
Final Report: Yaquina and Alsea River Basins Estuarine Wetland Site Prioritization Project *

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EXECUTIVE SUMMARY

Overview

Estuarine wetlands are vitally important habitats for salmon and other species. This project, commissioned in 1998, is part of the Mid-Coast Watersheds Council's efforts to better understand the status and condition of the area's natural resources and to work with interested landowners to enhance and protect important areas. This work complements and extends the assessment work being done in the streams and watersheds of the Yaquina and Alsea rivers.

This project surveyed estuarine wetland sites in the Alsea and Yaquina basins. Sites surveyed were tidal wetlands falling within Jefferson's (1975) plant community categories of low silt marsh, low sand marsh, sedge marsh, immature high marsh, and mature high marsh. (Mud flats, algal flats and eelgrass beds were not included.) The goal was to prioritize these tidal wetland sites for protection and restoration activity. The information provided by this study provides a basis for working with interested landowners to develop site-specific action plans. Development of these action plans will require landowner contact, field work, and other steps outlined elsewhere in this report.

Information critical to making decisions on site protection and restoration was gathered from interviews, publicly available sources and off-site field work (see below). Aerial photos were crucial to the analysis; copies of the most recent photos have been provided to the MidCoast Watersheds Council. Information gathered was stored in site information tables (Appendix B), which are to be used with accompanying site locator maps (Appendix C). Site-specific data fields in the site information tables include:

- legal description of location
- approximate acreage
- number of landowners
- major landowner names
- current vegetation community
- types of alteration (if any)
- date of first alteration
- possible actions (type of restoration, or protection)
- current land use on and adjacent to site
- connection to streams (other than mainstem rivers)
- site-specific comments from local and regional experts
- recommended next action step

Using the information gathered, sites were assigned to priority ranking groups for restoration or protection (see **Site ranking** below, and Appendix A).

Information sources. Sites were located and their characteristics determined using publicly-accessible records such as aerial photography, maps, databases, historic records, scientific literature and public documents. Interviews with local residents and other regional experts provided a historical context and other details for each site; contacts included local residents and experts on estuarine restoration, fish and wildlife biology, plant community ecology, land-use planning, and other resource management disciplines. To determine current site conditions, field observations of sites were made from publicly-accessible vantage points where possible; a few sites were visited with landowner permission.

Types of tidal wetlands. In this study, "tidal wetlands" refers to vegetated intertidal wetlands falling into the categories described by Jefferson (1975) as low silt marsh, low sand marsh, sedge marsh, immature high marsh, mature high marsh, and tideland spruce meadow (spruce tidal swamp). This study did not include mud flats, algal flats or eelgrass beds. Wetlands studied are classified as estuarine intertidal emergent, scrub-shrub and forested wetlands (E2EM, E2SS, and E2FO) in Cowardin (1979). Most sites identified are (or were formerly) high marsh, but a few low marsh sites and spruce tidal swamp sites were found. Many of the former high marsh sites are diked, tidegated or otherwise altered and are currently freshwater wetlands or upland.

Products. Products for this project include this report; ranked site summary tables (Appendix A); site information tables (Appendix B); a set of locator maps showing the general location of each site in the study (Appendix C); and a set of copies of aerial photographs showing the sites (provided to the MidCoast Watersheds Council in Newport, Oregon). These products provide guidance for the next step in the process of protecting and restoring these sites, namely, landowner outreach and development of site-specific action plans for site restoration and/or protection.

How to use the products of this project. Please note that Appendix A, Appendix B and Appendix C (ranked site summary tables, site information tables, and locator maps) are essential to understanding the results of the study. This report can not be used without referring to the tables and maps. If Appendix A, B or C is missing from a copy of this report, please contact the MidCoast Watersheds Council at (541) 265-9195 or Green Point Consulting at (541) 752-7671 for replacements.

Materials included in the Appendices are:

1. Ranked site summary table for Yaquina sites (Appendix A)
2. Ranked site summary table for Alsea sites (Appendix A)
3. Site information table for Yaquina sites (Appendix B)
4. Site information table for Alsea sites (Appendix B)
5. Site locator map for Yaquina sites (Appendix C)
6. Site locator map for Alsea sites (Appendix C)

The ranked site summary tables (Appendix A) provide a basin-wide perspective for initial decisions on site prioritization (see "**Site ranking**" below for details). The site information tables (Appendix B) provide details on each site, organized in a manner that allows quick comparison across sites, and also provide a framework for adding new information about sites as it is gathered. Locator maps (Appendix C) are used to find sites and road access to those sites.

In addition to the information tables, a narrative description of each site is provided in this report. The narrative description provides a place for more detailed and less-easily-categorized notes about each site, and provides some background on the setting, history and limitations of each site. Both the site information tables and the site narrative provide information on specific action steps that could be taken to restore or protect sites.

Site Ranking. Since a major goal of this project was to prioritize sites for restoration and protection, a prioritization (ranking) scheme was applied to the sites; the results are shown in the ranked site summary tables (Appendix A). The intention was to prioritize sites within each basin; sites were not compared between the Yaquina and Alsea. Sites were placed in 6 priority groups ranging from "1" (highest priority) to "6" (lowest priority). Highest priority was assigned to sites with large acreage, known salmonid use, unusual plant communities, a single landowner, and simple restoration needs. Lower priority was assigned to sites of smaller size, disturbed condition, many landowners, and more complex restoration needs. **Rankings are intended to provide a broad perspective and help guide decisions; they should not be used to eliminate any site from consideration for restoration or protection.** Details on how rankings were assigned are contained in "**Site prioritization**" below.

OVERVIEW: TIDAL WETLANDS IN YAQUINA AND ALSEA ESTUARIES

This section gives an overview of major tidal wetlands in the Yaquina and Alsea estuaries, and some background on alterations to the tidal wetland communities. For details on the plant communities described (high marsh, low marsh, and spruce tidal swamp) see "**Vegetation communities**" below.

Yaquina estuary

The Yaquina estuary is one of only three estuaries classified as a deep draft port under Oregon's Coastal Zone Management Program (Estuary Management Classification "DDD") (Good, 1996). The history of commercial use of the Yaquina estuary provides a different context for resource management compared to the Alsea estuary. Major uses in the Yaquina estuary include commercial navigation and shipping, commercial oyster culture and fisheries, and recreation fishing and clamming. Industrial land and water uses in the estuary's two ports (Newport and Toledo) also affect resource management in the estuary.

Yaquina Bay and the Yaquina estuary have been intensively studied by a wide variety of federal and state agencies and academic researchers. The presence of the Hatfield Marine Science Center in the Yaquina estuary has focused research and public education on this active port and the resources that support its economy and its diverse habitats and wildlife.

A good starting point for an overview of the estuary's natural resources is Range Bayer's compilation of information for an Important Bird Areas proposal for the American Bird Conservancy (Bayer, 1998). The proposal contains a detailed bibliography and is a very useful overview of resources in the bay. The proposal contains sections on bird life, plant communities, eelgrass bed locations, Estuarine Management Units used by the Lincoln County Planning Department, fish and shellfish resources, tideland ownership issues, threats to the area's resources, conservation measures in the area, and cultural resources.

The largest acreages of undisturbed (or minimally disturbed) tidal marsh in the Yaquina estuary are found in McCaffery Slough (site Y34) and Poole Slough (site Y40) on the south bank of the Yaquina at about River Mile 6. Other substantial areas of relatively undisturbed tidal marsh are found at Johnson Slough (site Y9), Blind Slough (Y5), Grassy Point (Y32), and on the north bank of the Yaquina between River Mile 10 and 11 (site 13a). All of these sites are predominantly high marsh; but the low marsh community is often found at their margins.

Low tidal marsh is relatively rare within the Yaquina system, compared to high tidal marsh. However, there is more low tidal marsh in the Yaquina system than

in the Alsea system. Sites in the Yaquina estuary which include substantial areas of low tidal marsh include Y1, Y2 (Airport), Y34 (McCaffery Slough), and Y40 (Poole Slough) (see "Vegetation communities" below).

King Slough (site Y33), low in the estuary and subject to high tidal energy, is occupied mainly by tidal flats rather than marsh.

A unique restoration opportunity exists in the Yaquina estuary: the Boone Slough/Nute Slough complex (site A6). This diked, former tidal marsh site is located on an old oxbow of the Yaquina and is about 600 acres in size, making it one of the largest restoration opportunities on the Oregon Coast (Lincoln County Planning Department, 1999). Parts of this site are currently used for grazing cattle. Another large area of diked, former tidal marsh is found at Depot Slough (site Y7). Development pressure is higher at this site, which lies on the west side of Toledo. Tidegates at Boone Slough/Nute Slough and Depot Slough are impounding fresh water; both sites have large areas of freshwater wetland that are inundated in the winter.

The Mill Creek watershed, which joins the Yaquina about 2 miles upstream of Toledo at River Mile 15, is a FEMAT-designated key watershed (USDA et al, 1993). This stream is dammed to form the Mill Creek Reservoir, a water supply for the city of Toledo. A fish ladder allows fish access to areas above the dam, and the Mill Creek system supports spawning chum, coho, steelhead, and chinook (Bob Buckman, ODFW, personal communication, 1999).

A number of sites in the Yaquina estuary (Y10, Y11, Y12, Y13, Y18, Y19, Y20, Y36, Y39, and Y41) are located on the inland (north) side of the North Bay Road; culverts have restricted tidal flow to some degree at each of these sites. Other disturbances such as ditching and heavy grazing are also found at some of these sites. The degree of flow impairment is indicated by the vegetation community: where tidal flow is restricted, freshwater wetland plants have invaded the tidal marsh community. One site on the north side of the North Bay Road (Y9, Johnson Slough) has a bridge instead of a culvert for the road crossing; since the bridge allows free tidal exchange, this site is in very good condition.

Site Y28, located at about River Mile 16 to 16.5, is an example of a rare plant community: the spruce tidal swamp. It is relatively undisturbed and has a vegetation community consisting of herbaceous tidal marsh with many scattered Sitka spruce. This site may be the spruce tidal swamp ("tideland spruce meadow") site on the Yaquina mentioned by Jefferson (1975). (See "**Vegetation communities**" below for more information.)

Alsea estuary

The Alsea estuary is one of only four estuaries in Oregon that are managed for conservation (Estuary Management Classification "CON") under the Oregon Coastal Zone Management Program (Good, 1996). Major uses of the estuary are limited to recreational fishing and clamming; this estuary lacks the commercial development present in the Yaquina estuary.

The Alsea basin once rated first in Oregon in importance for coho spawning (Sutterlinn et al, 1974). Though populations here are now severely depressed, as they are throughout Oregon, the hope is that the Alsea can soon regain its reputation for supporting the healthiest of coho runs.

A useful review of estuarine wetlands and other resources in the Alsea basin was provided by the Alsea Wetlands Review (U.S. Army Corps of Engineers, 1976). This document contains many details on the condition of natural resources in the bay and surrounding areas, and describes the history of alterations to those resources up to 1961. It is highly recommended background reading.

Alsea estuary has unusually large areas of high marsh in excellent condition. Over 400 acres of undisturbed high marsh are located on the east side of Alsea Bay (site A31 of this study), and in the lower reaches of Drift Creek (sites A27, A28, A29, and A30). Drift Creek is highly important to anadromous fish and is a FEMAT-designated key watershed (USDA et al, 1993), so these marshes are critical habitat.

Smaller areas of relatively undisturbed tidal marsh are found just west of Barclay Meadows (site A24) and scattered among disturbed sites along the south bank of the Alsea east of Eckman Lake. ("Undisturbed" indicates relative lack of disturbance; these areas and those mentioned in the previous paragraph may have been grazed, but today they show plant communities typical of high marsh).

Tidal marsh in Lint Slough currently has impaired water flow due to a dam built a few decades ago across its mouth, and excavation of an alternate channel for fish production. Planning for restoration of tidal flow to Lint Slough is currently underway, so Lint Slough was not included in this study. Information on the Lint Slough restoration project is available from the MidCoast Watersheds Council.

A large area (very roughly 150 acres) of diked former tidal marsh is found at the Bayview Oxbow (site A25). Smaller areas are found at sites A18 through A21 near River Mile 6, at Barclay Meadows East (site A23), and at various other sites along the river.

Bain Slough is a forested wetland located at River Mile 9. Despite a tidegate, some ditching, and residential development along the north bank of the Alsea,

the slough still has well-developed remnant tidal channels. The forest canopy at the site has a good number of mature Sitka spruce (*Picea sitchensis*). Judging from aerial photographs, this wetland was once tidal, and was very likely an example of a plant community that is now very rare in Oregon: spruce tidal swamp (also known as tideland spruce meadow; Jefferson, 1975). Reintroduction of tidal flow is recommended here, since very little spruce tidal swamp remains in Oregon, and this plant community has high value to salmonids (Charles "Si" Simenstad, University of Washington, personal communication, 1999).

Acreage of tidal marsh is reportedly diminishing in Alsea Bay (Dicken, 1961; U.S. Army Corps of Engineers, 1976). The largest acreages have been lost to filling, tidegating and diking over the past decades, but even the undisturbed areas of tidal marsh in the bay and near Drift Creek are slowly diminishing in size due to erosion. The margins of these high marsh sites (for example, sites A27, A28, A29, A30, and A31) are generally very steep and tall; blocks of soil and high marsh vegetation are actively eroding off the margins and falling into the bay (Dicken, 1961; U.S. Army Corps of Engineers, 1976). Although low marsh species (often Lyngby's sedge, *Carex lyngbye*) do colonize these eroded sediments, the net effect appears to be reduction of tidal marsh area, because only small areas of recent accretion are found. Based on qualitative examination of 1939 airphotos, the rate of erosion does not appear to be high; areas of high marsh in 1939 were similar to those found in the estuary today. However, closer study is recommended to determine actual areas lost to erosion in the past few decades. A time series of airphotos could be used to calculate erosional losses.

Low tidal marsh is uncommon in the Alsea estuary. Areas of recent and current sediment accretion support low tidal marsh; these are areas where sediment is currently being deposited and is building up to the level where it can support emergent low marsh vegetation. One area of recent sediment accretion is outside Eckman Lake (Site A5 of this study); another is at the High School Marsh (site A32 of this study). These are the main areas of low marsh found in the estuary. There is also reportedly some low marsh in a tidal channel inside the most northwesterly island of the East Bay Marsh site (Site A31) (U.S. Army Corps of Engineers, 1976). Field observation indicated some areas of low marsh on the north and east edges of the main bay (just south of site A25, Bayview Oxbow, and along the east side of the bay adjacent to site A31).

Pile dikes and rock dikes were installed in the north channel of the Alsea River in the 1960's and 1970's. The dikes were placed to increase flow and improve navigability in the south channel. However, the dikes also created a water quality problem in the north channel, with warm water and low dissolved oxygen concentration that made the channel unsuitable for salmonids. One of the dikes has been partly removed, and the others are deteriorated, but flow is still impeded compared to the north channel's flow in historical times (Jack Sleeper, USFS, personal communication 1998).

Interestingly, since the dikes were installed in the north channel, sedimentation along the south bank of the Alsea has increased, making access to the river more difficult (U.S. Army Corps of Engineers, 1976). However, to date this sedimentation has not been adequate for development of substantial new areas of low marsh, except outside Eckman Lake. It is not known whether hydrologic patterns prevent accretion to low marsh level, or whether the sediment deposition areas will eventually become low marsh.

The Alsea Wetlands Review (U.S. Army Corps of Engineers 1976) states that prior to 1957, the largest tidal slough in the Alsea estuary was Eckman Slough (later impounded to form Eckman Lake). However, based on review of historic aerial photographs, the Bayview Oxbow appears to have once been a tidal marsh as well. This conclusion was drawn from the site's soil series (Clatsop series, formed in alluvium deposited just above high tide; USDA SCS, 1973), topography, elevation, and tidal channels visible in the 1939 aerial photographs. (Most of the oxbow's tidal marsh had already been converted to agricultural use in 1939). The Bayview Oxbow site is at least 150 acres in size, twice the area of Eckman Lake. The Bayview Oxbow is recognized as a potential restoration site in the Lincoln County Comprehensive Plan (Lincoln County Planning Department, 1999).

Several areas were recommended as "wetlands of importance" by the authors of the Alsea Wetlands Review (U.S. Army Corps of Engineers, 1976): tideflats in the Bay; Lint Slough outside the dam; tideflats near Bayview Oxbow; tidal marsh on islands and on the east shore of the bay (site A31 of this study); tidal marsh at the mouth of Drift Creek (sites A29 and A30) and on the banks of Drift Creek (sites A27 and A28); McKinney Slough (site A33); and tidal marsh at the mouth of Eckman Lake (site A5). None of the tidal marsh sites on the south bank of the Alsea east of Eckman Lake (sites A6 through A21 of this study) were recommended as "wetlands of importance", nor were Barclay Meadows (sites A23 and A24) or Bain Slough (site A22). However, the review did acknowledge the value of these resources.

