</td></tr>
</table>
</td>
<td>score #35:
certainty #35:</td>
<td>Measure only the tributary channels that pass through the wetland. Don’t count the adjoining main river channel. Estimate length beginning at the wetland’s upland margin and extending to the upstream limit of fish-accessible waters. ODFW has information on salmonid use areas: rainbow.dfw.state.or.us/nrimp/information/fishdistmaps.htm

Used for: Xpt, Inv, Afish, NFW, Dux, LbirdM, [Mfish, Rfish, Sbird].</td>
</tr>
<tr>
<td>36.
Fresh</td>
<td>Types of freshwater sources that feed the wetland internally.

Select the maximum score in each group and then sum the two maxima:
<table>
<tr><th>Group A: Flowing into the wetland</th><th>score</th></tr>
<tr><td><i>perennial</i> fresh tributary</td><td>4</td></tr>
<tr><td><i>intermittent</i> fresh tributary or stormwater pipe</td><td>2</td></tr>
<tr><td>neither</td><td>0</td></tr>
</table>
<table>
<tr><th>Group B: Adjoining on the uphill side</th><th>score</th></tr>
<tr><td>large* non-tidal freshwater wetland, pond, or spring</td><td>4</td></tr>
<tr><td>small non-tidal wetland, seep, or <i>hydric</i> soil patch</td><td>3</td></tr>
<tr><td>other land cover, and tidal wetland is not an island</td><td>1</td></tr>
<tr><td>tidal wetland occupies nearly all of an island</td><td>0</td></tr>
</table>
* wider than the tidal wetland (width measured perpendicular to slope)</td>
<td>sum = score
0 = 0.01
1 = 0.1
2 = 0.2
3 = 0.3
4 = 0.5
5 = 0.7
6 = 0.8
7 = 0.9
8 = 1.00
score #36:
certainty #36:</td>
<td>Do not count major rivers adjoined by the wetland as freshwater sources. <i>Perennial</i> tributaries flow year-round most years. <i>Intermittent</i> tributaries flow seasonally and have recognizable channels extending uphill at least twice the width of the tidal marsh. <i>Non-tidal</i> wetlands on the Oregon Coast are typically dominated by alder, willow, cattail, skunk cabbage, slough sedge, small-fruited bulrush, and water parsley (some of these occur to a lesser degree in tidal wetlands). <i>Adjoining</i> means present within 10m.

Oregon coastal soils considered to be <i>hydric</i> are Blacklock, Bragton, Brallier, Brenner, Chetco, Clatsop, Coquille, Depoe, Fluvaquents, Hebo, Heceta, Langlois, Riverwash, Willanch, and Yaquina. Many others contain hydric inclusions.

Used for: AProd, Afish, NFW, Dux, LbirdM, [WQ, Xpt, Inv, Mfish, Rfish, Sbird].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>scale/score</th><th>guidance</th></tr>
<tr><td>37.
Width</td><td>Wetland's width at its widest part:
<table>
<tr><th>width ft.</th><th>score</th><th>width ft.</th><th>score</th></tr>
<tr><td><100</td><td>0.01</td><td>600–700</td><td>0.6</td></tr>
<tr><td>100–200</td><td>0.1</td><td>700–800</td><td>0.7</td></tr>
<tr><td>200–300</td><td>0.2</td><td>800–900</td><td>0.8</td></tr>
<tr><td>300–400</td><td>0.3</td><td>900–1,000</td><td>0.9</td></tr>
<tr><td>400–500</td><td>0.4</td><td>>1,000</td><td>1.0</td></tr>
<tr><td>500–600</td><td>0.5</td><td></td><td></td></tr>
</table></td><td>score #37:
certainty #37:</td><td>Measure this as a perpendicular line from aquatic (unvegetated river or bay edge or tideflat) to upland edge. If site is an island with no upland, measure to the water edge on opposite side of the island.
Used for: WQ, Xpt, Dux, Sbird.</td></tr>
<tr><td>38.
MudW</td><td>Maximum width of largest tideflat that adjoins the wetland:
<table>
<tr><th>width ft.</th><th>score</th><th>width ft.</th><th>score</th></tr>
<tr><td><100</td><td>0.01</td><td>600–700</td><td>0.6</td></tr>
<tr><td>100–200</td><td>0.1</td><td>700–800</td><td>0.7</td></tr>
<tr><td>200–300</td><td>0.2</td><td>800–900</td><td>0.8</td></tr>
<tr><td>300–400</td><td>0.3</td><td>900–1,000</td><td>0.9</td></tr>
<tr><td>400–500</td><td>0.4</td><td>>1,000</td><td>1.0</td></tr>
<tr><td>500–600</td><td>0.5</td><td></td><td></td></tr>
</table></td><td>score #38:
certainty #38:</td><td>Measure this using a USGS topographic map or (preferably) field observation at low tide, as a perpendicular to the external edge of wetland, or measure it to the external edge of other wetlands or flats on either side (contiguous to the wetland being measured).
Used for: NFW, Sbird.</td></tr>
<tr><td>39.
Roost</td><td>[Skip if the wetland contains no low marsh.]
Number of types of potential shorebird roosts within 1.5 mi. of the center of the wetland (check all that are present):
__ treeless high marsh, mostly wider than 300 ft
__ treeless uninhabited islands (dry at high tide)
__ beaches or bars, mostly wider than 100 ft at high tide
__ nontidal marsh/pond, mostly wider than 300 ft
__ unvegetated dike or jetty
__ seasonally flooded pasture >40 acres
__ sewage treatment lagoon
Add the number of checkmarks and use scale at right to derive score.</td><td>0 = 0.01
1 = 0.25
2-3 = 0.50
4-5 = 0.75
6-7 = 1.00
score #39:
certainty #39:</td><td>Include these if they occur within the wetland as well.
Used for: Sbird.</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>40.
Island</td>
<td>Wetland comprises all or part of an uninhabited island:
<table>
<tr><th>description</th><th>score</th></tr>
<tr><td>wetland comprises all or part of island; <i>and</i> the island contains essentially no high marsh or undeveloped upland, i.e., is completely underwater during daily high tide</td><td>0.01</td></tr>
<tr><td>wetland comprises all or part of island; <i>and</i> the island contains some high marsh and/or undeveloped upland, this being less than the area of low marsh</td><td>0.33</td></tr>
<tr><td>wetland comprises all or part of island; <i>and</i> the island contains some high marsh and/or undeveloped upland, this being greater than the area of low marsh</td><td>0.66</td></tr>
<tr><td>wetland does not comprise all or part of island</td><td>1.00</td></tr>
</table>
</td>
<td>score #40:
certainty #40:</td>
<td><i>Island</i> = land not permanently flooded and completely separated from upland at low tide by water at least 3 ft deep and 20 ft wide.
Used for: Inv, Dux, LbirdM, [Afish, Mfish, Rfish, Sbird, NFW].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>41.
Fetch</td>
<td>Direction and distance of external edge’s exposure to intense wave and/or river current action.
Enter the maximum appropriate number in the box to the right.
<table>
<tr><th></th><th colspan="3">SE, S, or SW exposure, and distance is:</th></tr>
<tr><th></th><th><100’</th><th>100 – 1,000’</th><th>>1,000’</th></tr>
<tr><td>External edge mostly protected by dikes, levees, upland topography.</td><td>0.01
(or marsh’s external edge faces a direction other than SE, S. or SW)</td><td>0.01</td><td>0.01</td></tr>
<tr><td>Gradual <i>drop-off</i> to deeper water; and large-boat traffic and severe river floods are both infrequent.</td><td>0.3</td><td>0.6</td><td>0.8</td></tr>
<tr><td>Sharp drop-off to deeper water; and/or large-boat traffic nearby; and/or large river floods are frequent. No protection. Driftwood often abundant.</td><td>0.5</td><td>0.8</td><td>1.00</td></tr>
</table>
</td>
<td>score #41:
certainty #41:</td>
<td><i>Dropoff</i> = the slope and bathymetry of deeper-water areas within about 30 ft of the marsh edge, not just to the marsh edge itself.
If local wind data show strongest waves consistently coming from a direction other than SE, S, or SW, you may modify the headers on this table to that direction.
Used for: WQ, Inv, Dux, [Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td>
</tr>
</table>