Tidal marsh along the south bank of the Alsea between Eckman Lake and Taylor's Landing (sites A6 through A21) is surrounded by residential development. This presents challenges for restoration and protection, but also presents very good opportunities for public education. The sites are highly visible and could be the focus for valuable interpretive activity. If safe parking were provided nearby, boardwalks and informational kiosks would be heavily used and would provide a glimpse into the tidal marsh environment that would otherwise not be easily accessible to many people. This area of the south bank of the Alsea also provides many opportunities for contrasting minimally-disturbed sites and restoration sites in close proximity. If possible, Lint Slough should be included with other nearby sites when planning publicly-accessible interpretive exhibits. An "interpretive tour" of several adjacent sites could be planned.

TIDAL WETLAND FUNCTIONS AND SALMONID PRODUCTION

The biological functions of tidal wetlands are currently the focus of a great deal of research. However, it is already very clear that tidal wetlands provide a variety of functions that are vital to salmonids. For example, tidal marshlands are located in the area where salt water from the ocean mixes with fresh water from streams and rivers. This mixing provides "osmotic transition zones" that allow juvenile salmonids to adapt gradually to salt water. Deeply incised tidal channels provide shelter from predators, and tidal flushing keeps water temperatures cool and dissolved oxygen concentrations high. Marshlands that are frequently inundated by tides are extremely productive and support a wide range of invertebrates that are prey for salmonids.

Because of their high productivity (Odum 1971), tidal marshes provide many ecological services besides salmon habitat. When high tides flood the tidal marsh, they carry many nutrients into the larger estuary system and the ocean beyond. These nutrients may be critical to many nearshore and ocean processes (Simenstad, 1983; Seliskar and Gallagher, 1983).

A summary of estuarine functions that support salmonids is attached to this report as Appendix D (Recht, 1999). Detailed descriptions of interactions between salmonids and tidal marsh ecosystems are also found in Lebovitz (1992), Simenstad (1983), and Seliskar and Gallagher (1983). Salmonid habitat requirements in estuary ecosystems are described in Schreffler and Thom (1993).

Tidal marsh site functions relate to the plant communities present as well as physical site characteristics. Sites that are no longer tidal because of human influence (diking, ditching, tidegates, filling, etc.) may still be wetlands and may still perform many wetland functions. However, they no longer perform tidal wetland functions like osmotic transition, and if dikes and tidegates form a barrier to fish, they may no longer function as fish habitat at all. Sites with reduced tidal flow or simplified physical structure may function at a reduced level.

For example, if tidal flow is altered, bank erosion may occur leading to loss of a portion of high marsh. (Alterations in tidal flow can also sometimes lead to "accretion", or new accumulation of sediment that supports development of new tidal marsh.) When meandering tidal channels are ditched, overhanging banks are removed, so shelter from predators is reduced. The water temperature may rise due to reduced shading, and the distance over which osmotic transition occurs is greatly reduced. Ditching (simplification of tidal channels) also greatly impacts hydrology, and undoubtedly affects benthic invertebrate communities -- for instance, ditching may reduce or eliminate periodic sheet flow over the high marsh community. This periodic sheet flow appears to play a vital role in organic material export from the marsh, and therefore has a strong impact on the ecology

of the entire marsh community and the estuary and ocean system beyond (Simenstad, 1983; Seliskar and Gallagher, 1983).

Human alterations to former tidal wetlands cause many other changes that relate directly and indirectly to salmonid production. For example, nontidal, freshwater wetlands and upland pastures support very different plant and animal associations from those found in tidal marshes, so the trophic structure differs and prey species used by salmon may not be present. When tidal flow is eliminated, oxidation of organic material in the soil profile occurs, with accompanying changes in soil biology, ground elevation and hydrology. Without tidal flushing, water temperatures become warmer. Dikes and tidegates generally impede the flow of freshwater off the land, so many former tidal marshes flood seasonally, forming freshwater wetlands. In fact, it is generally possible to walk on the surface of the high marsh without getting your feet wet, even in the middle of winter; while diked marshes are often inundated with several inches of water throughout most of the winter.

Large woody debris is considered important in tidal wetland functions. Woody debris provides structure to the marsh community. Wind and tide action creates turbulence around the debris, creating deeper pockets in tidal channels that provide resting places for salmonids, and creating "potholes" which contain a plant community that is different from the surrounding marsh (Jefferson, 1975). Drift logs that are washed onto tidal marshes provide the majority of the large woody debris (for example, in sites A29, A30 and A31 of this study). Some large woody debris is provided by spruce growing on natural levees at the river's edge of the marsh. In spruce swamp, the dominant trees (Sitka spruce, *Picea sitchensis*) provide plenty of large woody debris. However, spruce tidal swamp is a very rare plant community in Oregon and was found only at Site Y28 on the Yaquina. Bain Slough (Site A22) on the Alsea was probably originally spruce tidal swamp, and retains many characteristics of that community. Restoration of tidal flow to Bain Slough (by removing a tidegate) would help restore the original plant community.

VEGETATION COMMUNITIES¹

Jefferson (1975) described tidal marsh plant communities in detail, and provided a brief description of spruce tidal swamps. She divided tidal marsh communities into six types: low sand marsh, low silt marsh, sedge marsh, bulrush and sedge marsh, immature high marsh, and mature high marsh. Within each of these community types, she described a number of separate plant communities. Jefferson's community descriptions were used to help categorize plant communities in this study.

¹ Common and scientific plant names used in this report follow Hitchcock and Cronquist (1973).

For the purposes of this study, tidal wetland sites could be described as being predominantly low tidal marsh, sedge marsh, high tidal marsh, or spruce tidal swamp. In many cases, no publicly accessible vantage point was available. In these cases, the plant community type could not be determined precisely, and these sites were therefore simply described as "tidal marsh". Since salmonids use the entire spectrum of tidal wetland communities, and all of the tidal wetland communities were included in this study, this broad categorization adequately served the needs of this study.

Low tidal marsh communities observed in the course of this study were dominated by various combinations of seashore saltgrass (*Distichlis spicata*), pickleweed (*Salicornia virginica*), fleshy jaumea (*Jaumea carnosa*), and seaside arrowgrass (*Triglochin maritimum*). These dominants correspond to the "*Jaumea-Salicornia-Triglochin maritimum-Distichlis*" low sand marsh community described by Jefferson (1975).

Low tidal marsh was uncommon in both the Alsea and Yaquina river estuaries. Areas of low tidal marsh within each estuary are described in the sections "**Yaquina estuary**" and "**Alsea estuary**" above.

Sedge marsh is found at elevations between the low and high marsh, often at the fringe of high marsh or in areas of recent sediment accretion. This community usually consists of a nearly-pure stand of Lyngby's sedge (*Carex lyngbyei*). Sedge marsh generally does not occupy large areas in the Yaquina or Alsea estuaries. Some sedge marsh was observed in the Alsea estuary at site A24 (Drift dogleg E), and portions of the Yaquina site Y3 (Airport N) appear to be dominated by Lyngby's sedge (this determination was made from a distant offsite vantage point so needs to be field-checked). Onno Husing (OCZMA, personal communication, 1999) reports that site Y17 is also a sedge marsh. The most widespread tidal wetland community found in this project's study area was high tidal marsh. High tidal marsh communities were generally dominated by tufted hairgrass (*Deschampsia caespitosa*), often with Baltic rush (*Juncus balticus*) and Pacific silverweed (*Potentilla anserina*) as co-dominants. In lower portions of the estuary where salinity is still relatively high, pickleweed and seashore saltgrass are often dominant (or co-dominant with tufted hairgrass) in potholes created by large woody debris or in other depressions. These dominants correspond to the "*Salicornia-Distichlis-Juncus*" mature high marsh community described by Jefferson (1975).

Moving upstream on the mainstem rivers or on tributary streams, the water is increasingly fresh, and the high marsh community gradually changes to a freshwater tidal marsh community. This transition is marked by the replacement of tufted hairgrass and Baltic rush by bentgrasses (*Agrostis* spp.), slough sedge (*Carex obnupta*), and bulrushes (*Scirpus* spp.). Pacific silverweed remains a common dominant in the freshwater tidal marsh and the freshwater nontidal

wetlands further upstream. In some freshwater tidal and nontidal wetlands, probably areas that have been disturbed, reed canarygrass is present.

The transition from brackish tidal marsh to upland was described by Frenkel et al (1978) and Frenkel and Eilers (1976). Frenkel's vegetation descriptions will be useful when determining the boundaries of tidal marsh sites during development of site-specific action plans (see "**The next step: Action Plans**" below).

Spruce tidal swamp (also known as "tideland spruce meadow") is a vegetation community that was once extensive in the Columbia and Tillamook estuaries, and probably in other estuaries as well (Jefferson, 1975). This community has scattered-to-abundant Sitka spruce, often growing on "islands" (perhaps downed timber, natural hummocks, or natural levees near the mainstem river). The spruce "islands" have an understory typical of upland coastal forest (including, for example, false lily-of-the-valley, *Maianthemum dilatatum*, and red huckleberry, *Vaccinium parvifolium*). The only relatively undisturbed spruce tidal swamp community that was found in this study (site Y28) had scattered spruce with brackish to fresh tidal marsh vegetation growing between the spruce. The marsh was dominated by tufted hairgrass, bentgrasses, Pacific silverweed, and slough sedge, all species typical of brackish or freshwater high tidal marshes.

Eelgrass beds, though not part of this study, are important foraging areas for juvenile salmonids. Tidal marshes near eelgrass beds may be especially important to salmonids, because it provides shelter from predators and osmotic transition areas that are not found in the more open water occupied by eelgrass.

Although locations of eelgrass beds are dynamic (Thayer et al, 1984), the general areas where eelgrass has been mapped may be useful in the context of this study. EPA is currently mapping the distribution of two eelgrass species (*Zostera marina* and *Zostera japonica*) in Yaquina Bay using remote sensing techniques (EPA, 1998). Eelgrass sampling areas are located in the Sally's Bend area and along the banks of the Yaquina going south from Sally's Bend (Cortright et al, 1987). Sites Y36 (North Bay wetland) and Y43 are the only sites identified in this project that are near these eelgrass beds. (King Slough is also nearby, but contains little tidal marsh except at the far south end.) Eelgrass beds in the Alsea occur mainly on the north and northeast portions of the bay, near the Bayview Oxbow and East Bay Marsh sites (sites A24 and A31) (U.S. Army Corps of Engineers, 1976).

TYPES OF DISTURBANCE TO TIDAL WETLAND COMMUNITIES

Tidal wetlands have often been disturbed by human activity. Although estuary zoning and wetland protection regulations have been implemented to reduce human impacts to tidal wetlands (see Good, 1996), disturbance continues to some extent today, either through permitting processes or through nonpermitted activities.

Types of disturbance to tidal wetlands include diking and ditching; filling to provide upland for construction or other purposes; and tidegating to reduce tidal inflow while still allowing freshwater drainage. Diking and ditching, often used in combination with tidegates, are often intended to convert tidal marsh to pasture or agricultural use. However, the net result in many areas is increased flooding of areas behind the dikes, due to impeded freshwater drainage and subsidence of the soil surface in the diked areas. Subsidence (a gradual lowering of the soil surface elevation) is caused by soil compaction; by decomposition (oxidation) of organic plant material in the soil; and by loss of buoyancy when tidal influence is removed (Frenkel and Morlan, 1991). In this study, areas behind dikes were often inundated by several inches of fresh water during winter, while the surface of undisturbed high marsh was saturated but not inundated, even at high tide.

Tidal flow into tidal wetlands is often restricted by fill material placed for road construction. This is particularly common where roads follow riverbanks, and tidal flow and freshwater drainage is culverted (and sometimes tidegated) under the road. Examples are sites Y11, Y12, Y13, Y18, Y19, Y20, Y36 (North Bay wetland), Y39 (Parker Slough), and Y41 (Weiser Point slough) along North Bay Road on the Yaquina, Y14 and Y31 (Flesher Slough) along the South Bay Road on the Yaquina, and sites A34 (Starr Creek) and A35 (Walker Creek) on the Alsea. Even when not tidegated, culverts restrict the volume of tidal flow and can create barriers to fish passage, either through high culvert placement or high water velocities due to flow restriction. Even where culverts are large or where roads cross tidal wetlands on bridges, the effective tidal opening is often much smaller than the original tidal inlet, so tidal flow patterns are altered. These tidal flow changes are likely to affect tidal wetland functions through changes in salinity or through changes in patterns of sediment erosion and deposition. However, literature on this topic is scanty.

Ditches have often been dug to speed freshwater flow off diked sites, and to reduce tidal influence in non-diked sites. Tidegates are often placed at the mouth of the ditch. Where tidal flow still exists (non-diked sites without tidegates), ditches reduce channel complexity and reduce the distance across which salt and fresh water mingle, reducing the habitat available for osmotic transition by juvenile salmonids. Ditches also radically alter riparian vegetation, generally removing the overhanging vegetation that is typical of undisturbed tidal channels. Since undisturbed tidal channels are complex, meandering, and highly branched, conversion of these channels to ditches seems likely to have strong impacts on the ecology of the channels (Simenstad, 1983). However, few studies have been done on this topic.

FOCUS OF STUDY

The focus of this study was on tidal wetlands, because these areas are a part of the landscape that is often missed in salmonid habitat studies and resource management plans. Many habitat projects focus on upstream restoration activity, and shorelands and harbors are intensely studied because of development pressures. Because they occupy the interface between salt and freshwater systems, tidal wetlands sometime falls between the cracks. But tidal wetlands are crucial to salmonids and are also heavily impacted by human activity. Basic functions of tidal wetlands are discussed in "**Tidal wetland functions and salmonid production**" above.

The area covered by this study included all areas where tidal wetlands and former tidal wetlands were found within the Yaquina and Alsea basins. Salt marsh, brackish marsh, and freshwater tidal marsh were included, since all are important to salmonids. For example, freshwater tidal wetlands are very important to fish (e.g., as subyearling coho rearing habitat), so it's important not to limit investigations to salt marsh areas (Charles Simenstad, University of Washington, personal communication, 1998). This study's geographic coverage went beyond the area covered by estuarine land-use planning; for example, the Estuary Plan Book does not extend as far upstream as a number of brackish marsh and freshwater tidal sites found in this study. By extending further upstream, this study incorporated examples of the rare plant community known as spruce tidal swamp or tideland spruce meadow (Jefferson, 1975).

One site was excluded from this study, because it is currently undergoing study and planning for restoration (Lint Slough on the Alsea; see "**Overview: tidal wetlands in Alsea and Yaquina estuaries**" below). Areas where tributary streams enter the Alsea or Yaquina Rivers, but where little or no tidal marsh was present (as determined from historic aerial photographs), were excluded from this study. Some of these sites (such as Canal Creek, Arnold Creek, and Burnham Creek on the Alsea) provide important salmonid habitat and associated protection and restoration opportunities; but because the focus of this study was on tidal wetlands, they were not included.

Small tidal wetland sites (containing less than about an acre of tidal wetland) were not included in this study. There were a few exceptions. If a small tidal wetland site was referenced in another studies or in the Lincoln County Comprehensive Plan (LCCP), it was included for completeness. Some small sites were also included because they formed part of well-known geographic features (like the small tidal wetlands at the south end of King Slough).

It is important to note that this study was conducted at a reconnaissance level. Project emphasis, and budget and time limitations, precluded on-site field work. Such field work is essential for developing site-specific action plans. A suggested

sequence of activities for developing site-specific action plans is found under "**The Next Step: Action plans**" below.

METHODS

This section describes the methods used to collect the information shown in the site information tables (Appendix B), and the prioritization method used to rank the sites (Appendix A).

Site identification

Base maps

The first goal of this project was to identify tidal wetland and former tidal wetland sites. For each estuary, a base map was chosen as a location for marking sites, alterations to sites, and dates of alteration.

The base map for the Yaquina estuary was an 18" by 24" print from the Estuary Plan Book (EPB) map of Estuarine Habitats and Protected Sites (Cortright et al, 1987). In the main portion of the estuary (up to just downstream of Toledo), this map showed nearly all of this project's study sites as having fresh marsh, high salt marsh or low salt marsh, or diked marsh. Near Toledo and upstream of Toledo (ranging into the freshwater tidal area), a number of sites found in this study were not marked on the EPB map, so those sites were added by hand.

For the Alsea, the base map was a 22" by 30" print of a GIS layer of disturbances to the Alsea Bay estuary. The map was created by staff at the Siuslaw National Forest as part of the Lower Alsea Watershed Analysis project (USFS, 1999). The GIS layer shows areas of tidal influence, dikes, fill material, impaired flow, and unaltered areas of tidal influence. Like the Yaquina base map, this map showed most of the areas that became study sites for this project. Unlike the Yaquina base map, the Siuslaw National Forest GIS map extended upstream to the freshwater tidal areas.

Aerial photographs

To identify tidal wetland sites and former tidal wetland sites, historic aerial photographs were used. Where stereo pairs were available, we used a stereoscope to better visualize elevation changes. Aerial photographs were obtained from the Waldport Station of the Siuslaw National Forest; the University of Oregon Map Library; and the Coastal Ecology Branch of the U.S. EPA in Newport.

For the Alsea estuary, photos dating from 1939, 1952, 1961, 1966, 1972, 1979, 1980, 1982, 1989, 1993, and 1996 were used to identify sites and determine alterations to sites. The photos were provided by the Waldport Ranger Station of the Siuslaw National Forest. Color copies of the most complete recent set of photos, flown by the Bureau of Land Management (BLM) in 1993, were used in the field to locate sites. These are true color photos are at a scale of approximately 1" = 1000 ft. A set of copies of these photos, marked with site numbers, has been provided to the MidCoast Watersheds Council.

For the Yaquina estuary, photos dating from 1939, 1945, 1952, 1959, 1972, and 1976 were used at the University of Oregon Map Library. A set of color infrared photos flown for U.S. EPA in July 1997 provided current conditions; these were color infrared photos at a scale of approximately 1" = 750 ft on the contact prints. Copies of these prints were used in the field to locate and characterize sites. A set of copies of these photos, marked with site numbers, has been provided to the MidCoast Watersheds Council.

Upstream limit of tidal wetlands

Airphotos, field work and maps such as the National Wetland Inventory maps (USFWS, undated) were used to determine the upstream limit of tidal wetlands. On the Alsea, the upper limit of tidal wetlands is at about River Mile 9, at Bain Slough. The head of tide is farther upstream, past Tidewater, but beyond Bain Slough the riverbanks are steep, and river terraces are subject to tidal inundation only at extreme flood stage (Dicken, 1961), so no tidal wetlands exist above Bain Slough. Some of the pastures and agricultural lands along the banks of the Alsea upstream of Bain Slough are diked along the riverbank, and may once have been freshwater tidal wetlands. However, in the earliest photos examined, these areas were already in agricultural use and did not show evidence of tidal influence.

On the Yaquina, the upper limit of tidal wetlands is at about River Mile 18, at the sharp northward bend of the Elk City Road east of Toledo (just upstream of site Y42). As for the Alsea, the Yaquina in this zone is flanked by steep river banks and terraces that are not tidally influenced except at extreme tides. Some of the pastures and agricultural lands along the banks of the Yaquina upstream of site Y42 are diked along the riverbank, and may once have been freshwater tidal wetlands. However, (as for the Alsea), the earliest photos examined already showed these areas in agricultural use and did not show evidence of tidal influence.

For both mainstem rivers and tributary streams, tidal channel morphology was critical to the determination of the upper limit of tidal wetlands. For the purposes of this study, only areas with tidal channels were considered tidal wetlands.

For larger, diverse areas like Depot Slough, Boones/Nute Sloughs, Poole Slough, and McCaffery Slough, determination of the upstream limit of tidal influence was beyond the scope of this study. Regardless of the precise definition of tidal limits, restoration of open connections *via* dike breaching, tidegate removal, and reconnection of natural channels will most likely benefit salmonids. As noted in the site information table, some of these areas have active diking districts. In these cases and many others, it will be important to weigh trade-offs between current land use, current wildlife habitat functions, and likely benefits of restoration.

Site information tables

Public documents available from the county assessor's office and publicly available maps and aerial photographs were used to obtain some basic information for each site. Information from these documents were transcribed into the site information tables (Appendix B). Some of the information in the tables is likely to change frequently (for example, ownership and adjacent land use), so **the accuracy of this information should be verified during the development of site-specific action plans.**

Information contained in the tables is described below.

Site numbers and site names

Sites were assigned a site number and, where geographic place names were available, a site name. Site numbering progressed gradually as sites were located, divided and characterized. Site characterization proceeded by sections of the estuary, and sites could not be characterized sequentially because of limitations of tides, weather and available field time. Therefore, sites are not numbered in any particular order.

Site boundaries

Divisions between numbered sites were based on a combination of physical separation of the sites, apparent hydrologic connections, site alterations, and property ownership patterns. For example, Boone/Nute Sloughs are considered a single site because if tidegates were opened, this entire area would be hydrologically interconnected as it was historically. Also, the large size of this site as a whole makes it exceptionally valuable as a potential restoration area, so breaking it up into smaller sites would obscure its importance.

Site Y29 includes a number of adjacent parcels that are hydrologically isolated from each other, and were probably originally hydrologically isolated. This estimate of hydrologic isolation is based on location of tidal channels in historic airphotos: tidal channels ran in from the Yaquina, and did not connect longitudinally along the full length of site Y29. The parcels are likely to remain hydrologically isolated from each other due to land ownership patterns. Despite their hydrologic isolation from one another, these parcels were lumped together as site Y29 because they all require similar restoration methods.

The Mill Creek sites (sites Y23 through Y26) are hydrologically connected *via* Mill Creek, but they were divided into a number of separate sites. Mill Creek is a very high priority area, and it seemed advisable to provide more specific details on each sub-area. Similarly, tidal wetlands associated with Drift Creek were divided into large sub-areas based on ownership and type of alteration. The East Bay Marsh (site A31), is affected by the earthen dams across the north channel of the Alsea, so it is separated from site A30, "Drift Mouth W", which receives at least part of its tidal flow from the mainstem of the Alsea and from Drift Creek. Drift Dogleg E (site A27) and Drift Dogleg W (site A28) were separated because of land ownership patterns.

This project did not attempt to delineate wetland boundaries. In most cases, the limit of tidal marsh or former tidal marsh can be determined by using historic and current aerial photos. Areas that are still tidal marsh show a distinctive meandering, highly branched tidal channel morphology. These tidal marshes have emergent vegetation, while adjacent uplands (visible as a topographic break using stereo pairs) are generally forested if undisturbed. Identification of boundaries of tidal wetlands becomes trickier at the upper limit of tidal influence (see "**Upstream limit of tidal wetlands**" above).

Site location

Township, range, section and USGS quad name were obtained from USGS 7.5 minute quadrangles. Location was determined as accurately as possible by relating features visible on aerial photographs to features present on the USGS quads. However, **location is only approximate**, because for small sites, site location relative to features on the quad maps was not always obvious. This discussion also applies to the site locations shown on the site locator maps (Appendix C).

Aerial photo number

This column refers to the photo on which the site can be seen, in the recent aerial photographs that were used as a primary reference for this project (copies of

these photos have been provided to the MidCoast Watersheds Council). For the Yaquina sites, "7/97 CEB Color IR photo #" refers to the series of color infrared (IR) photos taken for the EPA's Coastal Ecology Branch in July 1997. It took 43 of these high-resolution photos to cover all of the project sites on the Yaquina. For the Alsea sites, "6/93 BLM color photo #" refers to a series of 8 true color photos taken for the BLM in June 1993; these are stored at the USFS Siuslaw National Forest, Waldport Station.

Site acreage

The size (acreage) of *the tidal wetland portion* of each site shown in the site information table is approximate and was determined using a dot grid. The acreage shown is the approximate area of vegetated tidal wetland (or former tidal wetland); it does not include adjacent mud flats, algal flats or eelgrass beds (which can constitute large areas, e.g. at King Slough). Thus, King Slough, for the purposes of this project, has a small area (<2 A) despite the fact that King Slough itself is large. It was difficult to define the exact area of some sites, where fringing tidal marsh and mud flat are highly interspersed.

Current vegetation type

Vegetation communities were determined from airphotos and from publicly accessible vantage points on the ground. First, the general community type was recorded. These general community types are high tidal marsh, low tidal marsh, spruce tidal swamp, sedge marsh, freshwater wetland, and upland. (Dominant species in the tidal wetland communities are described in "**Vegetation communities**" above.) Dominant species for each site were recorded they differed from the general community descriptions.

For sites that were not visually accessible, broad vegetation community types (for example, "tidal marsh") were tentatively assigned (see tables). Because vegetation communities reveal the type and degree of disturbance to a site, vegetation should be field-checked in detail before action is taken at a site.

For tidal marsh sites, salinity regime (salt, brackish, or fresh) is a major determinant of the plant community. Salinity regime can not be determined from airphotos; determination of salinity regime was not within the scope of this project. However, we know that sites are generally saline (salt marsh) nearer the mouth of the estuary, and freshwater (tidal freshwater marsh) towards the upper limits of tidal influence and at the upstream end of tidal tributaries like Wright Creek/Poole Slough (site Y40) and Mill Creek (sites Y23 through Y26). Between the salt marsh and freshwater marsh, sites would be expected to show a range of salinity from salt to brackish to fresh. It is important to note that salinity regime would also be expected to vary along a gradient **within** many of the project sites,

particularly large sites such as Boone/Nute Slough, Poole Slough, and McCaffery Slough, and sites which receive freshwater input from tributary streams. This salinity gradient is one of the factors that makes these tidal wetland sites valuable to salmon.

Alterations to sites

A preliminary determination of alterations to sites was made using the historic aerial photographs. Disturbance of tidal wetland sites was generally visible in aerial photographs, either directly (visible ditching, diking, tidegates, etc.) or indirectly as a change in the appearance of vegetation (vegetation "signature") compared to undisturbed areas. These vegetation signatures were verified where possible in the field (see "**Ground truthing**" below). Disturbed areas were generally being invaded by freshwater wetland plants (in a geographic setting where tidal marsh used to exist, or would otherwise be expected); or occasionally by weedy upland annuals, indicating loss of wetland hydrology. Reed canarygrass was a typical invader in disturbed wetlands, and Himalayan blackberry was common in disturbed areas that had been converted to upland.

Ground truthing

Aerial photos provided many clues to locations and conditions of tidal wetland sites. Information such as tidal channel and tide flat location and condition, structure of tidal channels, the location of the marsh in relation to mainstem river channels and tributary streams, and the condition and type of vegetation can be gained from these photographs. In addition, the presence of ditches, dikes, roads and fill areas can be determined and adjacent land uses characterized. Where airphoto clues indicated a likely tidal wetland site or former tidal wetland site, the location was ground-checked if possible to verify the information. This process of verifying information from airphotos is called "ground truthing".

As mentioned above, this project did not include on-site field work, but vegetation communities, general condition of sites, and alterations to sites could often be determined from publicly accessible viewpoints adjacent to sites. Some sites could be viewed only from a boat; boat trips provided by local residents made an overview of these sites possible. Limited river time and lack of alternative viewpoints meant that some sites were not visually accessible. For these inaccessible sites, only a general estimation of site characteristics and condition could be made.

Date of alteration

On the base maps, the year of the earliest historic airphoto in which alteration could be seen (ditching, diking, tidegating, roadbuilding across part of the tidal wetland, etc.) was marked for each site. Alteration occurred prior to this date, but the exact year of alteration could not be determined from airphotos.

Land ownership

Land ownership was determined using assessor's maps and tax rolls from the Lincoln County Assessor's Office. A rough list of tax lots for each site was compiled and used for this purpose. Because of time and budget limitations, the list of major owners is not complete (particularly for large sites like Boone/Nute Slough and Depot Slough), but the list includes most of the major owners for each site. Determining which tax lots are on each site was challenging, because assessor's maps show very few natural features. Tax lots for each site were determined as accurately as possible using measurements from aerial photos and the assessor's maps, but this process is subject to error. Therefore, the list of largest owners shown in the site information tables is tentative and **ownership should be verified when developing site-specific action plans**. A separate spreadsheet with this list of tax lots, subdivided by site, was provided to the MCWC; landowner addresses have been added to the database by a data service provider, and the records are stored at the MCWC office.

Possible actions

Protection. One possible action plan for a site is simply to help assure its long term protection. This is the best action for sites that are undisturbed or which are rapidly returning to their natural state without intervention. Protection may be through permanent or temporary conservation easements, deed restrictions, site acquisition or other means.

Tidegate modification and tidegate removal. Other possible actions consist of removing barriers to water flow. Tidegates can be modified to allow fish passage. Tidegate modifications (Charland, 1998) may be a good option where a landowner does not want to allow restoration of tidal flow. However, providing fish access to a site should not be considered equivalent to restoration of tidal flow, since providing fish access does not restore the ecological functions of the tidal marsh. A better option for restoration of the full tidal wetland community is complete removal of tidegates, combined with upgrading culverts if needed to accommodate substantial tidal flow.

Culvert replacements. Where tidegates are absent but culverts impede tidal flow, the culverts can be upgraded (larger sizes or multiple culverts installed), or culverts can be replaced with bridges to increase tidal flow. In any culvert replacement project, the placement of the new culvert will be critical. Culverts must be placed at an elevation that allows tidal exchange and fish passage.

Dike breaching / dike removal. Many sites in the Yaquina and Alsea basin are diked off from tidal influence. Dikes can be breached at selected locations (preferably at locations of former natural tidal channels), or removed completely. When dikes are breached in selected locations or removed completely, selection of an appropriate target elevation for the excavation work is critical in avoiding erosion of existing marsh habitat (Charles Simenstad, University of Washington, personal communication, 1998). When deciding whether to remove dikes completely or breach in selected locations, it is important to remember that complete dike removal to an appropriate target elevation will facilitate the periodic sheet flow that is important to nutrient export from the high marsh (Charles Simenstad, personal communication, 1998). During episodes of sheet flow, salmonids forage throughout the entire high marsh, not just in tidal channels (Dan Bottom, ODFW, personal communication, 1998).

Undisturbed high marsh sites are generally inundated only at very high tides. If at a given tide the undisturbed high marsh sites are not inundated, and a nearby disturbed site is inundated, the disturbed site may have subsided. However, since diking and tidegates often result in impoundment of freshwater above its natural level, inundation does not necessarily indicate a high degree of subsidence. Elevation surveys should be done at restoration sites to determine likely tidal ranges after restoration. Also consider the date of alteration shown in the site information tables; if the site was diked early (for example, prior to 1939), subsidence and soil changes are likely to be greater than if the site was diked in the 1950's or 1960's.

When target elevations are determined for these purposes, reference elevations must be taken from sites very nearby. Elevations of high marsh and low marsh vary greatly throughout a single estuary system due to variations in tidal flow, freshwater input, and other factors (Bob Frenkel, OSU, personal communication, 1999).

If no remnant channels remain in a diked former tidal marsh site, dike breaching or dike removal should be accompanied by excavation of tidal channels. This may help prevent large-scale erosion.

Dike setback (construction of a new dike farther away from the tidal water body) is another possible action in cases where a portion of a former marsh is in active use (or has a house), but a portion could be allowed to return to tidal influence. However, there is a risk of erosion to below tidal level outside (seaward) of the new dike. In the course of attending workshops and technical sessions on

estuary restoration, no examples of dike setback were mentioned, so this strategy may not have been tested in Oregon.

Discussion with others doing similar work will be important when developing site-specific action plans that involve dike breaching or dike removal. A variety of workshops and technical sessions contributed information for this report, and a synthesis of that information showed that the techniques for dike breaching and dike removal are still not yet well-established. In addition, thorough study of historic airphotos will be important at sites where dikes are to be breached, removed, or set back. The goal is to pursue actions that will encourage the re-establishment of original tidal channels.

Tidal channel restoration. The natural flow of water through tidal channels can sometimes be restored by blocking ditches to redirect tidal flow through remnant channels, or by filling ditches completely and excavating tidal channels, preferably where remnant channels are located. Design of tidal channels is not a trivial task and requires hydrologic expertise.

Fill removal. The most logistically complex and expensive type of restoration is removal of large areas of fill material. Since the original soils may no longer be present on extensively filled sites, this option seems least likely to be successful, and sites that were entirely filled were generally not considered in this study. In some cases, fill removal may be a feasible strategy for restoration if less than an entire site has been filled.

Buffer areas. An important action to be taken in conjunction with site restoration actions is establishment of buffer areas adjacent to sites. This action is not directly addressed in this report, but should be considered when developing site-specific action plans. Buffer areas of native vegetation can protect a site from water quality impairment, encroachment by adjacent residential development, intrusion of fill material, disturbance to wildlife, and many other impacts.

Current land use and adjacent land use

Land use on each site and adjacent to sites was determined by examining airphotos and by field observation. Current land use was described as vacant (not currently used by humans other than for recreation), forestry, agriculture, pasture, rural residential or urban development.

Connection to streams

Where a tidal wetland was directly connected to a stream system (other than the mainstem Yaquina or Alsea), that stream is mentioned here. Some of these

tributary streams provide known salmonid spawning habitat, such as Mill Creek on the Yaquina, and Drift Creek and Darkey Creek on the Alsea.

Comments from experts

Information about individual sites was gathered from local residents, experts in biological sciences and resource management, and others during meetings, workshops and technical sessions. This information may be key to site prioritization decisions, and may be very useful in developing site-specific action plans.

For some sites, biologists had comments on known salmonid spawning on the site or in streams connecting to the site. Where biologists reported high levels of salmonid spawning, or spawning by species at the edge of their range, these sites were assigned a high biological value ranking. Other than this ranking, this study did not evaluate fish presence at project sites. The available data on fish presence and abundance are not adequate for comparison between sites, because many of this study's sites have not been sampled.