code	indicator	scale/score	guidance
42. Pform	Number of easily-recognizable **vegetation structures** present within the wetland. Check all that predominate over at least 100 sq.ft: __ large robust grass-like plants (e.g., bulrush, cattail) __ other large native grass-like plants (mostly >8 inches long, e.g., *Deschampsia, Hordeum, Juncus*) __ fleshy, succulent plants (e.g., pickleweed) __ other non-woody plants (e.g., saltmarsh aster, other forbs) __ *nurse logs* supporting plants taller than 1 ft. __ submersed aquatics (e.g., wigeongrass or eelgrass) in internal channels or pools or externally within 50 ft. Derive score by comparing the number of items checked above with the scale in the next column.	0-2 = 0.01 3 = 0.25 4 = 0.50 5 = 0.75 6 = 1.00 **score #42:** **certainty #42:**	*Nurse logs* = large logs or stumps present on the marsh surface which, because of the elevated substrate they provide, protect germinating plants on top of the log from potentially lethal long-duration flooding and high salinity. Used for: AProd, Xpt, Inv, Dux, LbirdM, [WQ, Afish, Mfish, Rfish, NFW, Sbird].
43. FormDiv	Number of easily-recognizable **vegetation forms** within the wetland or *directly adjoining* its upland edge, from this list. For live vegetation, these *must* be present along >5% of upland edge or that comprise >5% of the wetland area: __ grazed or mowed grass and/or forbs __ ungrazed & unmowed grass and/or forbs __ shrubs 2-6 ft tall, conifer __ shrubs 2-6 ft tall, deciduous __ shrubs 6-20 ft tall, conifer __ shrubs 6-20 ft tall, deciduous __ live trees 20-60 ft tall, conifer __ live trees 20-60 ft tall, deciduous __ live trees >60 ft tall, conifer __ live trees >60 ft tall, deciduous __ standing snags, <6" diameter __ standing snags, >6" diameter Derive score by comparing the number of items checked above with the scale in the next column.	1 = 0.01 2 = 0.2 3 = 0.3 4 = 0.4 5 = 0.5 6 = 0.6 7 = 0.7 8 = 0.8 9 = 0.9 >9 = 1.0 **score #43:** **certainty #43:**	*Directly adjoining* = unobscured by a tree canopy. Used for: Inv, LbirdM, [Afish, Mfish, Rfish, NFW, Sbird].

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>44.
Alder</td><td>Percent of upland edge bounded (within 50 ft.) by alder:<table><tr><th>%</th><th>score</th></tr><tr><td><1 (or no upland)</td><td>0.01</td></tr><tr><td>1-10</td><td>0.33</td></tr><tr><td>10-50</td><td>0.66</td></tr><tr><td>>50</td><td>1.00</td></tr></table></td><td>score #44:
certainty #44:</td><td>Other deciduous plant species known to fix nitrogen (not simply take it up from the soil) may be included as well.
Used for: Inv, [Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td></tr>
<tr><td>45.
Eelg</td><td>Presence of eelgrass (either species):<table><tr><th>presence</th><th>score</th></tr><tr><td>not detected</td><td>0.01</td></tr><tr><td>observed only in adjoining waters or flats</td><td>0.50</td></tr><tr><td>observed within the wetland’s internal channels</td><td>1.00</td></tr></table></td><td>score #45:
certainty #45:</td><td>Based either on observations from shore (up to 50 ft. away), boat, or published reports or maps. “Certainty” should be scored low if no eelgrass is detected because detection at a distance can be difficult or impossible.
Used for: Inv, Dux, [Afish, Mfish, Rfish, NFW, Sbird, LbirdM].</td></tr>
<tr><td>46.
SoilFine</td><td><i>Predominant</i> soil texture in most of the wetland:<table><tr><th>soil texture</th><th>score</th></tr><tr><td>coarse sand, gravel</td><td>0.01</td></tr><tr><td>fine sand</td><td>0.40</td></tr><tr><td>silt, loam, muck, peat</td><td>1.00</td></tr></table></td><td>score #46:
certainty #46:</td><td>Assess this from county soil survey maps, unless better data are available from onsite examination of the upper 12 inches of the soil at several locations in the wetland.
<i>Predominant</i> = occupying the greatest proportion of the surface area of a site.
Used for: WQ.</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>47.
EstuSal</td>
<td>Tidal marsh acreage in this wetland’s major estuary:
<table>
<tr><th>description</th><th>score</th></tr>
<tr><td>Tidal marshes are absent (or nearly absent) from two of the three salinity zones (fresh, brackish, saline): Netarts, Siltcoos, Tenmile, Elk River, Chetco.</td><td>0.01</td></tr>
<tr><td>Tidal marshes are absent (or nearly so) from one of the three salinity zones, with one of the two remaining zones having much more marsh acreage than the other: Sand Lake, Salmon, Beaver Cr., Coquille, New River, Rogue, Winchuck.</td><td>0.33</td></tr>
<tr><td>Tidal marshes are present in all three zones, with one zone containing more than 50% of the estuary’s marsh acreage: Nehalem, Tillamook, Nestucca, Yaquina, Alsea, Coos.</td><td>0.66</td></tr>
<tr><td>Tidal marshes are present in all three zones, with no zone containing more than 50% of the estuary’s marsh acreage: Necanicum, Siletz, Siuslaw, Umpqua.</td><td>1.00</td></tr>
</table>
</td>
<td>score #47:
certainty #47:</td>
<td>The salinity zones are not based on salinity within the wetland, but rather in the adjoining bay or river.
These categorizations of estuaries are based on very limited salinity data and may be revised.
Used for: Afish, Mfish, Rfish, [WQ, Inv, NFW, Sbird, LbirdM].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>48.
SeaJoin</td><td>Estuary connection with ocean.
<table><tr><th>description</th><th>score</th></tr><tr><td>Estuarine connection to ocean is lost regularly, at least once every 1-10 yrs (some “blind” estuaries and coastal lagoons).</td><td>0.01</td></tr><tr><td>Usually connected to ocean, and almost the entire estuary is saline due to minimal freshwater input (as in some “bar built” estuaries).</td><td>0.50</td></tr><tr><td>Always connected to ocean, with much freshwater input from feeder streams and/or river.</td><td>1.00</td></tr></table></td><td>score #48:
certainty #48:</td><td>Used for: Afish, Mfish, [NFW].</td></tr>
<tr><td>49.
Estu%WL</td><td>Relative dominance of undiked tidal wetlands in this estuary.

Use the score from the appropriate estuary in this list:

Alsea = 0.8; Beaver Cr .= 0.9; Chetco = 0.1; Coos Bay = 0.7;
Coquille = 0.5; Ecola = 0.5; Elk R. = 0.3; Euchre-Greggs Cr. = 0.3;
Necanicum = 0.7; Nehalem = 0.9; Nestucca = 0.4; Netarts = 1.0;
New River = 0.8; Pistol = 0.2; Rogue = 0.2; Salmon = 1.0;
Sand Lake = 0.3; Siletz = 0.9; Siltcoos = 0.5; Siuslaw = 1.0;
Sixes= 0.2; Ten Mile = 0.8; Tillamook = 0.6; Two Mile = 0.4;
Umpqua = 0.7; Winchuck = 0.1; Yaquina = 0.8</td><td>score #49:
certainty #49:</td><td>Numbers were based on ratio of tidal marsh to subtidal water, as well as on total acres of tidal marsh. They do not account for previous extent or historical losses of tidal wetlands.

Used for: Afish, [NFW].</td></tr>
</table>

Data Form B2. Rapid Indicators of Function Requiring Aerial Photographs or Measuring Equipment

This form includes indicators known from technical literature or reasoned ecological principles to be associated with one or more of the 12 key functions of tidal wetlands. Some of the indicators were correlated statistically with one or more indicators of risk from Form A1. Others were uncorrelated, either due to the imprecision with which they and/or the Risk indicators were estimated, or to their being intrinsically unaffected by human activities. The uncorrelated functions were included because of their importance to assessing the functions, as documented in Part 2 of this guidebook. Note: A higher number for a particular indicator below does not always mean greater function–the number depends on the function and the indicator. Italicized terms are defined in the last column. Abbreviations for functions in the last column are shown in Appendix B.