Recommended next step

This is generally a recommendation for the form of landowner contact. Landowner contact should be coordinated by the MidCoast Watersheds Council and its basin planning teams. Landowners of highly-ranked sites should be contacted through a personal visit, telephone call or letter. However, since the total number of landowners for sites in the two estuaries is high, such a personal contact may not be feasible. As shown in the site information table, a more general form letter might be adequate for some sites. However, in every case, a personal contact, preferably from a member of the local basin planning team would be ideal.

Other reports

Two reports had specific references to a number of sites covered by this study: Lebovitz (1992) and the Lincoln County Comprehensive Plan (Lincoln County Planning Department, 1999). For each site that was mentioned in Lebovitz, the site information table shows Lebovitz's site number and the site's scores for four scoring regimes: 1) general status scoring for acquisition purposes, 2) salmonid habitat scoring for acquisition purposes, 3) general status scoring for restoration purposes, and 4) salmonid habitat scoring for restoration purposes. These scores are shown in that order in the site information table. Further discussion of Lebovitz's report is found in Appendix E.

For sites mentioned in the Lincoln County Comprehensive Plan's Mitigation section, the site number is shown in the "Other reports" column of the site information table. For example, site Y3 (Airport N) is marked "LCCP MIT #8", as it is described as site number 8 in the Lincoln County Comprehensive Plan's Mitigation section for the Yaquina estuary.

Site Prioritization

Site prioritization is summarized in ranked site summary tables (Appendix A). Sites were ranked for two parameters: logistical complexity, and biological value. Only a small number of rankings were used (3 rankings for logistical complexity, and 2 for biological value), because we felt that rankings would be most useful if they were simply used to provide a rough "first cut" of which sites deserve initial focus. As described above, **rankings are intended to provide a broad perspective and help guide decisions; the rankings should not be used to eliminate any site from consideration for restoration or protection.**

Narrative information in this report and the particular characteristics of each site will be more important than the rankings in making decisions on which sites are appropriate for action at a given point in time. For example, some sites are ranked lower for biological value because they are small in size. However, some of these sites have only a single landowner and require only protection, and these sites are excellent candidates for simple, direct implementation of permanent protection via a deed restriction or conservation easement, if the landowner is willing. In addition, small sites in developed or developing settings are often more visible than the more pristine sites, and can be ideal spots for informational signs, boardwalks, and other interpretive use, providing the landowner is willing. Such sites in the midst of development can help focus public attention on valuable resources, in a way that might never occur with large, more remote, pristine sites.

Logistical complexity

For logistical complexity, two factors were considered in a 3-way ranking:

1) number of landowners at the site, and 2) the type of work needed to restore the site. Three categories were used, from logistically easiest to most complex:

1. "Easy", with a single landowner and relatively simple restoration procedures (or no restoration needs, only protection) needed;
2. "Medium", with more than one landowner, and a relatively simple restoration procedures (or only protection) needed; or with a single landowner, but more complex restoration procedures needed;
3. "Complex", with more than one landowner, and more complex restoration procedures needed.

"Simple restoration procedures" refers to culvert replacement, tidegate modification, and tidegate removal. These procedures are conceptually simple; funding and implementing these procedures may not always be simple. However, the procedures considered "more complex" (dike breaching, dike removal, ditch filling, tidal channel excavation, and fill removal) generally involve a more complicated planning process and a higher level of funding.

Biological value

Both the Alsea and Yaquina estuaries are known to be used by chinook, chum, coho, and steelhead, and are known to be important to those salmonid species. Therefore, we began with the initial understanding that all tidal wetland sites within these estuaries are biologically important (or potentially important) to salmonids. The next step was to help establish a differential ranking for each site's biological value. We used two additional factors to produce a 2-way ranking: 1) acreage of the site, and 2) connectivity to known salmonid spawning streams. **This ranking is not intended to be a thorough assessment of site functions.** Most sites were on private property and could not be physically accessed; and assessment of tidal wetland functions is a complex and technical field (Simenstad et al, 1991). However, based on review of other site ranking schemes (White et al, 1998; Schreffler and Thom, 1993; Lebovitz, 1992), site acreage and known salmonid spawning use in connecting streams are among the most important factors in site prioritization. (Another factor that could be used to rank sites is salinity. Sites in the brackish to freshwater areas of the estuary are likely to be particularly valuable to juvenile salmonids. However, the scope of this report did not include evaluation of salinity at each site; see "**Current vegetation type**" above for more information.)

Acreage and connectivity were used to place sites in one of two categories ("1" for higher-ranking sites, or "2" for lower-ranking sites:)

1. Higher ranking: over 15 acres, or connects to stream with a high level of known salmonid spawning use (based on information from ODFW, USFWS, and USFS staff);
2. Lower ranking: less than 15 acres; and lacks connectivity to streams with a known high level of salmonid spawning activity (based on information provided by ODFW, USFWS, and USFS staff).

Site ranking groups

For each estuary, six ranking groups were produced by combining the biological ranking with the logistical complexity ranking. Group 1 is the highest ranking; Group 6 is the lowest:

	Logistical ranking		
Biological ranking	1 (Easy)	2 (Medium)	3 (Complex)
1 (higher)	Group 1	Group 2	Group 3
2 (lower)	Group 4	Group 5	Group 6

Special circumstances

Some sites were moved up in the tables to reflect special circumstances. Boone/Nute Slough was moved to Group 1 in the Yaquina because of its large size (over 600 acres), even though it falls into the logistically complex category. This site offers one of the best restoration opportunities on the Oregon coast and thus should be a very high priority for development of an action plan. Similarly, Depot Slough on the Yaquina was moved to Group 1, because of its large size and high existing and potential fish use. The Mill Creek sites (Y23 through Y26) were moved to Group 1 because they are located in a FEMAT-designated key watershed, and expert opinion supported prioritization of these sites.

On the Alsea, Bain Slough was moved up to Group 1 because if restored, it would be an example of spruce tidal swamp, a plant community that is now rare in Oregon. The tidal marsh at the mouth of Darkey Creek (site A17) was assigned a "biological value" ranking of 1 because it has a run of chum, which are rare in the Alsea basin (Jack Sleeper, USFS, personal communication, 1998). Bayview Oxbow was moved to Group 1 because of its large size and high restoration potential.

SITE NARRATIVES

The following site narratives must be used in conjunction with the site information tables; **critical information presented in the tables is not duplicated here.** The purpose of these site narratives is to present additional information that could not be presented in the matrices due to space limitations. Not all sites are represented in this narrative, since for many sites, the site information table was adequate to describe site characteristics.

Yaquina estuary

- Site Y1 consists of low to high marsh along the west edge of Idaho Flats, south of Hatfield Marine Science Center. The area includes some land owned by the Oregon Coast Aquarium, so there is high potential of coordinating restoration projects with the Aquarium's public education programs. Much of the low marsh on this site has accreted within the last 50 years. Because it represents an unusually large area of recent accretion, and because of its proximity to Hatfield Marine Science Center, the site also has high potential for research. Many alterations exist in this site, including channelized tidal and freshwater drainages, dikes, and culverts. Some parts of this site are already part of the Aquarium's outdoor interpretive area. Sites Y1 is also near "known herring spawning areas" described in Gaumer et al (1974).

A freshwater wetland at the southwest corner of 35th and Idaho Point Road (also part of site Y1) was probably once a tidal wetland, but tidal flow is mostly blocked by the road. A small culvert allows freshwater drainage and carries some tidal flow; a culvert upgrade or small bridge could restore this site to tidal influence. The hydrology of this freshwater wetland site is complicated; a series of ponds (possibly old log ponds) to the southwest appear to divert the drainage from adjacent creeks. A culvert upgrade could re-establish tidal flow to this wetland, but impacts on current land uses (e.g., current use of the log ponds) should be considered.

- Site Y2 (Airport) shows recent accretion of low salt marsh just west of the airport.
- Site Y3 (Airport N) has been used as a dredge material disposal site and is so marked in the Estuary Plan Book (Cortright et al, 1987. However, it is an appropriate site for restoration, since it is highly unlikely that it will receive additional dredge materials (Matt Spangler, Lincoln County Planning Department, personal communication, 1998). There is noticeable ponding behind the dikes on the west side of the site; and much of the southeast corner and south side of the site were inundated during winter 1998-99. This inundation shows that water flow across the site is impeded and freshwater may be impounded on the site, even though the dikes at this site have breached naturally. Further dike breaching or dike removal would help restore this site to natural functions.
- Site Y6 (Boone/Nute Slough) is probably currently used by resident salmonids (cutthroat) and possibly by lamprey (Tony Stein, ODFW, personal communication, 1998). If opened to tidal flow, this site would present good habitat for anadromous fish and lamprey.

Possible restoration strategies at Boone/Nute Slough are numerous, including tidegate removal or (with possible re-installation further upstream in the

slough system if necessary); breaching of internal dikes; filling ditches; and reconnecting remnant tidal channels or excavating new tidal channels. Another option that could help expand the area restored is dike setbacks (i.e., build new protective dikes to protect specific areas where landowners are unwilling to allow restoration of tidal flow). To some degree, fresh water has been impounded by the system of dikes and tidegates at this site. Where pastures have been flooded in winter, tidegate removal could help reduce flooding by improving freshwater drainage. Consultation with a tidal hydrologist is highly recommended for this site due to its complexity. Discussions with estuary restoration experts, and involvement of both local residents and the active diking district, will be especially important to success of restoration here.

Site Y7 (Depot Slough) is currently used by coho, chinook and steelhead (Tony Stein, ODFW, personal communication, 1998). Development activity is fairly intense around Depot Slough, but there is high potential for restoration. At least part of Depot Slough was once spruce tidal swamp (Bill Lapham, personal communication, 1999); spruce tidal swamp is a very rare vegetation type in both the Alsea and Yaquina estuaries and statewide (Jefferson 1975). Tradeoffs between existing freshwater wetland habitats and potential restored tidal wetland habitats need to be considered. Freshwater wetland habitats here have been created at least partly by the tidegates along Depot Slough, which impound freshwater in the winter. There is a gas pipeline easement through the area. As for Boone/Nute Slough, consultation with a tidal hydrologist is recommended, involvement of both local residents and the active diking district will be especially important to success of restoration here.

- Site Y10 appears to be in good condition, so the culvert that carries flow under the North Bay Road may be adequately sized. This site is publicly owned (by Lincoln County), so protection strategies should be discussed with the County.
- Site Y12 has a small culvert which appears to have once been tidegated but is now open. It appears to be undersized and was submerged at the time of field observation in winter 1998-99.
- Site Y13 has two culverts, a lower, concrete culvert and a metal culvert placed about a foot higher, both about 2 foot diameter. Neither is tidegated, but tidal inflow appears to be restricted judging from vegetation (*Agrostis* spp. are dominant not far from the road).
- Site Y13a seems to be the site considered by Jefferson (1975) to be one of the three best examples of mature high marsh left in Oregon. This site is ranked in Group 2 because it has more than one landowner. However, both landowners are public entities (Port of Toledo, and Oregon Board of Education). Therefore, protection may be easier to implement than with private ownership. Although the east end of the site was not visually accessible, airphotos indicate that tidal flow may be restricted by some alteration to the tidal channel that enters the site at the far east end.

- There are no sites numbered Y15 or Y16.
- Site Y18 is mostly mud flat; it looks as if the tidegate may have been fairly recently removed. Tidal inflow is evident, because Lyngby's sedge is colonizing at the edges of the mud flat. This site may already be undergoing restoration.
- Site Y19 has weedy upland vegetation mixed in with brackish marsh species. It is ditched.
- Site Y20 has only a small area of tidal marsh vegetation, and is highly altered, with roads on both sides of the site and outflow from an excavated pond running through the site. Due to the small size of the site and the level of disturbance, this site is a low priority for restoration.
- Although Site Y21 is ranked in the lowest group (Group 6) because it has several landowners and requires relatively complex restoration, John Johnson (ODFW, personal communication, 1999) reports that a major landowner is very interested in restoring their portion of this site (which is the largest holding on the site). In addition, the owners of the remainder of the site (a private party, and Georgia-Pacific) have also expressed interest in restoration projects in general and for specific areas nearby. Therefore, this site presents good opportunities for restoration.
- Site Y22 is still tidal despite ditching and some remnant dikes; vegetation near the road is dominated by Lyngby's sedge and bentgrasses, with some Pacific silverweed, orache (*Atriplex patula*), and seacoast bulrush (*Scirpus maritimus*).
- Sites Y23 through Y26 (Mill Creek) are assigned high priority for tidal marsh restoration projects for several reasons. Mill Creek supports healthy wild runs of several salmonid species including chum, coho, steelhead and chinook (Bob Buckman, ODFW, personal communication 1999). Mill Creek and its tributary Slack Creek have been the site of several restoration projects (Maleki, 1998), and the watershed is a FEMAT-designated key watershed (USDA et al, 1993). There may be possible NRCS program incentives for restoration activities at Mill Creek sites (Y23, Y24A, Y24B, Y25 and Y26) because of water flow issues (Mill Creek Reservoir is the water source for the City of Toledo). The limit of brackish marsh appears to be around site Y24b (where slough sedge becomes dominant). Reed canarygrass is dominant in ditched portions of site Y25.
- Site Y27 has been used for log stacking and appears highly disturbed, especially at its west end. However, it is a very large site and would present excellent opportunities for restoration, as well as a good site for some experimental work in restoration design. Because this site is large and could easily be divided into several different treatment areas, it might be a good location for experimental testing of different restoration methods.

- Site Y28 is an example of a plant community that is very rare in Oregon, the spruce tidal swamp (also called "tideland spruce meadow") (Jefferson, 1975).
- Site Y29 has several different subsections with different vegetation communities. The sections that are actively pastured have a mix of soft rush (*Juncus effusus*) and pasture grasses (identification not possible from the road); sections that are not currently in active use have a high proportion of cover in reed canarygrass, willows (*Salix* spp.) and other brush.
- Site Y30 is a proposed mitigation site (#13) in the Lincoln County Comprehensive Plan. The site is already in the process of restoration, and appears to be in good condition. There may have been a dike along the Yaquina at this site, but the dike is now in poor condition and is breached (perhaps naturally) in at least two locations. The recent aerial photo shows several ditches that could be blocked to restore flow through the original tidal channels, which are still clearly visible. The site was not easily visible from the road; on-site work will be needed to determine vegetation communities and the best restoration strategy.
- The mitigation section of the Lincoln County Comprehensive Plan (Lincoln County Planning Department, 1999) proposed a culvert upgrade for Flesher Slough (site Y31); the current culvert may indeed be an upgrade from the one that was in place when the mitigation section of the Comprehensive Plan was written. However, aerial photos taken in 1998 still show large turbulence pools on both sides of the culvert. It is unknown whether these pools are remnant from the earlier, smaller culvert, or whether the current culvert is in fact still undersized. During a site visit just before low tide, we observed turbulence and very high velocity flow through this culvert, indicating flow restriction. Any actions proposed for this site should be reviewed with both the Lincoln County Planning Department and the Confederated Tribes of the Siletz Indians, since there is a historic fish weir dating to about 300 years ago just upstream (Stan VanDeWetering, Confederated Tribes of the Siletz Indians, personal communication, 1998).

Site Y31 includes a small marsh less than 1000 feet to the west of Flesher Slough. The South Bay Road bends south around this small marsh, leaving the north side mainly undisturbed. North of the road, vegetation is mud flat with fringing high marsh vegetation like that at Flesher slough (dominated by tufted hairgrass). Tidal flow and freshwater drainage are culverted under the road at the south end of the small marsh. The culvert appears possibly undersized, with turbulence pools on either side.

- Site Y32 (Grassy Point) is an undisturbed high marsh site. This may be the same site referred to by Jefferson (1975) as Boone's Point. Boone's Point was described by Jefferson as one of three best examples of undisturbed high marsh remaining in Oregon; the other two being the large island at the mouth of Poole Slough (site Y40) and site Y13a.

- Site Y33 (King Slough) is mainly mud flat, with only small areas of fringing tidal marsh. Two possible restoration sites are the small areas of tidal marsh at the south end of the slough. The south end of the slough forks, and each fork has a road crossing and culvert. Turbulence pools at the culvert on the west indicate possible restriction of tidal flow. A creek flows into each fork of the slough; the eastern creek is longer (about 2 miles). No publicly-accessible vantage point was available for this site, so interpretation is based entirely on the aerial photos.
- Site Y34 (McCaffery Slough) is undisturbed except for minor ditching in one location. Because of its pristine condition, McCaffery Slough has been proposed as a NOAA Estuarine Research Reserve. Oyster culture has also been proposed recently for McCaffery Slough. Impacts to the tidal marsh from oyster culture would relate to the use of mooring blocks for the oyster rafts; these mooring blocks would probably be placed in the tidal marsh and could cause some impact to the marsh. Oyster culture at the mouth of Poole Slough has been accompanied by fill across the adjacent high marsh (for a road out to the oyster beds) and by ditching in the marsh along that road.
- Site Y35 (Montgomery Creek) has only a small acreage of fringing tidal marsh. A group of logs are present on the mud flat; their status (historic fishing weir?) and behavior (movement during high tides?) should be checked. If the logs are of historic interest, protection of the area should be implemented.
- Sites Y36 (North Bay wetland), Y39 (Parker Slough), and Y41 (Weiser Point slough) are all near "known herring spawning areas" described by Gaumer et al (1974).
- Site Y37 (Olalla Slough) (above the dam at Sturdevant Road) is used as the industrial water supply for the Georgia-Pacific mill to the south. The mill requires fresh water and monitors salinity at the dam; a fish ladder is maintained here (Onno Husing, OCZMA, personal communication, 1999). Because of the industrial use of the water in the slough, restoration of tidal flow to this site seems highly unlikely.
- Site Y40 (Poole Slough) is the largest remaining intact tidal marsh in the Yaquina estuary. The large island at the mouth of site Y40 (Poole Slough) was considered by Jefferson (1975) to be one of the three best examples of mature high marsh remaining in Oregon. Since Jefferson's report was written, this island has been disturbed by construction of an oyster culture facility; a road was built across the south part of the island between 1976 and 1997.