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>50.
WetField%</td>
<td>Percent of land within 1.5 mi. that appears (in a 1:24,000 scale aerial photograph) to be ponds, lakes, nontidal marsh, sewage lagoons, cropland, or pasture in <i>flat terrain.</i>
<table>
<tr><th>%</th><th>score</th></tr>
<tr><td><5</td><td>0.01</td></tr>
<tr><td>5-9</td><td>0.25</td></tr>
<tr><td>10-19</td><td>0.50</td></tr>
<tr><td>20-29</td><td>0.75</td></tr>
<tr><td>>29</td><td>1.00</td></tr>
</table>
</td>
<td>score #50:
certainty #50:</td>
<td><i>Flat terrain</i> = slopes less than about 10%.
After drawing a circle of 1.5 mi. radius from the wetland center (4 inches on a 1:24,000 scale aerial photograph or map), measure the acreage of the named cover types and divide by 45.24 to get the percent. Performing this measurement with a GIS is preferred.
If no access to aerial photographs, attempt to estimate but score certainty “0.01”.
Used for: NFW, Sbird, Dux.</td>
</tr>
<tr>
<td>51.
BuffCov</td>
<td>Percent of the area surrounding this wetland that appears (in a 1:24,000 scale aerial photograph) to be <i>developed</i> or <i>persistently bare</i>.
<table>
<tr><th></th><th><5%</th><th>6-14%</th><th>15-24%</th><th>>25%</th></tr>
<tr><td>within 1500 ft:</td><td>0.50</td><td>0.25</td><td>0.15</td><td>0.10</td></tr>
<tr><td>within 3000 ft:</td><td>0.50</td><td>0.20</td><td>0.10</td><td>0.01</td></tr>
</table>
Select one number from each row and sum them to derive the score.
</td>
<td>score #51:
certainty #51:</td>
<td><i>Developed</i> = lawns, landscaping, pavement, buildings.
<i>Persistently bare</i> = bare compacted soil or rock (not sand dunes).
After drawing a circle of 1500 ft. outward from the wetland center (3/4 inch on a 1:24000 aerial photograph or map), subtract from 162 acres (the area of the circle) the acreage of any included tidelands. Then divide the developed acres you measured by this number. Do likewise for the 3000’ circle, but substitute 650 for 162. Multiply the results by 100 to get percent. Performing this measurement with a GIS is preferred. If no access to aerial photographs, attempt to estimate but score certainty “0.01”.
Used for: NFW, LbirdM.</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr><td>52.
BlindL</td><td>Internal channel complexity.

While viewing a 1:24,000 scale aerial photograph, imagine all the wetland's <i>blind channel</i> segments strung end-to-end and straightened out. Relative to the wetland's <i>width</i>, would their cumulative length be:

<table>
<tr><th>length relative to width</th><th>score</th></tr>
<tr><td>less than half (50%)</td><td>0.01</td></tr>
<tr><td>50-100%</td><td>0.20</td></tr>
<tr><td>1-1.9 times longer</td><td>0.40</td></tr>
<tr><td>2-2.9 times longer</td><td>0.60</td></tr>
<tr><td>3-3.9 times longer</td><td>0.80</td></tr>
<tr><td>>3.9 times longer</td><td>1.00</td></tr>
</table></td><td>score #52:

certainty #52:</td><td><i>Blind channels</i> = channels located entirely within the wetland (do not originate in adjoining uplands) that flood with the incoming tide.

<i>Width</i> = the wetland's maximum width measured perpendicular to adjoining bay or river.

If no access to aerial photographs, attempt to estimate but score certainty "0.01".

Used for: AProd, WQ, Xpt, Inv, Afish, Mfish, Rfish, [NFW, Sbird, LbirdM].</td></tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>53.
Exits</td>
<td>Number of internal channel exits.

Count these using a 1:24000 aerial photograph and enter in the bottom box (“datum”) in the next column.

Then in the top row of the relevant table below (A or B), find the wetland edge length. In that column find the number of channel <i>exits</i> this wetland has. Then look along that row to the last column for the resulting score.

A. Wetlands on silt, clay, or muck substrate:
<table>
<tr><th colspan="3">length of <i>external wet edge</i> (ft)</th><th rowspan="2">score</th></tr>
<tr><th><1000’</th><th>1000-3400’</th><th>>3400’</th></tr>
<tr><td>0 exits</td><td>0 exits</td><td>0 exits</td><td>0.01</td></tr>
<tr><td>1</td><td>1-2</td><td>1-3</td><td>0.25</td></tr>
<tr><td>2</td><td>3-5</td><td>4-6</td><td>0.50</td></tr>
<tr><td>3-4</td><td>6-10</td><td>7-12</td><td>0.75</td></tr>
<tr><td>>4</td><td>>10</td><td>>15</td><td>1.00</td></tr>
</table>

B. Wetlands on sand substrate:
<table>
<tr><th>exits</th><th>score</th></tr>
<tr><td>0</td><td>0.01</td></tr>
<tr><td>1</td><td>0.50</td></tr>
<tr><td>>1</td><td>1.00</td></tr>
</table>
</td>
<td>score #53:

certainty #53:

datum #53:</td>
<td><i>Exits</i> = where internal channels flow into unvegetated waters or tideflats outside of the wetland.

<i>External wet edge length</i> is measured as the wetland’s edge with unvegetated water or tideflat at low tide. For channels that connect at both ends to a tideflat or unvegetated bay or river, count both ends as exits. Do not count constructed drainage ditches.

IMPORTANT: The number of exits is strongly related to marsh size, substrate type, and HGM subclass—sometimes even more than to marsh disturbance. See note for #52, above.

If no access to aerial photographs, attempt to estimate but score certainty “0.01”.

Used for: AProd, WQ, Xpt, Inv, Afish, Mfish, Rfish, [NFW, Sbird, LbirdM].</td>
</tr>
</table>

<table>
<tr><th>code</th><th>indicator</th><th>score</th><th>guidance</th></tr>
<tr>
<td>54.
JuncMax</td>
<td>Number of internal channel junctions.

Count these along the single longest internal channel, using a 1:24000 scale aerial photograph, and enter in the bottom box ("datum") in the next column.

Then in top row of the relevant table below (A or B), find the wetland area. In that column find the number of channel <i>junctions</i> this wetland has. Then look in along that row for the last column for the resulting score.

A. Wetlands on silt, clay, or muck substrate:
<table>
<tr><th colspan="3">wetland area (acres)</th><th rowspan="2">score</th></tr>
<tr><th>< 8</th><th>8-30</th><th>>30</th></tr>
<tr><td>0 jcts</td><td>0 jcts</td><td>0 jcts</td><td>0.01</td></tr>
<tr><td>1</td><td>1</td><td>1-4</td><td>0.50</td></tr>
<tr><td></td><td>2-3</td><td>5-7</td><td>0.75</td></tr>
<tr><td>>1</td><td>>3</td><td>>8</td><td>1.00</td></tr>
</table>

B. Wetlands on sand substrate:
<table>
<tr><th>junctions</th><th>score</th></tr>
<tr><td>0</td><td>0.01</td></tr>
<tr><td>1</td><td>0.50</td></tr>
<tr><td>>1</td><td>1.00</td></tr>
</table>
</td>
<td>score #54:

certainty #54:

datum #54:</td>
<td><i>Junctions</i> = visible confluences between two internal tidal channels regardless of their relative sizes.

Do not count constructed drainage ditches.

Important: The number of channel junctions is strongly related to marsh size, substrate type, and HGM subclass – sometimes even more than to marsh disturbance. See note for #52, above.

If no access to aerial photographs, attempt to estimate but score certainty "0.01".

Used for: AProd, WQ, Xpt, Inv, Afish, Mfish, Rfish, [NFW, Sbird, LbirdM].</td>
</tr>
<tr>
<td>55.
FreshSpot</td>
<td>Internal freshwater.

At a given point in time, the maximum difference between salinity in unconfined waters within the wetland vs. outside the wetland is:
<table>
<tr><th>difference</th><th>score</th></tr>
<tr><td>internal is <10 ppt fresher, or is more saline</td><td>0.01</td></tr>
<tr><td>internal is 10-20 ppt fresher</td><td>0.50</td></tr>
<tr><td>internal is >20 ppt fresher</td><td>1.00</td></tr>
</table>
</td>
<td>score #55:

certainty #55:</td>
<td>Measure salinity from tidal water (internal channel or pool), preferably around the time of low tide, and subtract from salinity measured (almost) simultaneously in the adjoining bay or river. If possible, repeat during other seasons and use the greatest differential, which often is in mid-summer. Do not measure if any rainfall has occurred in last 24 hours.

If no access to a refractometer, attempt to categorize based on any observed sources of freshwater input, but score certainty "0.01".

Used for: AProd, Afish, NFW, Dux, LbirdM, [WQ, Xpt, Inv].</td>
</tr>
</table>

Data Form C. Rapid Indicators of the Values of Functions

Logs large enough to be elevated substantially above the surface provide perches for birds that forage in tidal marshes.

This optional form for assessing **values** of functions is perhaps the most time-consuming and requires the most thought and background investigation. The required information *often will not exist* for a particular site and may be unobtainable in the short-term. Nonetheless, values of functions are important in assessing fairly the overall importance of particular tidal wetlands. Much of the form can be completed in the office and by consulting other resource professionals and local citizens. It is best to complete this form after assessing functions with forms B1 and B2. Note that the form is organized around functions, with one set of questions for each of the 12 tidal wetland functions (in a few cases, multiple functions are grouped). For each row, place a check mark in whichever column seems to better reflect the wetland you're assessing. Alternatively, you may score each value indicator on a scale of 0 (lowest value) to 1.0 (highest value) and place the score in the middle column of each row. If some of the requested information is not available, proceed with other items in the assessment. Then copy your data to the accompanying spreadsheet. If you wish, you may assign weights to each row, but there is no defensible way of mathematically combining the scores for individual values into an overall value score for each function (i.e., no total "values" scoring models). Note that these are proscriptive as well as descriptive evaluations–designed to help prioritize as well as describe.

Primary Production and Exporting Aboveground Production

highest function value	**suggested score (0 to 1)**	**lowest function value**
___ The wetland's tidal marsh plants are extensively and sustainably grazed, and livestock are an important part of the local economy.	**#101:**	___ The wetland currently is not grazed and, due to wetness or its location, has little potential as pasture.
___ The wetland's estuary has not experienced major die-offs of marine animals as a result of diminished dissolved oxygen.	**#102:**	___ The wetland's estuary has experienced frequent and major die-offs of marine animals as a result of diminished dissolved oxygen, and the wetland is near the estuary mouth or other areas where this has occurred.
___ Uplands in this estuary, especially those closest to the water, are largely devoid of vegetation, e.g., sand dunes, pavement.	**#103:**	___ Uplands in this estuary are completely vegetated.
___ The site is one of only a few, or is one of the largest ones, of its subclass* in this estuary that supports and exports primary production to at least this degree.	**#104:**	___ Sites of this subclass and size that support and/or export primary production to this degree are relatively abundant in this estuary.
___ Other factors suggest that primary production specifically from this wetland is of unusually great importance to food webs located in the wetland or in receiving waters of the adjoining estuary or river. Explain:	**#105:**	___ Other factors suggest that primary production specifically from this wetland is not especially important to food webs located in the wetland or in receiving waters of the adjoining estuary or river. Explain:

* Tidal wetlands are provisionally labeled by their HGM subclasses in maps on the accompanying DVD.

Maintaining Element Cycling Rates and Pollutant Processing and *Stabilizing Sediment*

highest function value	**suggested score:**	**lowest function value**
opportunity to perform these functions:		
___ Element inputs to the wetland may be relatively large as suggested by a score of 1.00 for items NutrIn, ChemIn, BuffAlt, and/or SedShed in the accompanying spreadsheet.	**#106:**	___ Element inputs to the wetland may be relatively small as suggested by a score of 0.01 for NutrIn, ChemIn, BuffAlt, and/or SedShed.
___ Large populations of salmon spawn very near the wetland.	**#107:**	___ Populations of spawning salmon are absent from this river basin.
___ Substantial volumes of woody and other organic matter enter the river or estuary a short distance upriver from the wetland as a result of recent fires, logging, or other factors.	**#108:**	___ Inputs of woody and other organic matter to the wetland are probably at or below historical (pre-settlement) rates.
___ Validated computer models of watershed processes indicate major net influx of sediments, nutrients, or metals to this estuary and wetland.	**#109:**	___ Validated computer models of watershed processes indicate no major delivery of sediments, nutrients, or metals to this estuary or wetland.
significance of this wetland (assuming these functions occur):		
___ The site is near the estuary's main head of tide.	**#110:**	___ The site is near the estuary mouth (where its individual effect, if any, may be dwarfed by marine circulation).
___ Rapid sedimentation and shoaling near the mouth of this estuary is a major concern and expense and/or the estuary is regularly dredged.	**#111:**	___ Sedimentation and shoaling near the mouth of this estuary are not a major concern or expense; no dredging occurs.
___ The wetland's estuary has experienced frequent and major die-offs of marine animals as a result of diminished dissolved oxygen. The wetland is capable of processing internally much of the carbon it produces or imports, and thus avoids contributing to this problem. The wetland also is near the estuary mouth or other areas where severe oxygen deficits have occurred.	**#112:**	___ The wetland's estuary has not experienced major die-offs of marine animals as a result of diminished dissolved oxygen.
___ The wetland is one of only a few of its subclass and size in this estuary that may stabilize sediments, remove nitrogen, and/or process carbon & pollutants to this or greater degree.	**#113:**	___ Wetlands of this subclass and size, that remove nitrogen or process carbon & pollutants to this or greater degree, are abundant in this estuary.
___ Other factors suggest that element cycling and removal functions of this wetland are of unusually great importance to biological or human resources in the wetland or in receiving waters of the estuary or river. Explain:	**#114:**	___ Other factors suggest that element cycling and removal functions of this wetland are not atypically important to biological or human resources in the wetland or in receiving waters of the estuary or river. Explain:

Maintaining Invertebrate Habitat

highest function value	**suggested score:**	**lowest function value**
___ This estuary ranks as one of the best for revenue and/or jobs from harvesting of crabs and other native mobile invertebrates.	**#115:**	___ This estuary supports little or no revenue and/or jobs from harvesting of native crabs and other native mobile invertebrates.
___ The wetland is one of a very few known on the Oregon coast known to be used by a particular native invertebrate species, and it otherwise supports a normal assemblage of invertebrates..	**#116:**	___ All invertebrate species known from this wetland are widespread in tidal wetlands of the Oregon coast.
___A large portion of the uplands and deeper waters near this wetland have very limited capacity to support invertebrates, e.g., largely devegetated, chemical contamination, frequent soil or sediment disturbance.	**#117:**	___ Upland and deepwater areas near this wetland have considerable capacity to support invertebrates, e.g., land cover is mostly unaltered, sedimentation is normal, there is little or no chemical contamination.
___ The site is one of only a few, or is one of the largest ones, of its subclass in this estuary that support native invertebrates to this or greater degree.	**#118:**	___ Sites of this subclass and size that support native invertebrates to this or greater degree are relatively abundant in this estuary.
___ Other factors suggest that invertebrate species or densities produced at this site are of unusually great importance to food webs or ecological processes in the wetland or its estuary. Explain:	**#119:**	___ Other factors suggest that invertebrate species or densities produced at this site are not atypically important to food webs or ecological processes in the wetland or its estuary. Explain:

Maintaining Anadromous Fish

highest function value	**suggested score:**	**lowest function value**
___ One or more federally-listed anadromous fish species or subpopulations are known to use this particular wetland frequently and extensively during critical periods.	**#120:**	___ No federally-listed anadromous fish species (or recognized subpopulation) is known from the wetland or nearby waters.
___ In the past, considerable funds have been expended to restore or enhance this particular wetland specifically for (among perhaps many objectives) anadromous fish.	**#121:**	___ In the past, no funds have been expended to restore or enhance this particular wetland specifically for anadromous fish.
___ The site is one of only a few, or is one of the largest ones, of its subclass and size in this estuary that supports anadromous fish to this or greater degree.	**#122:**	___ Sites of this subclass and size that support anadromous fish to this or greater degree are relatively abundant in this estuary.