Based on historic airphotos, some of the smaller tidal channels within Poole Slough were tidegated in the past. In 1999, all tidegates appear to have been removed or have deteriorated to a point where they no longer function. Some of the high marsh in Poole Slough may have been diked in the past as well, but the dikes are low, and tidal flow appears to be present throughout the high marsh at this time. (Some of the apparent dikes may in fact be natural levees

that were supplemented by a small amount of fill, and have since subsided). In addition, a hatchery operated in the past on Wright Creek (which flows into Poole Slough).

- Of this project's 43 sites on the Yaquina, 13 are proposed mitigation sites within the Lincoln County Comprehensive Plan: sites Y3 (Airport N), Y6 (Boone/Nute Sloughs), Y11, Y17, Y18, Y19, Y20, Y27, Y30, Y31 (Flesher Slough), Y37 (Olalla Slough), Y38 (Olalla Slough S), and Y41 (Weiser Point Slough). (Note: The location of some of these mitigation sites was difficult to determine from LCCP text, so the Lincoln County Planning Department should be consulted when proposing action at any site described in this study.)

Alsea estuary

- There are no sites numbered A1 or A2.
- Site A3 is located adjacent to a developing residential area. Tidal marsh acreage is very small, and part of the formerly tidal area has been filled. Restoration would involve fill removal. Restoration would be complicated by the numerous property owners, and the presence of some houses on very low ground immediately adjacent to the site.
- Site A5 includes tidal marsh at the mouth of Eckman Slough and the island in the Alsea channel that extends east of Eckman Lake. This area is important as a herring spawning site (Gaumer et al, 1973). The site contains a high diversity of tidal wetland types including low sand marsh, sedge marsh, immature and mature high marsh and diked marsh (Jefferson, 1975; Gaumer et al, 1973; U.S. Army Corps of Engineers, 1976). This site could be negatively affected by reintroduction of tidal flow to Eckman Lake, since portions of the marsh at site A5 accreted after tidal flow to Eckman Lake was blocked (see site A36 below).
- Site A6 is diked and actively grazed, and has fruit trees on the west end. It does not appear to be wetland on the west end. The east side of the site is low and wet, but its status (tidal or nontidal) could not be determined from the only vantage point on Highway 34.
- Many of the sites on the south bank of the Alsea, east of Eckman Lake and west of Barclay Meadows (sites A6 through A21) are separated from each other by dikes and/or ditches leading from Highway 34 out to the Alsea. Some of these cross-dikes were built to provide access to docks along the Alsea; others were probably built to confine tidal flow. Sites A7, A8, and A9 are still

tidal marsh and appear to be in good condition despite some ditching at their margins.

- A stream (not named on the USGS Waldport quad) enters the Alsea river between sites A12 and A13. The stream is impounded behind Highway 34 by a small dam, forming a perennial pond. Two culverts control the depth of water in the pond, one high (elevation several feet above the tidal marsh) and one lower and possibly tidegated (it was submerged at the time of field observation).
- As viewed from Highway 34, the area just north of the buildings on site A13 appears to have been filled.
- Site A17 contains some buildings and some relatively undisturbed tidal marsh. The landowner is apparently aware of the value of the resource, since the marsh is marked with a sign that says "Wilson Wetlands."
- Sites A18 through A21 are highly altered, with dikes along the Alsea, cross-dikes, and ditching of former tidal channels visible in the airphoto. Several mobile homes are located on low ground here; fires during the winter of 1998-99 destroyed some of these structures. This area floods in the winter; the dikes appear to impede the drainage of fresh water. Vegetation is a mixture of disturbed freshwater wetlands (reed canarygrass visible from Highway 34; some willows near the highway) and weedy upland vegetation on high spots (mostly Himalayan blackberry). A new home was recently built on site A21; the land around it (landward of the dike) was inundated in winter 1998-99, as was the access road to the new home.
- Site A22 (Bain Slough) is tidegated and possibly diked (residential development along the Alsea here may be on a natural levee rather than a man-made dike). Based on tidal channel morphology, current vegetation, historic airphotos, and the site's location in the estuary, this site appears to have once been spruce tidal swamp, a vegetation community that is rare in Oregon. (An example of intact spruce tidal swamp is found at site Y28 on the Yaquina River.) The banks of the Alsea at this site were grazed meadow in 1939; at that time, the remainder of the site was similar to the current vegetation at site Y28. The reduced salinity due to the tidegate has altered the plant community, increasing the presence of alder (*Alnus rubra*), willows, spiraea (*Spiraea douglasii*), slough sedge, reed canarygrass, and other freshwater wetland species. However, some of the original vegetation is still present, particularly the scattered, large Sitka spruce that were present in 1939. Re-introduction of tidal flow might allow restoration of the brackish marsh vegetation that is found at site Y28 on the Yaquina River.
- Site A23 (Barclay Meadows East) is highly altered, with a tidegate on the original main tidal channel, cross-ditching, and a high, well-maintained dike along the Alsea. Much of the site is inundated during winter, apparently due to impoundment of fresh water by the dikes and tidegate. Homes along the Alsea are subject to flooding from this inundation (several were sandbagged

during winter 1998-99). Vegetation in the meadow behind the dike and tidegate is freshwater wetland to upland pasture, with large areas of reed canarygrass and velvetgrass (*Holcus lanatus*). Skunk cabbage (*Lysichiton americanum*) and slough sedge are dominant in low areas, especially near ditches.

- Site A24 (Barclay Meadows West) was not accessible, but appears to have tidal exchange. If dikes are present, they have breached (perhaps naturally). Vegetation could not be determined from offsite. Scattered Sitka spruce may indicate areas of current or former spruce tidal swamp.
- Site A25 (Bayview Oxbow) is an extensive area of former tidal wetland. In the earliest photos examined (1939), this site was already ditched, diked and actively used for agriculture. Tidegates are present at both the east and west sides of the oxbow, where Bayview Road crosses the site. These tidegates are malfunctioning at the present time, allowing limited tidal exchange, particularly at the east end. Tidegate function has also been impaired by large amounts of storm wrack deposited along Bayview Road during recent winter storms.

Many interconnecting ditches have been excavated over the past several decades in an attempt to drain the site, but despite this effort, much of the site is freshwater wetland, dominated by soft rush, reed canarygrass, and slough sedge.

- Site A26 (Drift Bend) is a diked former tidal marsh inside the first large bend in Drift Creek (between 1 and 2 miles upstream of the mouth of Drift Creek). A small culvert under the dike road at the mouth of the main former tidal channel allows limited tidal exchange. However, the size of the tidal channel and the pattern of vegetation in historic photos shows that tidal exchange was once much greater. Dike breaching or construction of a bridge where the dike crosses the tidal channel could restore this site to tidal marsh function. The site is actively grazed, and the dike and the dike road are actively maintained at present. The easternmost portion of the dike provides access to a utility pole, so complete removal of this portion of the dike (which is adjacent to the main tidal inlet) may not be an option.
- Sites A27, A28, A29, A30, and A31 are all undisturbed high marsh sites. Together, they total over 400 acres and are the Alsea estuary's highest priority for protection. Some areas were grazed in the past, but all now show typical high marsh plant communities. The only exception is mild disturbance of the plant community at site A28, apparently due to haying activity in past decades: giant vetch (*Vicia gigantea*) and cleavers (*Galium aparine*) are common at this site, mixed in with the usual dominant high marsh species (tufted hairgrass, Pacific silverweed, and Baltic rush).

Several of these sites have unusual features that make them particularly valuable. Site A30 has a stand of Sitka spruce on a natural levee near the mouth of Drift Creek, and also has large accumulations of drift logs amid

storm wrack deposited at the upland edge of the marsh (at the base of the adjacent slope). Sites A29, A30, and A31 all have large woody debris scattered throughout the marsh, with accumulations on the natural levee that forms at the river's edge. This large woody debris serves important ecological functions in the mature high marsh community (see "**Tidal wetland functions and salmonid production**" above).

Sites A30 and A31 are affected by the restricted flow in the north channel of the Alsea river, caused by construction of piling dams there in the 1960's and 1970's. The dams (partly removed in recent years) do not appear to have affected the vegetation communities of the marsh, but they do affect the salmonid habitat functions of the sites (see "**Overview: Tidal wetlands in Alsea and Yaquina estuaries**" above). Continued efforts to remove the remnant blockages and restore full flow in the north channel would improve salmonid access to these sites.

- Site A32 is a low salt marsh at the mouth of Lint Slough. Sediments supporting the low marsh community appear to have accreted since the construction of the dam at the mouth of Lint Slough. The site offers excellent opportunities for education, since it is located adjacent to Waldport High School. It is also a high priority for protection, since low marsh is an uncommon plant community in the Alsea estuary.
- Site A36 (Eckman Lake) was originally a large tidal slough, with extensive tidal flats. The freshwater lake was created in 1957, when the earthen causeway was filled for Highway 34 and tidegates were installed (U.S. Army Corps of Engineers, 1976). The water level in the lake is now maintained *via* a concrete weir. The lake is a recreational resource; consideration of restoring tidal flow should be brought to the community early on in any decision-making process. The mouth of Eckman Slough is important as a herring spawning site (Gaumer et al, 1973). Recently, low water quality and high water temperature have been a concern to local residents (Wayne Hoffman, MCWC, personal communication, 1999). When developing restoration plans for this site, consultation with a tidal hydrologist is recommended; it will be important to avoid erosion of the tidal marsh outside the lake (see site A5 above).
- Sites A31, A34, A35 are near eelgrass beds shown in the Army Corps of Engineers' Alsea Wetlands Review (US Army Corps of Engineers, 1976). Although eelgrass bed locations are dynamic (Thayer et al, 1984), the main part of Alsea Bay in general will continue to provide the most likely area for eelgrass beds. The proximity of sites A31, A34 and A35 to eelgrass habitat may give these sites additional importance as salmonid habitat.
- Of the 36 sites on the Alsea identified by this project, 4 are proposed mitigation sites within the Lincoln County Comprehensive Plan: sites A23 (Barclay Meadows E), A25 (Bayview Oxbow), A26 (Drift Bend), and A36 (Eckman Lake). (Lint Slough was also listed but was not covered in this study; another site described as a diked agricultural site is also listed in the

Comprehensive Plan, but its location is not described.). It is especially important to coordinate any action on these sites with the Lincoln County Planning Department.

THE NEXT STEP: ACTION PLANS

Choosing project sites

The site prioritization provided in Appendix A should be used as a starting point for setting action priorities. As described above, these rankings are intended to provide a broad perspective and help guide decisions; they should not be used to eliminate any site from consideration for restoration or protection. As sites on the list are investigated and landowners are contacted regarding their interest, there will no doubt be some sites that are lower on the priority list that present ideal opportunities for rapid action.

In general, project sites should be chosen so as to complement other existing restoration and protection efforts. For example, Mill Creek on the Yaquina was placed in the highest ranking group because it is important to salmonids (has active runs of chum, coho, chinook, and steelhead), and is the site of other efforts to maintain and restore salmonid runs: it is a FEMAT-designated key watershed, and a fish ladder is maintained at the outlet of the Mill Creek reservoir.

Contacting landowners

The recommended next step for each site is shown in the site information table. In most cases, this consists of landowner contact. Further information gathered after the completion of this study may suggest alternative approaches. As for site selection, local knowledge provided by watershed group members will be crucial in the landowner contact process. For each landowner, a single contact person should be designated (preferably someone from the local Basin Planning Team). Having a single contact person will help keep the process coordinated and efficient, and will help ensure that consistent information is provided to the landowner.

The MidCoast Watersheds Council, Lincoln County Soil and Water Conservation District, Oregon Department of Fish and Wildlife, USDA Farm Services Agency, and USDA Natural Resources Conservation Service have information on the topic of technical and financial support for estuary restoration and protection. Informational brochures from these groups will help acquaint landowners with the range of possibilities.

Developing site-specific plans

- In developing plans for each site, the following points should be addressed. This list is not intended to be comprehensive, but provides a starting point that may help avoid missing important steps in the process. Many of these steps require technical expertise that may not be present within a Basin Planning Team. Technical assistance should be sought from the MidCoast Watersheds Council's technical team, which is composed of federal, state, tribal, and private resource managers and scientists. Other scientists can be brought in and consulted as necessary.

Restoration sites:

- Consider the sites in a watershed context. Identify what opportunities, concerns, and constraints may exist upstream of the site. How does this effect estuarine health and restoration value?
- Contact the Lincoln County Planning Department to coordinate site plans with County Comprehensive Plan and other planning goals. Make sure restoration goals won't conflict with existing zoning and planning goals.
- Establish a 'point' person for each site. Have that person contact the landowner(s) and determine their interest in restoring the site. Discuss which funding and technical assistance strategies might work best for the site. Review this checklist and try to obtain the funding needed for all the steps, including public meetings (if needed), technical assistance and monitoring.
- Contact regulatory agencies (such as the Oregon Division of State Lands Wetlands Program, the U.S. Army Corps of Engineers, and the Oregon Department of Fish and Wildlife) to explain plans for the site. Contact these agencies early in the process, before too much time and energy is invested in site planning. Ask for their help in determining what permits might be needed for the proposed restoration work.
- Evaluate current uses of the site that may conflict with restoration, such as active agricultural use.
- Be aware of the differences between the wildlife habitat currently provided by a site, and the type of habitat that will result from restoration. Some sites, particularly sites that have been diked for decades, will have subsided and may restore to mud flats initially. Mud flats provide rich wildlife habitat, but mud flats may not be what landowners expect to see following re-introduction of tidal flow. Discuss these potential changes and the value of these resources with landowners and neighbors.
- Set up a regular communication schedule to assure that the point person is keeping the landowner, MCWC, and the local basin planning team informed of decisions being made, progress, and problems.
- Where a restoration site has many landowners, is highly visible, or offers potential for controversy, hold public meetings to discuss the project. Landowners and neighbors will provide information that will be critical to

successful restoration. In turn, information provided to landowners and neighbors can help allay concerns and prevent conflict.

- Consult historic airphotos for original (pre-alteration) conditions. Make copies of these photos and keep them on file for reference during project planning.
- Working with the landowner, establish restoration goals (for example, "restoration of tidal flow"). Avoid excessively specific vegetation goals. Re-establishment of salt marsh communities can take a long time (Frenkel and Morlan 1991). Develop a map of the site showing locations of planned restoration activities.
- Include buffers around a site as a part of the restoration plan, especially for small sites. The buffers should be planted to native vegetation, if they don't already have native plant communities in place.
- Measure soil surface elevations on the site and compare to nearby undisturbed tidal wetland sites, to help predict the likely outcome of restoration.
- Establish a monitoring protocol and record baseline information **before** restoration is begun. Use quantitative (numeric) monitoring techniques and get expert advice on how and what to monitor. Conduct on-site field work to record existing conditions at the site (especially vegetation communities). Photographic monitoring is a useful supplement to quantitative monitoring data, especially if photo points are permanently marked, and photos are taken at about the same time each year.
- Choose a reference site at a similar elevation and with similar tidal range for comparison to the project site as it develops following restoration. Record the same kinds of data on the same schedule for the reference site, as for the restoration site.
- Get technical help on designing and implementing restoration procedures. Dike breaching, culvert upgrades, ditch filling, and excavation of tidal channels all require technical expertise. Consultation with a tidal hydrologist might be needed, even for small projects like tidegate removal.
- After implementing restoration procedures, practice "adaptive management." In other words, stay flexible, adjust procedures, or design new procedures as necessary to achieve the project goals. Such changes are almost always necessary, because tidal wetland restoration is still a new science.
- After restoration is implemented, publicize the project locally and regionally (provided the landowner is willing). Local support is essential to long-term project success, and local support comes only from understanding.
- As much as possible, seek input from, and share project information with, other groups planning and implementing restoration in the area and regionally. Present results of restoration work at workshops and meetings so that others can benefit from the experience.
- Further information on procedures for restoration projects can be found in Good (1999).