Maintaining Habitat for Resident Fish and *Maintaining Habitat for Visiting Marine Fish*

highest function value	**suggested score:**	**lowest function value**
___ This estuary ranks as one of the best for revenue and/or jobs from harvesting of resident and visiting marine fish.	**#123:**	___ This estuary supports little or no revenue and/or jobs from harvesting of resident and visiting marine fish.
___ The wetland is one of a very few on the Oregon coast known to be used by a particular non-anadromous fish.	**#124:**	___ All non-anadromous fish species known from this wetland are widespread in tidal wetlands of the Oregon coast.
___ The wetland or closely connected waters provide some of the most consistently productive fishing for native tidal marsh fish species and/or marine species on the Oregon coast.	**#125:**	___ Site does not provide atypically productive fishing for any native tidal marsh fish species or marine species on the Oregon coast.
___ The site is one of only a few, or is one of the largest ones, of its subclass in this estuary that supports non-anadromous fish to at least this degree.	**#126:**	___ Sites of this subclass and size that support non-anadromous fish to this degree or greater are relatively abundant in this estuary.
___ Other factors suggest that non-anadromous fish species or densities of native mobile invertebrates inhabiting the wetland are of unusually great importance to food webs or ecological processes in the wetland or closely connected waters. Explain:	**#127:**	___ Other factors suggest that non-anadromous fish species or densities of native mobile invertebrates inhabiting the wetland are not atypically important to food webs or ecological processes in the wetland or closely connected waters. Explain:

Maintaining Habitat for Ducks and Geese **and** ***Maintaining Habitat for Shorebirds***

Some potential sources of data:

www.ohjv.org/pdfs/northern_oregon_coast.pdf
www.ohjv.org/pdfs/southern_oregon_coast.pdf
www.oregoniba.org/
www.oregoniba.org/links.htm
www.wetlandsconservancy.org/oregons_greatest.html
audubon2.org/webapp/watchlist/viewWatchlist.jsp

highest function value	suggested score:	lowest function value
___ The wetland is consistently and/or extensively used by many waterbird species that are regionally uncommon and/or have declining populations in the Pacific Northwest.	**#128:**	___ All waterbird species that regularly use the wetland are common and widespread over most of the Oregon coast, and the wetland is distant from areas used by waterbird species that are regionally uncommon and/or have declining populations in the Pacific Northwest.
___ The wetland is one of a very few that contains habitat conditions identified as optimal for one or more particularly rare and/or regionally declining waterbird species.	**#129:**	___ The wetland does not contain habitat suitable for any particularly rare and/or regionally declining waterbird species, nor is it near such areas.
___ The wetland or its estuary was identified as being of exceptional importance for waterbirds by the Oregon Wetland Joint Venture Plan, North American Waterfowl Management Plan, or the North American Shorebird Plan.	**#130:**	___ Neither the wetland nor its estuary was identified as being of exceptional importance for waterbirds by the named documents, and is distant from such areas.
___ The wetland or its estuary is registered or has been formally proposed as an Important Bird Area (IBA) of the National Audubon Society.	**#131:**	___ The wetland is not within an estuary that is registered or formally proposed as an IBA, and is distant from such areas.
___ Other factors suggest that waterbird species or densities at this site are of unusually great importance to food webs or ecological processes in the wetland or estuary.	**#132:**	___ Other factors suggest that waterbird species or densities at this site are not atypically important to food webs or ecological processes in the wetland or estuary.
___ In the past, considerable funds have been expended to restore or protect specifically the suitability of this particular wetland for (among perhaps many objectives) waterbird habitat.	**#133:**	___ In the past, no funds have been expended to restore or protect specifically the suitability of this particular wetland for waterbird habitat.
___ The site is one of only a few, or is one of the largest ones, of its subclass in this vicinity that support waterbirds to this degree.	**#134:**	___ Sites of this subclass and size that support waterbirds to at least this degree are relatively abundant in this estuary and elsewhere on the Oregon coast.

Maintaining Habitat for Native LandBirds, Small Mammals, and Their Predators and *Maintaining Habitat for Nekton-feeding Birds*

Some potential sources of data:

oregonstate.edu/ornhic/
www.oregoniba.org/
www.oregoniba.org/links.htm
audubon2.org/webapp/watchlist/viewWatchlist.jsp

highest function value	suggested score:	lowest function value
___ The wetland is consistently and/or extensively used by native land bird or mammal species that are listed as Threatened, Endangered, or Sensitive, or are recognized as conservation priority species or communities by Partners-in-Flight or the Oregon Natural Heritage Program.	#135:	___ No such species or communities are present in the wetland or nearby parts of the estuary.
__ Other native land bird or mammal species that are regionally uncommon and/or have declining populations in the Pacific Northwest are consistently and/or extensively present in the wetland.	#136:	___ All native land bird or mammal species that use this wetland occur widely on the Oregon coast and none are known to be declining at a regional scale.
___The wetland is one of a very few that contains habitat conditions identified as optimal for one or more particularly rare and/or regionally declining wetland-associated bird species (other than waterbirds).	#137:	___ The wetland does not contain habitat suitable for any particularly rare and/or regionally declining, wetland-associated bird species (excluding waterbird species).
___ Other factors suggest native land bird or mammal species or densities at this site are of unusually great importance to food webs or ecological processes in the wetland or its estuary.	#138:	___ Other factors suggest that native land bird or mammal species or densities at this site are not atypically important to food webs or ecological processes in the wetland or its estuary.
___ In the past, considerable funds have been expended to restore specifically the suitability of this particular site for (among perhaps many objectives) wetland-associated native land birds or mammals.	#139:	___ In the past, no funds have been expended to restore specifically the suitability of this particular site for wetland-associated native land bird or mammal species.
___ The site is one of only a few, or is one of the largest ones, of its subclass in this vicinity that support wetland-associated native land bird or mammal species to this degree.	#140:	___ Sites of this subclass and size that support native land bird or mammal species to this degree are relatively abundant both locally and regionally.

Maintaining Natural Botanical Conditions

Some potential sources of data:

www.oregonstate.edu/ornhic
www.npsoregon.org
cladonia.nacse.org/platlas/jclass/OPAJava20.htm
ocid.nacse.org/cgi-bin/qml/herbarium/plants/vherb.qml

highest function value	**suggested score:**	**lowest function value**
___ Site contains many native plant species or associations that are uncommon and/or have declining populations in Oregon coastal tidelands. This may include, but is not limited to, species categorized as G1, G2, S1, or S2 by the Oregon Natural Heritage Program.	**#141:**	___ All plant species and associations at this site also occur widely in Oregon coastal tidelands, and none have been documented to be declining in the ecoregion.
___ Site is one of a very few that contains habitat conditions identified as optimal for one or more particularly rare and/or regionally declining native plant species or associations. This includes, for example, sites with extensive woody vegetation (especially Sitka spruce) that are regularly flooded by tides. In Oregon this is a relatively rare type of wetland that has declined dramatically.	**#142:**	___ Site does not contain habitat suitable for any particularly rare and/or regionally declining native plant species or association.
___ Other factors suggest that native plants at this site are of unusually great importance to food webs or ecological processes located onsite or in the region generally.	**#143:**	___ Other factors suggest that native plants at this site are not atypically important to food webs or ecological processes located onsite or in the region generally.
___ The site is one of only a few, or is one of the largest ones, of its subclass in this estuary that support native tidal vegetation to this degree.	**#144:**	___ Sites of this subclass and size that support characteristic vegetation to this degree are relatively abundant both in this estuary and regionally.
___ In the past, considerable funds have been expended to restore specifically the suitability of this particular site for unusual or characteristic native plant species or associations.	**#145:**	___ In the past, no funds have been expended to restore specifically the suitability of this particular site for native plant species.

Other Factors Potentially Relating to Value or Concern

A potential source of data:

www.coastalatlas.net/metadata/TidalWetlandsofOregonsCoastalWatersheds,Scranton,2004.htm

highest concern	**suggested score:**	**lowest concern**
__ Loss of tidal wetlands has been greater in this estuary than in any other on the Oregon Coast.	**#146:**	__ Loss of tidal wetlands has been less in this estuary than in any other on the Oregon Coast.
__ This wetland is the only one of its HGM subclass in this estuary.	**#147:**	__ This wetland belongs to an HGM subclass that is the most common one in this estuary.
__ The wetland belongs to an HGM subclass that has experienced the most losses of any tidal HGM subclass in this estuary.	**#148:**	__ The wetland belongs to an HGM subclass that has experienced the lowest losses (or greatest gain) of any tidal HGM subclass in this estuary.
__ The entire wetland is designated as a Hazardous Waste Site.	**#149:**	___ No portion of the wetland or its immediate tributaries is designated as a Hazardous Waste Site.
__ Much of the wetland is known to contain artifacts of high archaeological importance.	**#150:**	__ None of the wetland is known to contain artifacts of high archaeological importance.
__ The wetland is visited by many people engaging in activities that are compatible (in moderation) with its natural functions, e.g., kayaking, educational tours, hunting, fishing, birding.	**#151:**	__ The wetland is almost never visited, or is visited to such a large degree that some functions are impaired.

Vegetation Quadrat Data Form

Site:______________________________ **Date:** _________ **Times:** __________________ **Person(s):** ____________________

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Achillea millefolium																				
Agrostis stolonifera (=alba)																				
Alisma gramineum																				
Alnus rubra																				
Angelica lucida																				
Argentina egedii (= Potentilla pacifica)																				
Atriplex patula																				
Bidens cernua																				
Carex lyngbyei																				
C. obnupta																				
Castilleja ambigua																				
Cicuta douglasii																				
Cirsium arvense																				
C. vulgare																				
Cordylanthus maritimus																				
Cotula coronopifolia																				
Cuscuta salina																				
Deschampsia caespitosa																				
Distichlis spicata																				
Eleocharis palustris																				
E. parvula																				
Epilobium ciliata																				
Erechtites glomerata																				
Festuca rubra																				
F. arundinacea																				
Galium aparine																				
G. trifidum																				
Glaux maritima																				
Grindelia stricta																				
Heracleum lanatum																				
Holcus lanatus																				
Hordeum brachyantherum																				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Jaumea carnosa																				
Juncus balticus																				
J. acuminatus																				
J. bufonius																				
J. effusus																				
J. gerardii																				
J. lesueurii																				
Lathyrus palustris																				
Lilaeopsis occidentalis																				
Limonium californicum																				
Lonicera involucrata																				
Lotus corniculatus																				
Ludwigia palustris																				
Lythrum salicaria																				
Oenanthe sarmentosa																				
Parentucellia viscosa																				
Phalaris arundinacea																				
Phleum pratense																				
Picea sitchensis																				
Plantago maritima																				
Plectritis congesta																				
Puccinellia pumila																				
Ranunculus repens																				
Rumex aquaticus																				
R. conglomeratus																				
R. crispus																				
Sagittaria latifolia																				
Salicornia virginica																				
Salix spp.																				
Schoenoplectus (Scirpus) americanus																				
Isolepis (Scirpus) cernuus																				
Scirpus maritimus																				
S. microcarpus																				
S. acutus																				
Sparganium spp.																				
Spergularia canadensis																				
S. macrotheca																				
S. salina (marina)																				

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Spiraea douglasii																				
Stellaria humifusa																				
Symphyotrichum (Aster) subspicatus																				
Trifolium repens																				
T. wormskoljii																				
Triglochin concinnum																				
T. maritimum																				
Typha latifolia																				
Veronica americana																				
Vicia spp.																				

Appendix B. Abbreviations Used In This Document

Function abbreviations used in this document	description
Afish	Maintain Habitat for Anadromous Fish
AProd	Produce Aboveground Organic Matter
BotC	Maintain Natural Botanical Conditions
Dux	Maintain Habitat for Ducks and Geese
Inv	Maintain Habitat for Native Invertebrates
LbirdM	Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators
Mfish	Maintain Habitat for Visiting Marine Fish
NFW	Maintain Habitat for Nekton-feeding Birds
RA	Assessment of Risks to Wetland Integrity & Sustainability
Rfish	Maintain Habitat for Other Visiting and Resident Fish
Sbird	Maintain Habitat for Shorebirds
WI	Wetland Integrity
WQ	Maintain Element Cycling Rates and Pollutant Processing; Stabilize Sediment
Xpt	Export Aboveground Plant & Animal Production

Appendix C. Scoring Models and Scales Used to Assess the Functions

The abbreviations of the indicator variables are listed in Appendix A and in the left-hand columns of Forms B1 and B2. In the following formulas, "*" denotes multiplication. Items within parentheses are averaged (AVG) or their maximum (MAX) is taken. Calculations involving items within brackets are performed only after calculations within parentheses contained within those brackets are performed. Reasons for the particular choices of combination rules are given in Part 2 of this guidebook. The accompanying Excel™ spreadsheet will produce the same scores, but in some cases slightly different formulas were embedded for more efficient data processing.

Scoring Models

Produce Aboveground Organic Matter (AProd)
NutrIn + [(AVG: Fresh, FreshSpot) + Pform – Bare – SoilX – Shade

Export Aboveground Plant & Animal Production (Xpt)
AProd + [AVG: BlindL, Jcts, Exits, Flood, TribL, (1- Width)]

Maintain Element Cycling Rates and Pollutant Processing; Stabilize Sediment (WQ)
AProd + (AVG: BlindL, Jcts, Exits, Flood) + Width + UpEdge + SoilFine –
[AVG: TranAng, (1-RatioC), Fetch, SoilX]

Maintain Habitat for Native Invertebrates (Inv)
AProd + (AVG: BlindL, Jcts, Exits) + (AVG: Pform, FormDiv, SppPerQd) + (MAX: Eelg, Alder) + (AVG: Fetch, LWDchan, LWDline, Pannes, UpEdge) + (AVG: Fresh, FreshSpot, TribL) – Invas – ChemIn – SedShed – Instabil – (1-Island)

Maintain Habitat for Anadromous Fish (Afish)
(AVG: Flood, SeaJoin) * {AVG [Inv, Estu%WL, (AVG: BlindL, Jcts, Exits), (1-ChemIn)} + (MAX: Eelg, LWDchan) + (MAX: TribL, Fresh, FreshSpot) + EstuSal + ShadeLM

Maintain Habitat for Marine Fish (Mfish)
(AVG: Flood, SeaJoin) * {AVG [Inv, Eelg, (AVG: BlindL, Jcts, Exits), (1-ChemIn)]}

Maintain Habitat for Other Visiting and Resident Fish (Rfish)
Flood * + [(MAX: LWDchan, Eelg) + (MAX: TribL, Fresh, FreshSpot) + Pannes]

Maintain Habitat for Nekton-feeding Wildlife (NFW)
(MAX: Rfish, Afish, Mfish) + (AVG: TribL, BlindL, Exits, Jcts) + (MAX: Bare, MudW, Pannes) + (AVG: WetField%, Fresh, FreshSpot) + [AVG: BuffCov, (1-FootVis), (1-Boats)]

Maintain Habitat for Ducks and Geese (Dux)
(AVG: BlindL, Exits, Jcts, Flood) + (AVG: Eelg, Bare, MudW, NutrIn, Pform) +
(AVG: Fresh, FreshSpot, TribL) + WetField% + (1 – Fetch) + {[MAX: (Width, 1 - Island)] –
[AVG: FootVis, Boats]}

Maintain Habitat for Shorebirds (Sbird)
Inv + (MAX: Bare, Pannes, Flood) + [(MAX: Roost, MudW, WetField%) – FootVis – (AVG: FormDiv, UpEdge) – (1-Width)

Maintain Habitat for Native Landbirds, Small Mammals, & Their Predators (LBM)
[UpEdge + (AVG: Pform, BuffCov) + (AVG: SppPerQd, Inv) + (AVG: TribL, FreshW, FreshSpot) + (AVG: LWDmarsh, LWDline) – HomeDis – RoadX – Flood] * Island

Maintain Habitat for Native Botanical Conditions
SppPerQd – NNgt20

Wetland Integrity Index
AVG: Ratio C, SpDeficit, DomDef, NNdef, AnnDef, TapPCdef, StolPCdef, TuftPCdef

Scales Used for Computed Indicators

RatioC:

mean absolute difference	score
<40	**1.00**
40-59	**0.80**
60-69	**0.60**
70-99	**0.40**
100-250	**0.20**
>250	**0.01**