Protection sites

- Consider the sites in a watershed context. Identify what the opportunities, concerns, and constraints may exist in the up-river areas. How does this effect estuarine health and protection value?
- Contact the Lincoln County Planning Department to coordinate site plans with County Comprehensive Plan and other planning goals.
- Establish a 'point' person for each site. Have that person contact the landowner(s) and determine which protection strategies would work best for the site. Discuss which funding and technical assistance might be available. Consider the funding needed for all the steps.
- Conduct on-site field work to record existing conditions at the site (especially vegetation communities). Photographic monitoring is especially useful if photo points are permanently marked, and photos are taken at about the same time each year. This baseline data will be needed to determine whether the site is changing over the years. Such change might indicate a need for restoration work or further protection.
- Determine the site's existing level of protection. Many of the sites in this study are zoned "Estuarine Natural" as shown in the Oregon Estuary Plan Book (DLCD, 1987), providing a certain degree of protection. Such zoning protection is considered a very important tool for protection of tidal wetlands (Good, 1996). However, the exact boundaries of areas so zoned versus biological boundaries (e.g., limit of tidal marsh) could not be determined in a project of this scope. Protection afforded by estuarine zoning is also limited by the fact that this zoning does not extend to the upper limit of tides within each estuary (tidally-influenced plant communities are found upstream of Toledo to about river mile 19 on the Yaquina, and at least to Westwood Village at river mile 10 on the Alsea). In addition, estuarine zoning (at least in the EPB 1987 edition) excludes diked former tidal marsh sites such as Boone/Nute Slough on the Yaquina and Bayview Oxbow on the Alsea. A summary of existing protective regulations that affect Oregon estuaries is provided in Good (1996).
- Set up a regular communication schedule to assure that the point person is keeping the landowner, MCWC, and the local basin planning team up to speed on information gathered, decisions being made, progress, and problems.
- Working with the landowner, implement the chosen protection strategy. Include buffers around a site as a part of the protection plan, especially for small sites. The buffers should be planted to native vegetation, if they don't already have native plant communities in place.

Locating funding sources

- Contact the MidCoast Watersheds Council and the Lincoln County Soil and Water Conservation District for up to date information on possible sources of

funding and technical assistance for tidal wetland restoration projects. Some sources include programs administered through federal agencies including the Farm Service Agency, Natural Resource Conservation Service, U.S. Fish and Wildlife Service, and U.S. Forest Service. State programs include grants through the Oregon Watershed Enhancement Board (formerly GWEB), Oregon Department of Fish and Wildlife (STEP program) or county/ODFW partnerships that provide tax breaks or funding for road culvert upgrades.

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APPENDIX A. RANKED SITE SUMMARY TABLES

I. YAQUINA

YAQUINA Ranked site summary table						
For MidCoast Watersheds Council						
Estuarine wetland site prioritization and assessment project, Green Point Consulting, Sept.1999						
Group 1 has highest priority; Group 6 has lowest priority.						
WITHIN A GIVEN GROUP, ORDER OF SITES IS BY SITE NUMBER; no prioritization is intended by the order of sites within a group.						
This matrix must be used with accompanying 3 page site locator map, and with accompanying report for details on methods used.						
All information was gathered from publicly available records, documents, maps and aerial photographs that were current at the time of this report.						
No on-site field work was conducted without landowner permission; visual observations were made from off-site vantage points.						
Accuracy of information in this matrix will change over time, so details should be verified before action is taken based upon this information.						
* "Logistical ranking" rates logistical complexity of restoration/protection: 1=easy, 2=medium, 3=complex						
** "Biological ranking" rates sites as having relatively high (1) or lower (2) biological value based on acreage, connectivity and fish use						
Ranking group	Site #	Site name	Logistical ranking	Rationale for Logistical ranking	Biological ranking	Rationale for Biological ranking
Group 1						
1	Y6	Boone/Nute Sloughs	3	many landowners, requires complex restoration actions; however, moved to top group due to large size (>600A) & high potential fish use	1	>>15A; connectivity (high potential fish use)
1	Y7	Depot Slough	3	many landowners, requires complex restoration actions; however, moved to top group due to large size (>100A), high existing and potential fish use	1	>>15A; connectivity (high potential fish use)
1	Y23	Mill Creek*	2	medium-complexity restoration action needed; moved to top group because of high fish use, key watershed status	1	connectivity (high level of salmonid use); FEMAT key watershed
1	Y24a	Mill Creek*	2	medium-complexity restoration action needed; moved to top group because of high fish use, key watershed status	1	connectivity (high level of salmonid use); FEMAT key watershed
1	Y24b	Mill Creek*	2	medium-complexity restoration action needed; moved to top group because of high fish use, key watershed status	1	connectivity (high level of salmonid use); FEMAT key watershed
1	Y25	Mill Creek*	2	medium-complexity restoration action needed; moved to top group because of high fish use, key watershed status	1	connectivity (high level of salmonid use); FEMAT key watershed
1	Y26	Mill Creek	1	1 owner; needs only protection	1	connectivity (high level of salmonid use); FEMAT key watershed

1	Y28		1	1 owner; needs only protection	1	>15A; rare plant community (spruce tidal swamp)
1	Y30		1	1 owner; may need only protection	1	>15A
1	Y32	Grassy Point	1	1 owner; needs only protection	1	>15A
1	Y34	McCaffrey Slough	1	individual landowner parcels have biological integrity; needs only protection	1	>>15A
1	Y40	Poole Slough	1	individual landowner parcels have biological integrity; needs only protection in most areas	1	>>15A; connectivity (high level of salmonid use)
Group 2						
2	Y3	Airport N	2	requires medium-complexity restoration actions	1	>15 A
2	Y5	Blind Slough	2	>1 owner	1	>15 A
2	Y9	Johnson Slough; also marked as "Hinton Slough"	2	>1 landowner	1	>15A
2	Y13a		2	>1 landowner	1	>15A
2	Y27		2	1 owner; complex restoration action needed	1	>>15A
2	Y29		2	>1 owner; medium-complexity restoration action needed	1	>15A
2	Y38	Olalla Slough S	2	medium-complexity restoration action needed	1	>15A
Group 3						
3	Y37	Olalla Slough	3	many landowners; requires complex restoration action	1	>>15A; connectivity; high potential fish use
Group 4						
4	Y1		2	>1 owner	2	
4	Y8		1	1 landowner, only protection needed	2	
4	Y10		1	1 landowner, simple restoration action needed (culvert fix)	2	
4	Y14		1	1 landowner, simple restoration action needed (culvert fix)	2	
4	Y17		1	1 landowner, only protection needed	2	
4	Y31	Flesher Slough	2	>1 owner	2	
4	Y33	King Slough	1	1 owner; simple restoration action needed (culvert fix)	2	
Group 5						
5	Y2	Airport	2	requires medium-complexity restoration actions	2	
5	Y4	Arnold Slough	2	>1 owner	2	
5	Y11		2	>1 landowner	2	
5	Y12		2	>1 landowner	2	
5	Y13		2	>1 landowner	2	
5	Y18		2	>1 landowner	2	
5	Y19		2	>1 landowner; medium-complexity restoration action needed	2	

5	Y20		2	1 landowner?, medium-complexity restoration action probably needed	2	
5	Y22		2	medium-complexity restoration action needed	2	
5	Y35	Montgomery Creek	2	>1 owner	2	
5	Y36	N. Bay Wetland	2	>1 owner	2	
5	Y39	Parker Slough	2	>1 landowner	2	
5	Y41	Weiser Point Slough	2	>1 landowner	2	
5	Y42		2	medium-complexity restoration action needed	2	
5	Y43		2	>1 landowner	2	
Group 6						
6	Y21		3	>1 landowner; complex restoration action needed	2	
		(NO SITE 15)				
		(NO SITE 16)				

II. ALSEA

ALSEA ranked site summary table						
For MidCoast Watersheds Council						
Estuarine wetland site prioritization and assessment project, Green Point Consulting, Sept. 1999						
Group 1 has highest priority; Group 6 has lowest priority.						
WITHIN A GIVEN GROUP, ORDER OF SITES IS BY SITE NUMBER; no prioritization is intended by the order of sites within a group.						
This matrix must be used with accompanying 2 page site locator map, and with accompanying report for details on methods used.						
All information in this matrix was gathered from publicly available records, documents, maps and aerial photographs that were current at the time of this report.						
No on-site field work was conducted without landowner permission; visual observations were made from off-site vantage points.						
Accuracy of information in this matrix will change over time, so details should be verified before action is taken based upon this information.						
* "Logistical ranking" rates logistical complexity of restoration/protection: 1=easy, 2=medium, 3=complex						
** "Biological ranking" rates sites as having relatively high (1) or lower (2) biological value based on acreage, connectivity and fish use.						
Ranking group	Site #	Site name	Logistical ranking*	Rationale for Logistical ranking	Biological ranking**	Rationale for biological ranking
Group 1						
1	A22	Bain Slough	3	>1 owner; medium-complexity restoration action required; moved to top group because of rarity of original plant community	1	>15A; original wetland type (spruce tidal swamp) is rare
1	A24	Barclay Meadows W	1	1 landowner; needs only protection	1	>15A
1	A25	Bayview Oxbow	3	>1 landowner; complex restoration action required. Moved to top group because of large size (~150 A), high restoration potential.	1	>15A
1	A27	Drift dogleg E	1	individual landowner parcels have biological integrity; needs only protection	1	>15A; connectivity to Drift Cr. (high level of salmonid use); FEMAT key watershed
1	A28	Drift dogleg W	1	1 landowner; needs only protection	1	>15A; connectivity to Drift Cr. (high level of salmonid use); FEMAT key watershed
1	A29	Drift mouth E	1	individual landowner parcels have biological integrity; needs only protection	1	>15A; connectivity to Drift Cr. (high level of salmonid use); FEMAT key watershed
1	A30	Drift mouth W	1	1 landowner; needs only protection	1	>15A; connectivity to Drift Cr. (high level of salmonid use); FEMAT key watershed
1	A31	E Bay marsh	1	individual landowner parcels have biological integrity; needs only protection	1	>15A; pristine condition

1	A32	High school marsh	1	1 landowner; needs only protection	1	low salt marsh is rare in Alsea estuary
Group 2						
2	A17		2	1 landowner; protection is primary need (medium-complexity restoration action also possible)	1	Darkey Creek has chum (unusual; at S end of range)
2	A26	Drift Bend	2	1 landowner; complex restoration actions required	1	>15A; connectivity to Drift Cr. (high potential fish use); FEMAT key watershed
Group 3						
3	A23	Barclay Meadows E	3	>1 landowner; medium-complexity restoration action required.	1	>15A
3	A36	Eckman Lake	3	>1 landowner; complex restoration action required	1	>15A
Group 4						
4	A4		1	1 owner; needs only protection? (field-check)	2	
4	A5		1	1 owner; needs only protection	2	
4	A7		1	1 owner; needs only protection	2	
4	A9		1	1 owner; needs only protection	2	
4	A16		1	1 landowner; simple to medium-complexity restoration action required.	2	
4	A34	Starr Creek	1	1 landowner; simple restoration action required.	2	
Group 5						
5	A6		2	1 owner; complex restoration action needed	2	
5	A8		2	>1 owner; needs only protection	2	
5	A10		2	1 owner; complex restoration action needed	2	
5	A11		2	1 owner; complex restoration action needed	2	
5	A12		2	>1 owner; needs only protection	2	
5	A19		2	1 landowner; complex restoration action required.	2	
5	A33	McKinney Slough	2	>1 landowner; needs only protection	2	
Group 6						
6	A3		3	>1 owner; complex restoration action required.	2	
6	A13		3	>1 owner; complex restoration action needed	2	
6	A14		3	>1 owner; complex restoration action needed	2	
6	A15		3	>1 owner; complex restoration action needed	2	
6	A18		3	>1 landowner; complex restoration action required.	2	
6	A20		3	>1 landowner; complex restoration action required.	2	
6	A21		3	>1 landowner; complex restoration action required.	2	
6	A35	Walker Creek	3	>1 landowner; complex restoration action required.	2	

APPENDIX B. SITE INFORMATION TABLES

PDF file note: The following page shows a portion of the Yaquina site information table. This partial table is provided as an example of the type of information included in the site information matrix.

The full report contains complete site information tables for both Yaquina and Alsea sites. For full site details and coordination of site actions and landowner contacts, please contact MidCoast Watersheds Council, Newport, OR, (541) 265-9195.

YAQUINA Project site matrix		PLEASE NOTE: all landowner contacts are coordinated															
For MidCoast Watersheds Council		by MidCoast Watersheds Council, Newport, OR (541) 265-9195															
Estuarine wetland site prioritization and assessment project, Green Point Consulting, Sept.1999																	
PDF FILE NOTE: IF INCLUDED WITH A PDF FILE, THIS MATRIX IS ONLY A SUBSET OF THE ORIGINAL MATRIX. FOR FULL MATRIX, CONTACT MIDCOAST WATERSHEDS COUNCIL, NEWPORT, OR (541) 265-9195																	
This matrix must be used with accompanying 3 page site locator map.																	
All information in this matrix was gathered from publicly available records, documents, maps and aerial photographs that were current at the time of this report.																	
No on-site field work was conducted without landowner permission; visual observations were made from off-site vantage points.																	
Accuracy of information in this matrix will change over time, so details should be verified before action is taken based upon this information.																	
Est	Site #	Site name	Location (T,R,S, and USGS quad)	7/97 CEB Color IR photo #	Description	Size (-A)	# of owners	Current veg type	Type(s) of alteration	Alteration prior to:	Largest owner(s)	Possible actions	Current land use	Adjacent land use	Connection to streams	Recommended next step	Other reports?
Y	Y1	n/a	T11S R11W, E 1/2 Sec 17 and NW 1/4 Sec 16 (Newport S)	4-9	tidal marsh S of Hatfield Marine Science Center on W side of bay	13	7	low to high tidal marsh along bay margin; to W (W of dikes & roads), some freshwater wetlands where not filled	diking (marsh accreted outside dikes); ditching of streams; fill; road culverts	1939	OR Coast Aquarium; Fred & Ernest Yeck; Philip Hartog; OR State Board of Higher Education	Protection, fill removal, culvert upgrades. Dike removal might lead to erosion of accreted marsh.	vacant	commercial, industrial, residential	small creek at S 32nd St, South Beach; other impounded drainages	Landowner "form letter"? (non-ag site). Contact OR Coast Aquarium separately about protection/restoration options on their property.	
Y	Y2	Airport	T11S R10W NE 1/4 Sec 19 (Toledo S)	11-5	tidal marsh just N of airport, & W of airstrip	8	2	low to high tidal marsh, disturbed and weedy just N of airport hangars	~none; some ditching just N of airport hangars	?	Georgia-Pacific, State of OR Aeronautics	reconnect tidal channels, fill ditches	vacant	airstrip	none	Contact state OR Aeronautics, GP (Kevin Roberts) via personal visit/phone call/letter from a knowledgeable local contact person	

Y	Y3	Airport N	T11S R10W SE 1/4 Sec 18 (Toledo S)	11-6	diked tidal marsh N of Airport (N end of Sunny Ridge)	25	1	high tidal marsh, possibly sedge marsh, maybe mixed with freshwater marsh where tidal flow is impeded	diking (now naturally breached), ditching. None just N of airport.	1959	Georgia-Pacific	few additional dike breaches, or dike removal; reconnect tidal channels & block ditches; protection	Vacant. Past dredge material disposal site. LCCP mentions possible log storage onsite	forestry	none	Discuss with Kevin Roberts.	LCCP MIT #8
Y	Y4	Arnold Slough	T11S R10W NW 1/4 Sec 29 (Toledo S)	11-3	tidal marsh at mouth of Babcock Creek	10	9	high tidal marsh dominated by tufted hairgrass, Baltic rush	road crossing (bridged)	1939	Luther; Strand; Wiles; Cook; Butler; Jones	protection	vacant; houses on margins	rural residential	Babcock Crk.	landowner "form letter"? non-ag site	
Y	Y5	Blind Slough	T11S R10W NW 1/4 Sec 31 (Toledo S)	10-3	tidal marsh on E bank of Yaquina opposite Boone Slough	17	3	high tidal marsh dominated by tufted hairgrass	~none	n/a	Vaneck; Georgia-Pacific; Newell	protection	vacant; houses on upland at E side	rural residential; forestry	none	landowner "form letter"? non-ag site	
Y	Y6	Boone/Nute Sloughs	T11S R11W Secs 23, 24, 25, 26 (some in T11S R10W Secs 19 and 30) (Toledo S)	7-9, 8-8, 8-9, 9-5, 9-6, 9-7, 9-8, 10-6	extensive former tidal marsh, many remnant channels	>600	>20	freshwater wetland to upland pasture	diking, ditching, fill, tidegates. Nute SI (E side): 2 iron tidegates on 4' culverts in riprap. Restricted inflow & outflow. Boone SI (W side): similar tidegates, in concrete apron.	1952	Sapp; Miller; Leech; Hansen; Joe Steenkolk; Stanwood; Pridgeon; Ring	remove or modify tidegates; move tidegates upstream; build bridges @ N Bay Rd.; reconnect tidal channels; breach dikes	some pasture, some vacant	rural resid., forestry	Derby, Chetco, Blue, 1 other	Contact landowners or neighborhood group (diking district?) via personal visit/phone call/letter from a knowledgeable local contact person	LCCP MIT #6 and 7. Leibovitz site 74. Scores: 15, 7, 14, 11; ranked 9th for acquisition, 8th for restoration