SpPerQd:

mean number per quad	score
<2	**0.01**
2.1-2.6	**0.10**
2.7-3.2	**0.20**
3.3-3.8	**0.30**
3.9-4.2	**0.50**
4.3-4.8	**0.60**
4.9-5.4	**0.80**
5.5-5.8	**0.90**
>5.8	**1.00**

SpDeficit:

adjusted difference	score
<5.00	**0.01**
5.00-5.56	**0.25**
5.57-6.06	**0.50**
6.07-6.82	**0.75**
>6.82	**1.00**

AllPC90:

proportion	score
>0.66 (>13 quads)	**0.01**
0.38-0.66 (8-13 quads)	**0.10**
0.34-0.37 (7 quads)	**0.20**
0.24-0.33 (5-6 quads)	**0.40**
0.16-0.23 (3-4 quads)	**0.50**
0.10-0.15 (2 quads)	**0.60**
0.06-0.09 (1 quad)	**0.80**
<0.06 (no quads)	**1.00**

DomDef:

adjusted difference	score
> 1.11	**0.01**
1.01-1.11	**0.25**
0.94-1.00	**0.50**
0.82-0.93	**0.75**
<0.82	**1.00**

NN20PC:

proportion	score
>0.95 (>19 quads)	**0.01**
0.70-0.94 (14-19quads)	**0.10**
0.53-0.69 (11-13 quads)	**0.20**
0.35-0.52 (5-6 quads)	**0.40**
0.20-0.34 (4 quads)	**0.50**
0.11-0.19 (3 quads)	**0.60**
0.05-0.11 (1-2 quads)	**0.80**
<0.05 (none)	**1.00**

NNdef:

adjusted difference	score
>1.21	**0.01**
1.04-1.21	**0.25**
0.94-1.03	**0.50**
0.80-0.93	**0.75**
<0.80	**1.00**

AnnDef:

adjusted difference	score
>1.05	**0.01**
0.96-1.05	**0.25**
0.80-0.95	**0.50**
0.72-0.79	**0.75**
<0.72	**1.00**

TapPCdef:

adjusted difference	score
<5.05	**0.01**
5.05-6.28	**0.25**
6.28-7.47	**0.50**
7.48-11.13	**0.75**
>11.13	**1.00**

StolPCdef:

adjusted difference	score
>98	**0.01**
93-98	**0.25**
84-92	**0.50**
74-83	**0.75**
<74	**1.00**

TuftPCdef:

adjusted difference	score
<22	**0.01**
22-24	**0.25**
25-27	**0.50**
28-32	**0.75**
>32	**1.00**

Appendix D. Glossary

Assessment unit: (also called “site” or “assessment area”) the wetland area that is being examined; may include all or part of an entire marsh, wetland, or wetland polygon. If the wetland contains multiple HGM subclasses, it is classified according to whichever subclass comprises the largest area. If one of the component subclasses comprises more than 20% of the area, that area is assessed as a separate unit.

Calibration: the process of standardizing (scaling) data to a specific numeric range (scale) by dividing by a constant, such as the maximum value in a data set.

Channel: a distinct semi-linear depression with a definable outlet and with identifiable bank edges that have been shaped by flowing water; includes manmade ditches and swales that may flow only intermittently, and includes both tidal channels and non-tidal (stream or river) channels.

Channel pool: an unvegetated, intermittently-isolated depression (of least $2m^2$) in a channel bottom, that fails to empty completely during low tide. Salinity is similar to that of the channel network to which it connects during high tide. Compare with *panne* and *fresh pool*.

Ecoregion: a large geographic area delimited by its relative homogeneity of climate, topography, and land cover.

External edge: the interface between vegetation at the lowest point in the low marsh (i.e., the outer edge of the marsh) and unvegetated tidal or subtidal habitat (the receiving waters).

Fetch: the distance over water in which waves are generated by a wind having a constant direction and speed. Generally considered synonymous with the maximum open water distance in the direction from which the strongest and most constant winds blow.

Flood tide: the rising tide that occurs twice daily in Oregon.

Fresh pool: an unvegetated, apparently-isolated depression of least $2m^2$ in the surface of the high marsh plain, of natural or artificial origin, that contains surface water whose salinity is less than that of nearby channels. Fed mainly by rain and/or groundwater discharge. Adjoining vegetation is not halophytic. Compare with *panne* and *channel pool*.

Function: what a site does; especially, the hydrologic, geochemical, and biological processes it (potentially) performs without human assistance. Functions support ecosystems and economies.

Function capacity: an estimate of the rate or magnitude (i.e., effectiveness, *sensu* Adamus 1983) an assessment site and its supporting landscape perform a specified function, relative to other wetland sites in its subclass. Termed “potential functional performance” by Hruby et al. (1999).

HGM: *see Hydrogeomorphic.*

High marsh: a wetland that is inundated by tidal surface water at least once annually but not daily. Synonymous with *supratidal* marsh and with the *MSH* (marine-sourced high) subclass of the Oregon HGM classification scheme.

High tide: as used in this guidebook, the maximum height reached by the two rising tides that occur daily at a given location. Mean high tide is the average of all daily high tides at the location over the span of a month.

Highest functioning standard: a site or small group of sites that received the highest score for a specified function, among a much larger group of sites similarly assessed.

Hydrogeomorphic (HGM): pertaining to water, geologic setting, and/or morphological (landform) features.

Hydrogeomorphic (HGM) approach: a framework (Smith et al. 1995) for the regional development of rapid assessment methods that features: (a) preclassification of wetland sites according to their likely water sources and flow direction; (b) use of rapid indicators of wetland functions, based on regional literature review and expert opinion; (c) calibration of the indicators at a series of regional reference sites prior to methods development; and (d) specification of rules (scoring models) to combine the calibrated data for individual indicators into scores representing relative capacity of each of a site's wetland functions.

Hydrogeomorphic (HGM) Classification: the national classification of wetlands based on geomorphic setting, water source and transport, and hydrodynamics, as proposed by Brinson (1993). Use of a regionalization of this approach for Oregon (Adamus 2001b) is required by the Oregon Department of State Lands in applications for Removal-Fill permits and for local Wetlands Inventories.

HGM subclass: one of 13 types of wetlands, defined by hydrological and geomorphic characteristics, that occur in Oregon, as described by Adamus (2001b). Three of these subclasses are the subject of this guidebook.

Indicator: characteristics or variables that are relatively easy to observe and (in this guidebook) are believed to correlate with (but are not necessarily causally linked with) processes that support specific wetland or riparian functions. Not limited to "field indicators" used to delineate wetlands.

Integrity: *see Wetland Integrity.*

Internal tidal channel: a low-gradient tidal channel that is surrounded by marsh, is much narrower than the marsh, and may not extend into uplands beyond the marsh.

Inundated, Inundation: covered wholly or partly with surface water; the water may come directly from precipitation, subsurface water table rise, runoff, tides, or channel flow.

Least-altered standard: a site or small group of sites that, by consensus, are the least likely among many in a region to have been exposed to lasting or chronically serious alterations as a result of human activities.

Low marsh: a marsh that is inundated twice daily by the tide. Synonymous with *intertidal marsh*. Includes the *MSL* (marine-sourced low) and *RS* (river-sourced) subclasses of the Oregon HGM classification scheme.

Low tide: as used in this guidebook, the lowest level reached by the two falling (ebbing) tides that occur daily at a given location. Mean low tide is the average of all daily low tides at the location over the span of a month.

Model, scoring: a mathematical device (formula, equation) for combining numeric estimates of indicators, in a manner thought to represent function or some other attribute of a site.

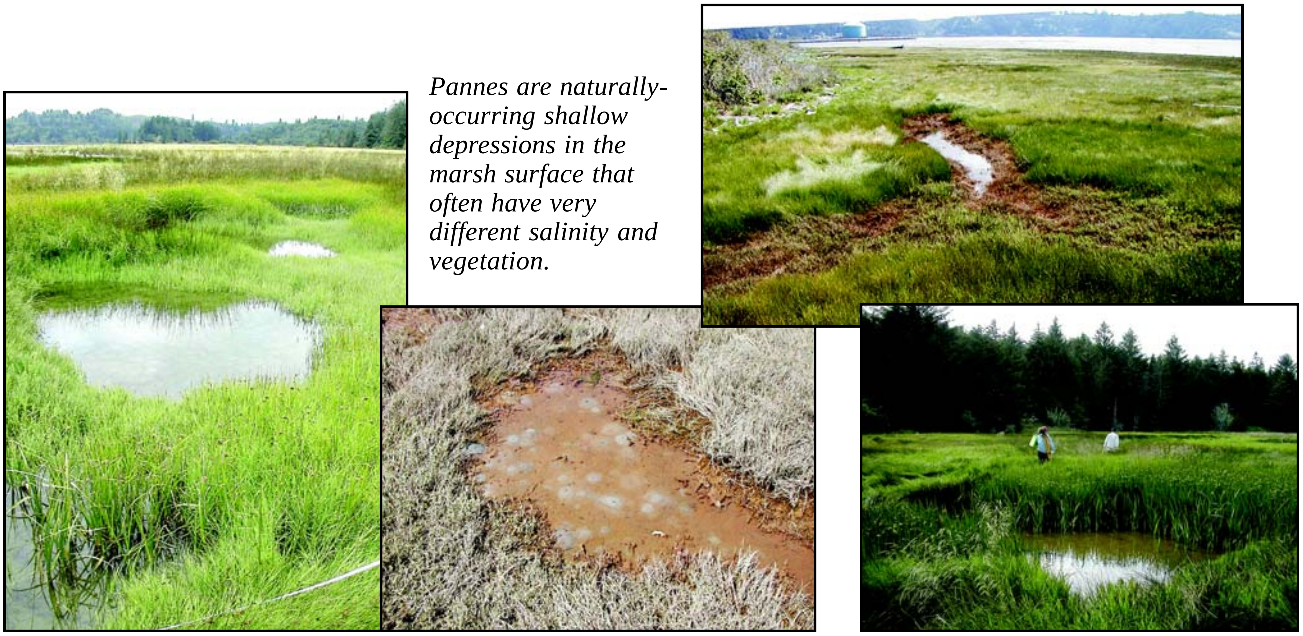
MSH: *see High Marsh*.

MSL: *see Low Marsh*. (Also an abbreviation for Mean Sea Level, but not used in that context in this guidebook.)

Neap tide: a tide occurring at or near the time of half-moons. The neap tide range is usually 10% to 30% less than the mean tidal range.

Non-native: species not present in Oregon tidal marshes during pre-settlement times, but currently occurring as the result of natural or human-aided establishment. Used synonymously with “exotic” or “alien” species. Includes a few species, e.g., *Phalaris arundinacea*, that were historically present but whose range and regional dominance has expanded tremendously.

Panne (also spelled **pan**): a mostly-unvegetated, apparently isolated, generally circular or oval microdepression in the surface of the high or low marsh plain, generally at least 2m^2 in area, sometimes caused by shading and tidal scouring around deposited logs and driftwood, or by relicts of former channels or ditches. May or may not contain surface water; the salinity of any surface water is usually equal or greater than that of the nearest tidal channel. If vegetation is present, it is generally sparse and comprised mainly of halophytic species. Compare with *fresh pool* and *channel pool*.



Pannes are naturally-occurring shallow depressions in the marsh surface that often have very different salinity and vegetation.

Predominant, Predominating, Predominance: comprising the largest portion of space in the horizontal dimension; need not comprise a majority of the space (i.e., 50% or any other threshold).

Quadrat: a square-shaped unit, generally a few meters or less per side, used to standardize sampling. Sometimes used synonymously with "plot."

Reference site: an assessment site or unit that, together with others, is used to calibrate regional scoring models of wetland function for the particular HGM subclass. Such sites are selected to encompass the expected natural and human variability among wetlands of their subclass in the region. In the HGM method, altered sites are allowed to be reference sites (see *Reference Standard Site*).

Reference standard site: a reference site that, along with a very few others, is among the least-altered sites of its type in an ecoregion. Data from such sites may be used as the "gold standard" against which the performance of other wetlands (of the same subclass and ecoregion) may be judged.

Risk (to wetland integrity): the probability that stressors may, over the short or long term, threaten a wetland's geomorphic and/or biological integrity, primarily as related to the magnitude and duration of the stressor rather than to the intrinsic sensitivity of the wetland.

Salt marsh: a tidal marsh that is predominantly influenced by marine-sourced waters.

Site: the tidal marsh assessment area or polygon. Tidal marshes do not always exist as highly discrete units in space and time.

Shrub: a woody plant that is between 6 and 20ft. tall; includes early stages of species that eventually grow to be trees.

Spring tide: a tide occurring at or near the time of new or full moon and that rises highest and falls lowest from the mean sea level.

Tidal amplitude: the difference in level between low tide and high tide on a given day.

Tidal range: the difference in level between all low and high tides at a specific location and averaged over a long period, generally 18.6 years.

Tidal channel: a channel whose water is primarily from downgradient (subtidal) sources; the water is transported into the tidal channel by tidal forces. Such channels are often "blind," i.e., are not connected to freshwater subsidiary tributaries that enter the marsh from its upland edge.

Tidal marsh: a wetland, usually with a predominance of emergent herbaceous vegetation, that usually is inundated by the tide once or twice a month during spring high tides, and once annually at the very least. Includes both low (intertidal) and high (supratidal) marsh. As used in this guide, includes tidal shrub and spruce wetlands, but not eelgrass beds. May have fresh, saline, or brackish surface water.

Tidal prism: the difference in water volume between high and low tide.

Tidegate: a mechanical device placed in a dike or natural riverbank to block saltwater from entering channels and lowlands behind the dike that otherwise would be flooded by high tide while allowing fresh water to drain during low tide. Tidal fluctuations behind the point where it is placed are eliminated or muted. Tidegates may consist of a wooden or metal flap hinged on the top of a downstream end of a culvert. The tidegate is positioned so that a rising tide forces the gate against the culvert, preventing flooding inside the dike by the rising tide. Freshwater then backs up behind the gate. On the ebb tide, the gate opens when the downstream level is lower than the freshwater level, allowing drainage of the land or wetland behind the dike (Giannico & Souder 2004a, b).

Topographic map: a map showing elevations. Maps at a very coarse scale can be viewed online at: topozone.com .

Tree: for purposes of this guidebook, a woody plant taller than 20ft.

Tributaries: non-tidal freshwater subsidiary channels, that may or may not contain water year-round, and which traverse the marsh on their path into the mainstem estuarine channel or bay.

Upland: as used in this guidebook, any terrestrial area not exposed to tides. Includes freshwater wetlands that are not so exposed, but which may remain inundated for long periods due to runoff from the watershed. Often delimited by the transition from herbaceous marsh to closed-canopy woodland or sand dune, and sometimes by a line of weathered driftwood.

Values: as used in this guidebook, the economic, ecological, or social importance assigned a function as a result of its opportunity to provide functions, goods, and services–and the significance of these.

Variable: as used in this guidebook, a factor that determines wetland function; may or may not be relatively easy to measure (see *Indicator*).

Wetland integrity: the ability of a wetland to support and maintain: (a) dynamic hydrogeomorphic processes within the range found in wetlands that have experienced the least alteration by humans; and (b) a balanced, integrated, adaptive community of organisms having a species composition, diversity, and functional organization comparable to that found in relatively unaltered native habitats of the region. That ability is also characterized as influenced by (and influencing) geomorphic processes. Together, these define the ability to support and maintain wetland complexity and capacity for self-organization with respect to species composition, physical and chemical characteristics, and functional processes. **A wetland may be considered to have high integrity** (or be in “intact” condition) when all of its natural processes and parts are functioning within their natural ranges of variation. Integrity often is used synonymously with “naturalness,” although the linkage between naturalness, wetland complexity, and wetland self-organizing capacity may not always be clearly apparent. Estimates of a wetland’s integrity commonly are expressed by a single word or score. Although indices for assessing biological integrity of Oregon streams have been tested and applied (Hughes et al. 2004), no such indices have yet been successfully tested for Oregon wetlands.

Wrack: flotsam and other floating debris, e.g., seaweed, plant litter, trash. Often deposited by tides along the daily high tide level in a “wrack line.”

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