APPENDIX C. SITE LOCATOR MAPS

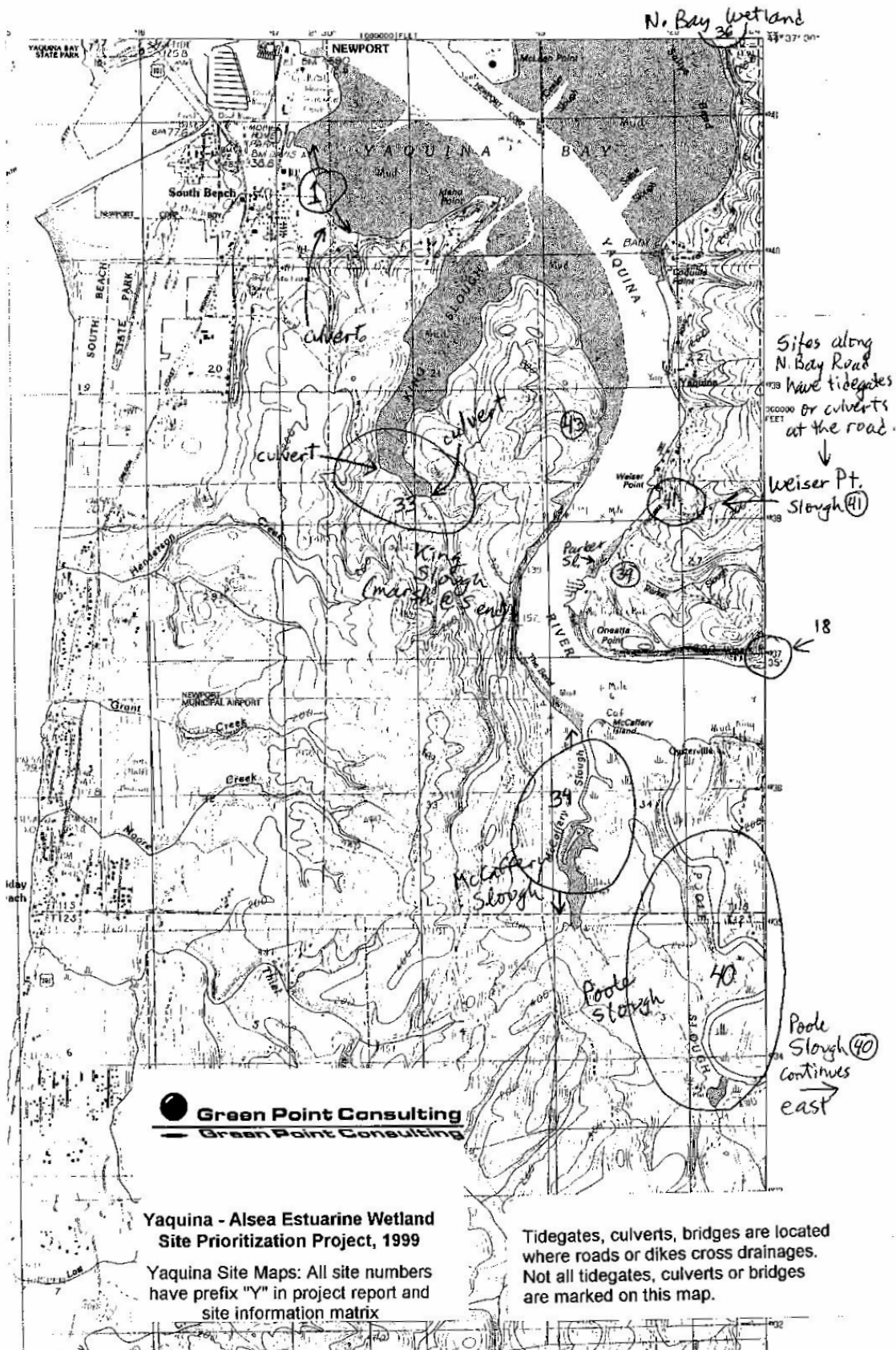
I. YAQUINA

see 3 following pages:

Ymap1.jpg (Newport S quad)

Ymap2.jpg (Toledo South quad)

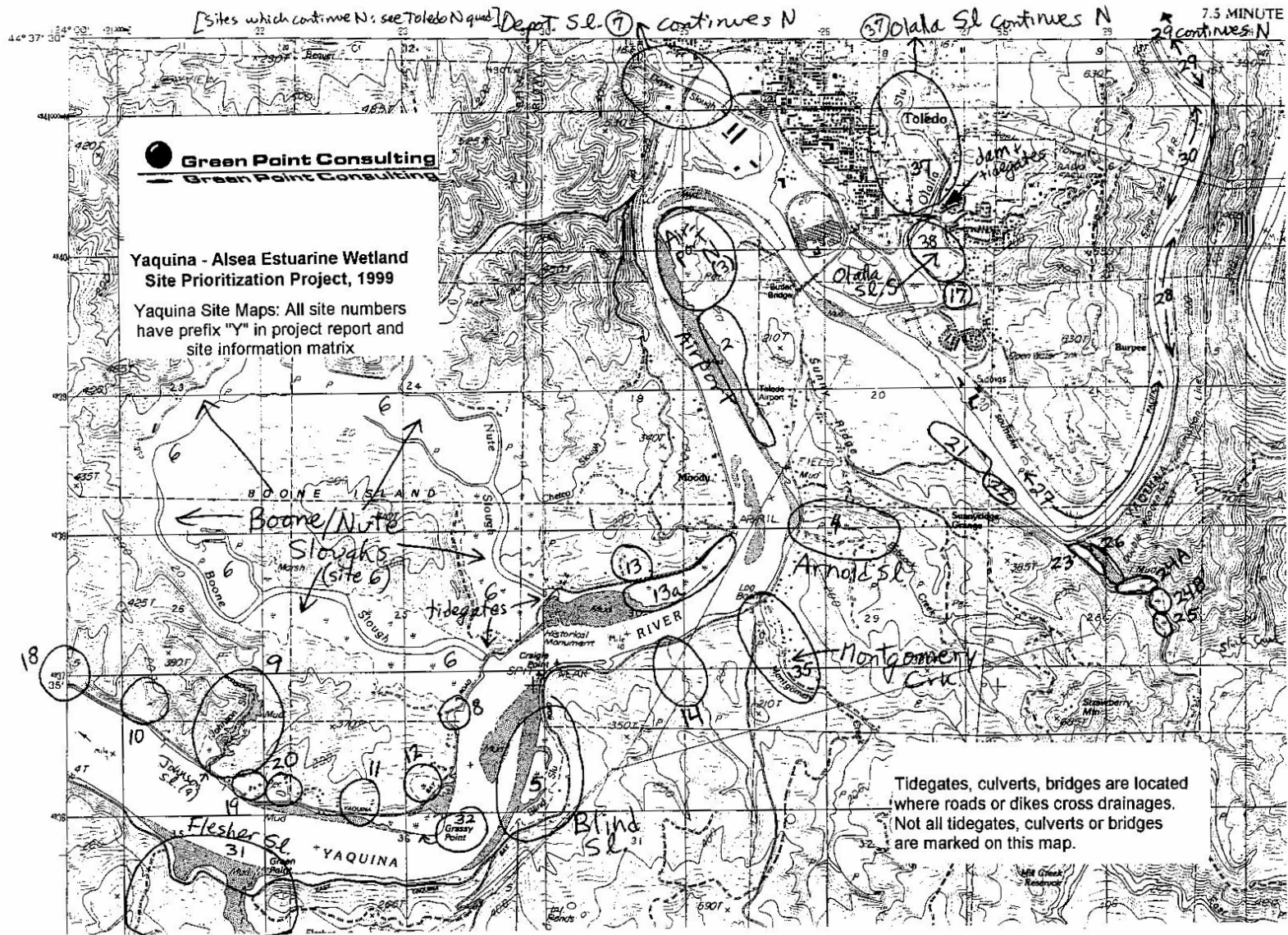
Ymap3.jpg (Toledo North quad)

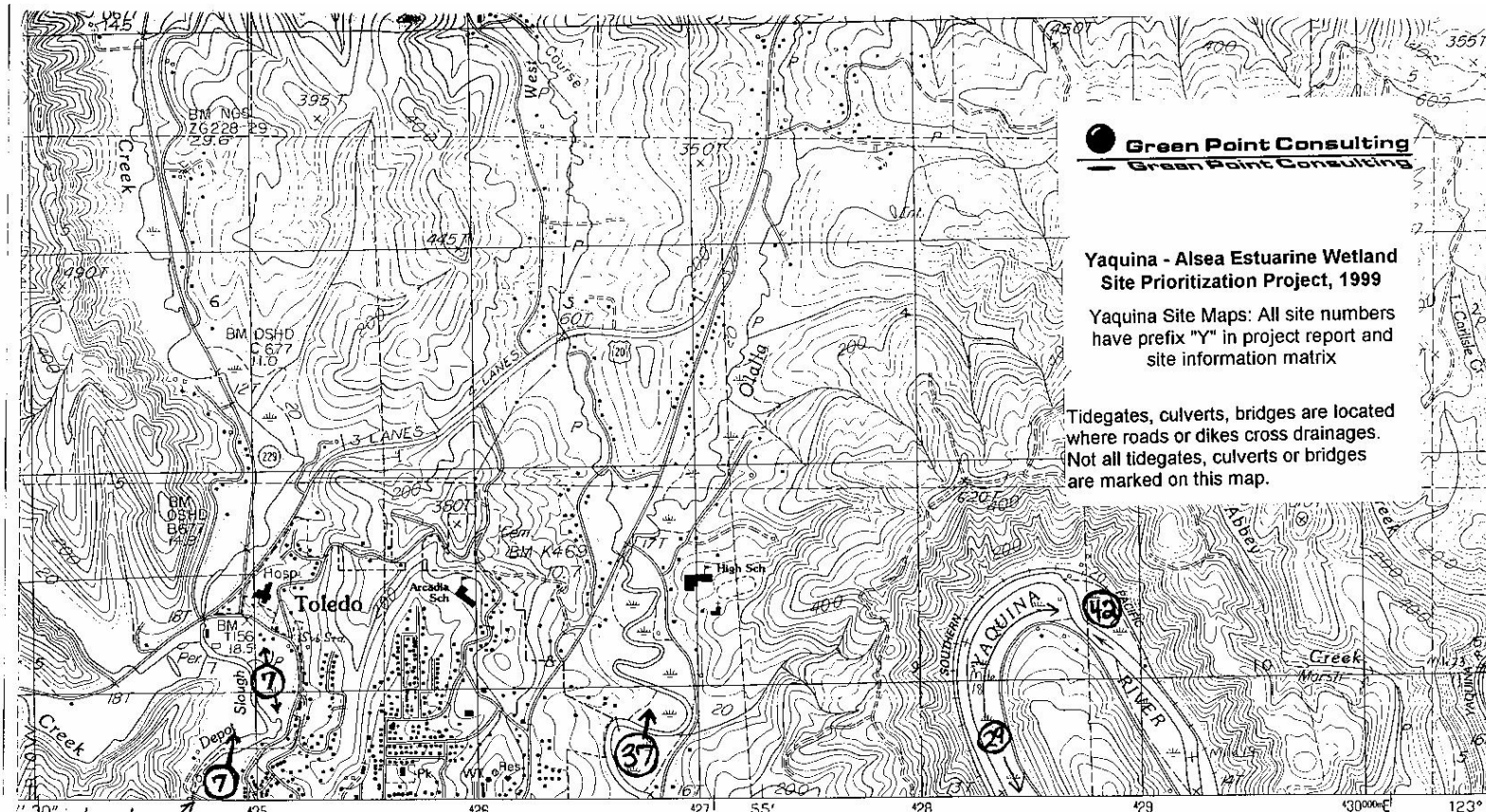


Yaquina - Alsea Estuarine Wetland Site Prioritization Project, 1999

Yaquina Site Maps: All site numbers have prefix "Y" in project report and site information matrix

Tidegates, culverts, bridges are located where roads or dikes cross drainages. Not all tidegates, culverts or bridges are marked on this map.





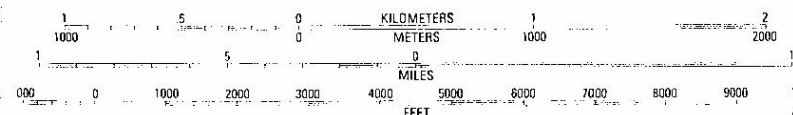
Green Point Consulting
 Green Point Consulting

Yaquina - Alsea Estuarine Wetland Site Prioritization Project, 1999

Yaquina Site Maps: All site numbers have prefix "Y" in project report and site information matrix

Tidegates, culverts, bridges are located where roads or dikes cross drainages. Not all tidegates, culverts or bridges are marked on this map.

30" tidegates? 125 126 127 128 129 130 123°



CONTOUR INTERVAL 40 FEET
 SUPPLEMENTARY CONTOUR INTERVAL 20 FEET
 CONTROL ELEVATIONS SHOWN TO THE NEAREST 0.1 FOOT
 OTHER ELEVATIONS SHOWN TO THE NEAREST FOOT
 To convert meters to feet multiply by 3.2808
 To convert feet to meters multiply by 0.3048

1	2	3	1 Depoe Bay
4		5	2 Mourey Landing
6	7	8	3 Euchre Mtn.
			4 Newport North
			5 Eddyville
			6 Newport South
			7 Toledo South
			8 Elk City

ADJOINING 7.5 QUADRANGLE NAMES

ROAD LEGEND
 Improved Road
 Unimproved Road
 Trail
 Interstate Route (circle with I) U.S. Route (circle with 1-3) State Route (circle with 1-3)

TOLEDO NORTH, OREG.
 PROVISIONAL EDITION 1984

44123-F8-TF-024

II. ALSEA

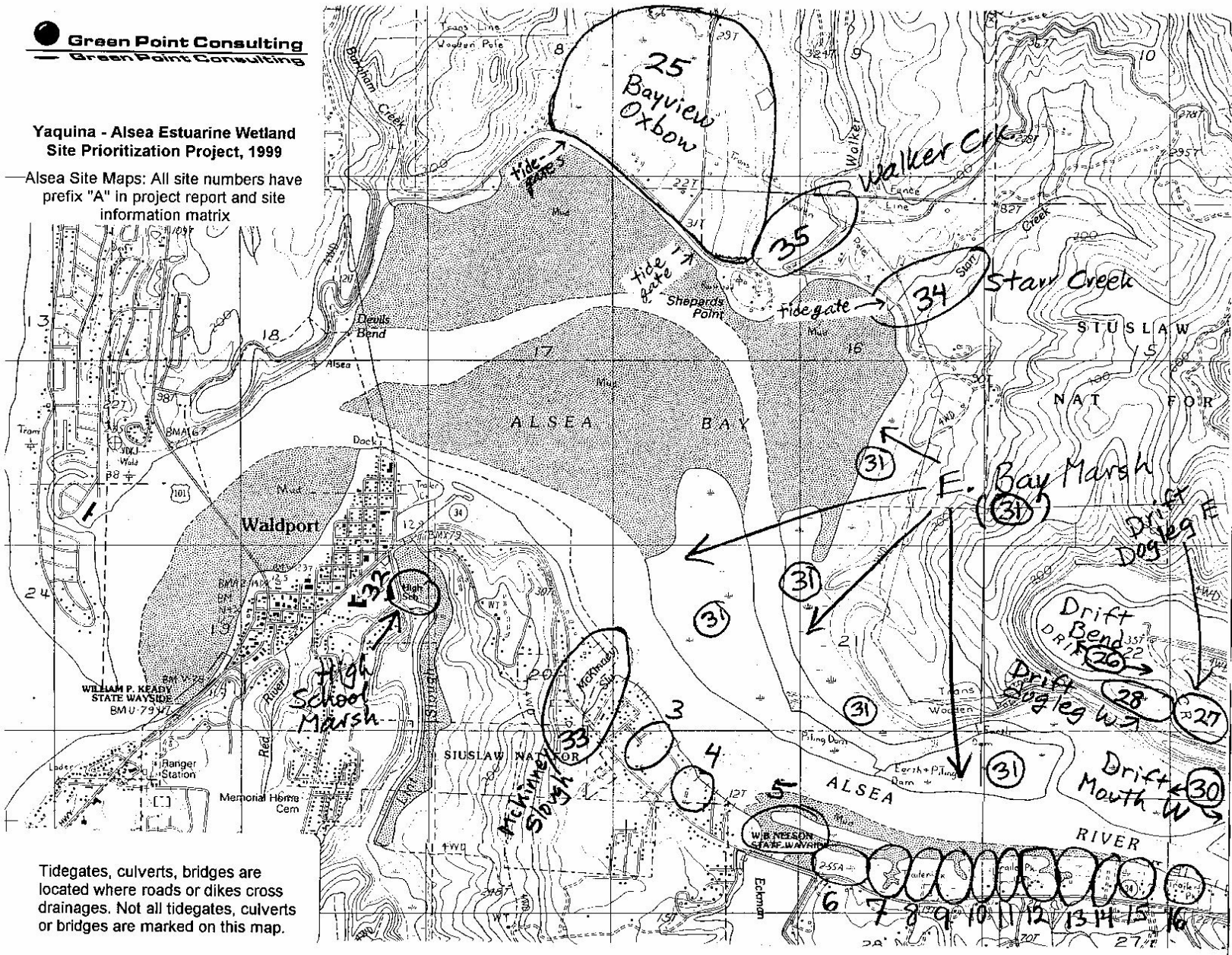
see following 2 pages:

Amap1.jpg (Waldport quad)

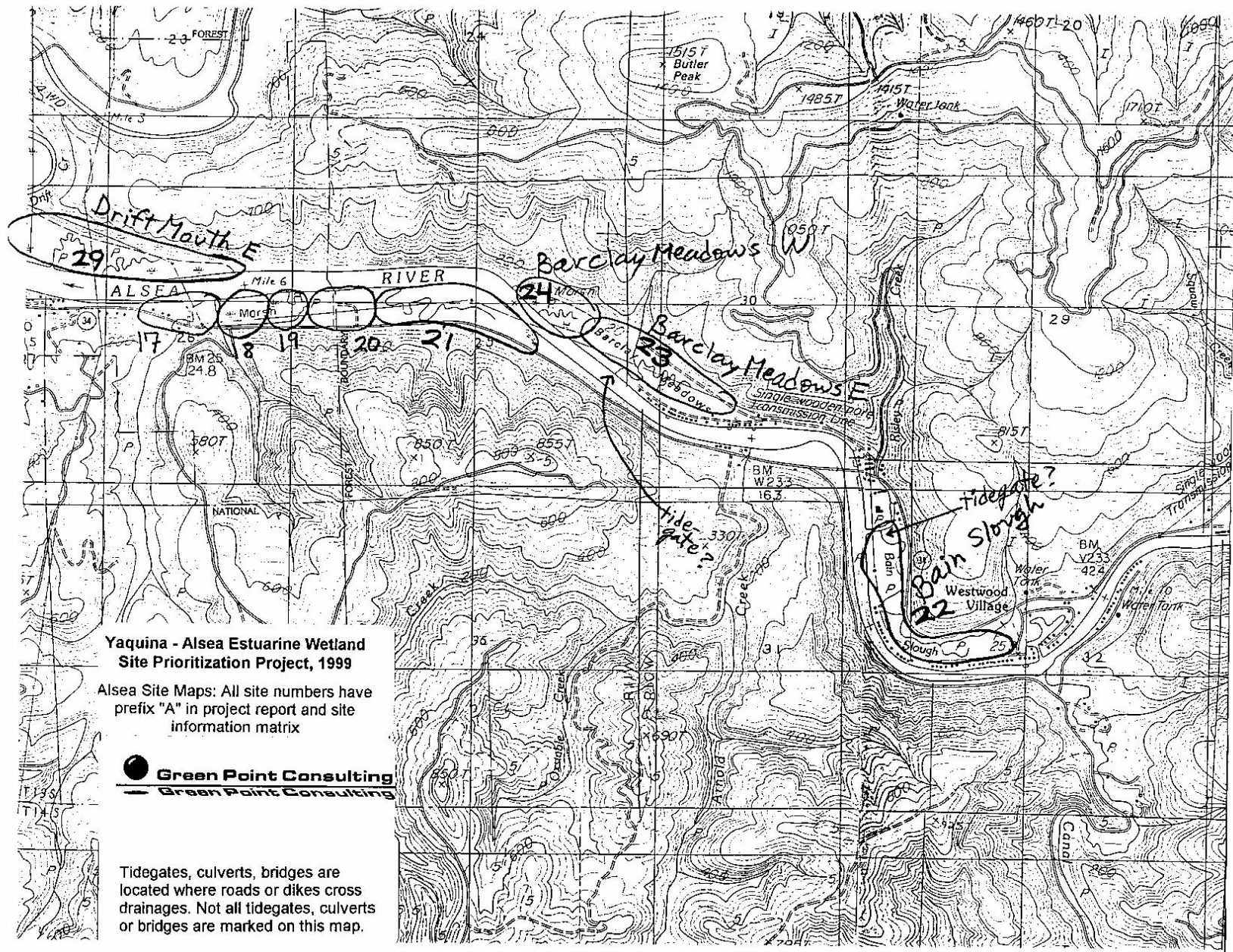
Amap2.jpg (Tidewater quad)

Yaquina - Alsea Estuarine Wetland Site Prioritization Project, 1999

Alsea Site Maps: All site numbers have prefix "A" in project report and site information matrix



Tidegates, culverts, bridges are located where roads or dikes cross drainages. Not all tidegates, culverts or bridges are marked on this map.



Yaquina - Alsea Estuarine Wetland Site Prioritization Project, 1999

Alsea Site Maps: All site numbers have prefix "A" in project report and site information matrix



Tidegates, culverts, bridges are located where roads or dikes cross drainages. Not all tidegates, culverts or bridges are marked on this map.

APPENDIX D. YAQUINA AND ALSEA BAYS ARE IMPORTANT SALMON HABITAT

by Fran Recht, Pacific States Marine Fisheries Commission

Both adult and juvenile salmon spend time in Yaquina Bay and Alsea Bay on their migrations to and from the ocean. These bays are also called 'estuaries' --indicating the area where fresh water from the river mixes with ocean water.

Though estuaries are important for adult salmon (providing the necessary transition and holding areas for the fish before they begin their upstream migration), they are absolutely crucial for juvenile salmon survival. The estuaries provide the young salmon with:

- * a food rich environment that promotes rapid growth and thereby an increased chance for survival
- * refuge from predators in the murky, shallow waters and the mazes of submerged vegetation
- * a mixed salinity (brackish) area that allows salmon to make the physiological transition between the fresh and salt water environments.

SALMON IN THE ESTUARIES

Almost all juvenile salmon migrate into estuarine habitats between mid-winter to late summer and spend varying lengths of time there, depending on the estuary and the species, before they continue their migration out to the ocean. The attached tables show that the timing of juvenile (as well as adult) presence in the estuary varies a bit between the Alsea and Yaquina estuaries and between species. For example, **chinook** salmon juveniles can generally be found in Yaquina Bay between April and December, with peaks in June through August, while in the Alsea they are found between April and November, with higher numbers in May through September. In contrast, juvenile **chum** salmon are generally found in the estuary between March and April in the Alsea, but with both earlier and later presence in the Yaquina (between February and May). Note that chum presence precedes the timing of large numbers of chinook juveniles in the estuary (which may indicate an adaptive strategy to avoid food competition).

The amount of time individual juvenile salmon spend in the estuary also varies between fish species (see table). Individual **chinook** juveniles may spend between 6 and 189 days in the estuary, though most individuals spend a few months in the estuary. **Chum** individuals may spend between 4 and 32 days in the estuary, with most spending a few weeks. **Cutthroat trout** spend varying length of time in estuaries-- some up to a few months while others may spend almost their entire life in the estuary. **Coho** juveniles may spend from several days to several weeks in the estuary before they migrate out to sea. Additionally, during their fresh-water phase of life, coho juveniles may use brackish-water estuarine areas in summer and migrate upstream to fresh water to over-winter. **Steelhead** generally spend only a few days in the estuary, moving quickly into the marine environment.

ESTUARY HABITAT PROMOTES RAPID GROWTH

Size counts! The larger the juvenile fish, the better its survival chances when it reaches the ocean. Growth rates in estuaries are quite rapid and impressive. In various estuaries, both juvenile chinook and chum have been observed to add 3.5-5.8% per day to their body weight, though growth rates of up to 10% per day have been reported in some estuaries. Studies on young chinook have shown that they enter estuaries as 35-40 mm 'fry' and leave as 70-110 mm 'smolts', with growth rates documented from .22mm /day to .86 mm/day for populations of fish, and as high as 1.32 mm/day for groups of marked fish. Estuarine growth rates for juvenile cutthroat are equally dramatic. Cutthroat growth rates have been reported as ranging from .5 mm to 1.3 mm/day, though growth rates of up to 2.6 mm/day have also been reported. Obviously, the food required to support these accelerated growth rates is also great. Food requirements have been estimated at about 3 times the daily growth rate.

HABITAT PREFERENCES

Estuarine eelgrass beds, algae, emergent marsh vegetation, marsh channels, and tidal flats provide particularly important estuarine habitats for the production and retention of food for salmon and their prey. Additionally estuarine marsh vegetation, overhanging riparian vegetation, eelgrass beds, and shallow turbid waters of the estuary provide cover to help salmon avoid predators.

Different species use the estuaries in different ways and at different sizes. For example, chinook fry and subyearlings prefer salt marsh areas, tending to reside primarily in marsh channels upon first entering estuaries. They tend to prefer those areas with lower salinity, moving from the edges of marshes during high tide to protected tidal channels and creeks during low tide, although they venture into less-protected areas at night. In contrast to chinook fry, chinook fingerlings (larger fish) take up residence in deeper-water estuarine habitats. Like chinook fry, chum salmon also tend to reside in marsh channels, seeking intermediate salinities which are common to these areas though they move throughout the estuary with tidal flows, frequenting tidal creeks, sloughs, and marshes. Coho are found in both intertidal and deeper habitats, with deep, marine-influenced habitats often preferred.

Woody debris is also important in the estuary (as it is in the stream) particularly for coho salmon, contributing to the estuarine food web, helping to create structure and complexity important to salmon, as well as providing protection from mammals and birds.

HABITAT LOSS AND RESTORATION

The loss or alteration of estuarine habitat can impact salmon through reduction in the amount of rearing habitat or food available and increased exposure to marine mammal and avian predators. Currently Alsea Bay (with a total area of 2516 acres) had about 57 acres of low salt marsh and about 403 acres of high salt marsh (i.e. marsh is about 18% of the estuarine acreage). It has lost about 640 acres tidal marsh due to historical diking and about 25 acres due to filling activities. Yaquina Bay (with a total acreage of 4349 acres) has about 144 acres of low salt marsh and 475 acres of high salt marsh currently (i.e. marsh is about 14% of estuarine acreage). It has lost about 1240 acres of tidal marsh through historical diking and between 202 and 257 acres due to filling. As a part of efforts to rebuild salmon runs, the Oregon Salmon Plan has set a goal for the restoration of 5000 acres of altered estuarine habitat statewide.

REFERENCES:

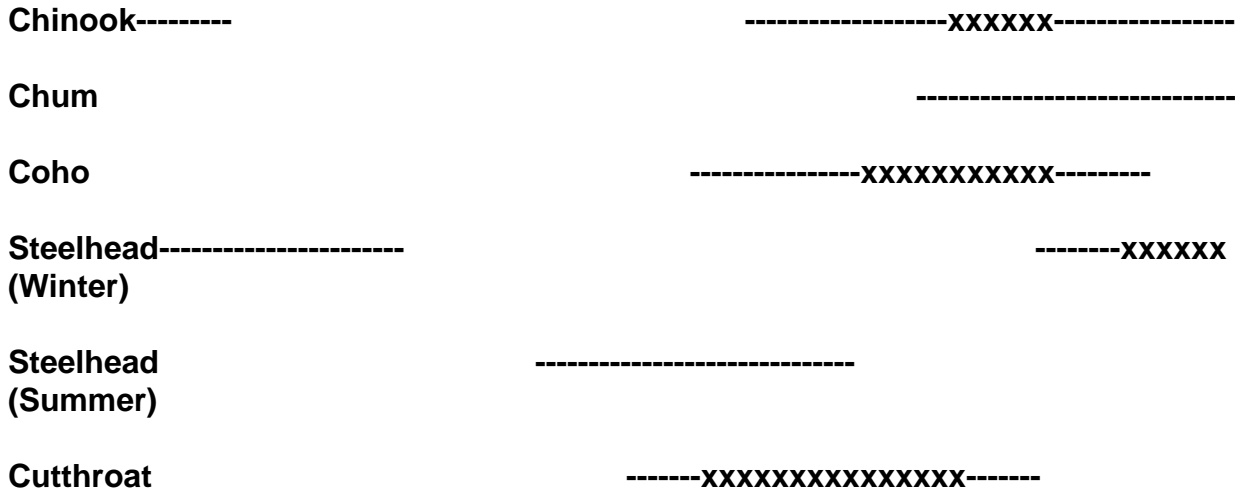
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Months That Adult Salmonids Are Found In The Estuary

YAQUINA BAY	Jan	F	M	A	M	Jun	Jul	Au	S	O	N	D
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ALSEA BAY	Jan	F	M	A	M	Jun	Jul	Au	S	O	N	D
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Relative abundance
 ----- common
 xxxx abundant
 XXX highly abundant

Source: NOAA. March 1990. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries, Vol. 1: Data Summaries. National Marine Fisheries Service, Hammond, Oregon.

Length of Residency in Estuaries For Individual Salmon Juveniles

chinook	6-189 days	(most a few months)
cutthroat	90 days	(many stay a few months, though some stay their whole life)
chum	4-32 days	(most stay a few weeks)
coho	several days to several weeks during their out-migration (but during their freshwater stage may also use brackish-water estuarine areas in summer)	
steelhead	few days	

References:

- Lebovitz, Allen. December 1992. Oregon Estuarine Conservation and Restoration Priority Evaluation: Opportunities for Salmonid Habitat and Wetlands Functions Enhancement in Oregon's Estuaries. Oregon Trout. Portland, Oregon.
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OTHER FISH THAT DEPEND ON ALSEA AND YAQUINA ESTUARIES FOR JUVENILE REARING HABITAT:

Green and White Sturgeon	Yaquina Bay
American Shad	Yaquina and Alsea Bays
Pacific Herring	Yaquina (abundant), lesser so Alsea Bay
Northern Anchovy	Yaquina and Alsea Bays
Surf smelt	Yaquina and Alsea Bays
Longfin smelt	Yaquina and Alsea Bays
Pacific Tomcod	Yaquina and Alsea Bays
Topsmelt	Yaquina (abundant), lesser so Alsea Bay
Threespine stickleback	Yaquina and Alsea Bays
Shiner Perch	Yaquina and Alsea Bays (abundant in both)
Pacific Sand Lance	Yaquina and Alsea Bays
Arrow goby	Yaquina Bay
Lingcod	Yaquina Bay
Pacific staghorn sculpin	Yaquina and Alsea Bays
English sole	Yaquina and Alsea Bays
Starry flounder	Yaquina and Alsea Bays

Reference:

- NOAA. March 1990. Distribution and Abundance of Fishes and Invertebrates in West Coast Estuaries, Vol. 1: Data Summaries. National Marine Fisheries Service, Hammond, Oregon.

APPENDIX E. OREGON TROUT STUDY: A SHORT DISCUSSION

In a study conducted for Oregon Trout, Lebovitz (1992) ranked estuarine wetlands in Oregon for protection or restoration. Lebovitz's work is relevant to this study in many ways. In his study, Lebovitz assigned points to each site in two separate categories: suitability for acquisition and suitability for restoration. Each of these two categories was further subdivided into general status characteristics such as acreage, land ownership, and development pressure; and salmonid habitat characteristics such as number of salmonid species present, presence of tidal channels, and salinity. Sites rated as very suitable for acquisition and restoration, and which were judged as potentially or actually providing good salmonid habitat, had numerically low scores. Sites which were judged difficult to acquire or restore, and which were judged to provide poor salmonid habitat, had numerically high scores. Lebovitz ranked 7 sites in the Yaquina basin and 9 Alsea sites. In general, the sites that Lebovitz ranked as good prospects also ranked high in this study.

Lebovitz assigned an individual numeric ranking to each site. In this study, sites were placed in broad groups for prioritization purposes, rather than given individual numeric rankings. The "ranking group" approach is intended to indicate that decisions within a ranking group need to be made on a qualitative basis, through discussions with landowners and knowledgeable local contacts. This report and the detailed site data matrix are intended to provide a basis for beginning those discussions. Those who implement the next phase of this project (landowner contacts and development of site-specific action plans) will probably find that the ranking groups helped focus initial outreach. However, particularly between adjacent ranking groups, the projects that are actually implemented will depend heavily on the responses of landowners and other involved groups, and on the availability of funds. For that reason, it is important to note that the rankings in this study are not intended to eliminate any site from consideration for action.

This study focused on a much smaller area than Lebovitz's study, and therefore it includes many more sites (36 for the Alsea compared to 9 in Lebovitz; 43 for the Yaquina compared to 7 in Lebovitz). In addition, because of the more local geographic focus, this study could provide details that were missing from Lebovitz's study because they are difficult to provide for a larger geographic area (such as field observations of alterations and vegetation communities, the specific type of restoration action needed, the recommended next action step, and comments of experts about the site).

A copy of the Lebovitz report is available at the MCWC office in Newport, OR.