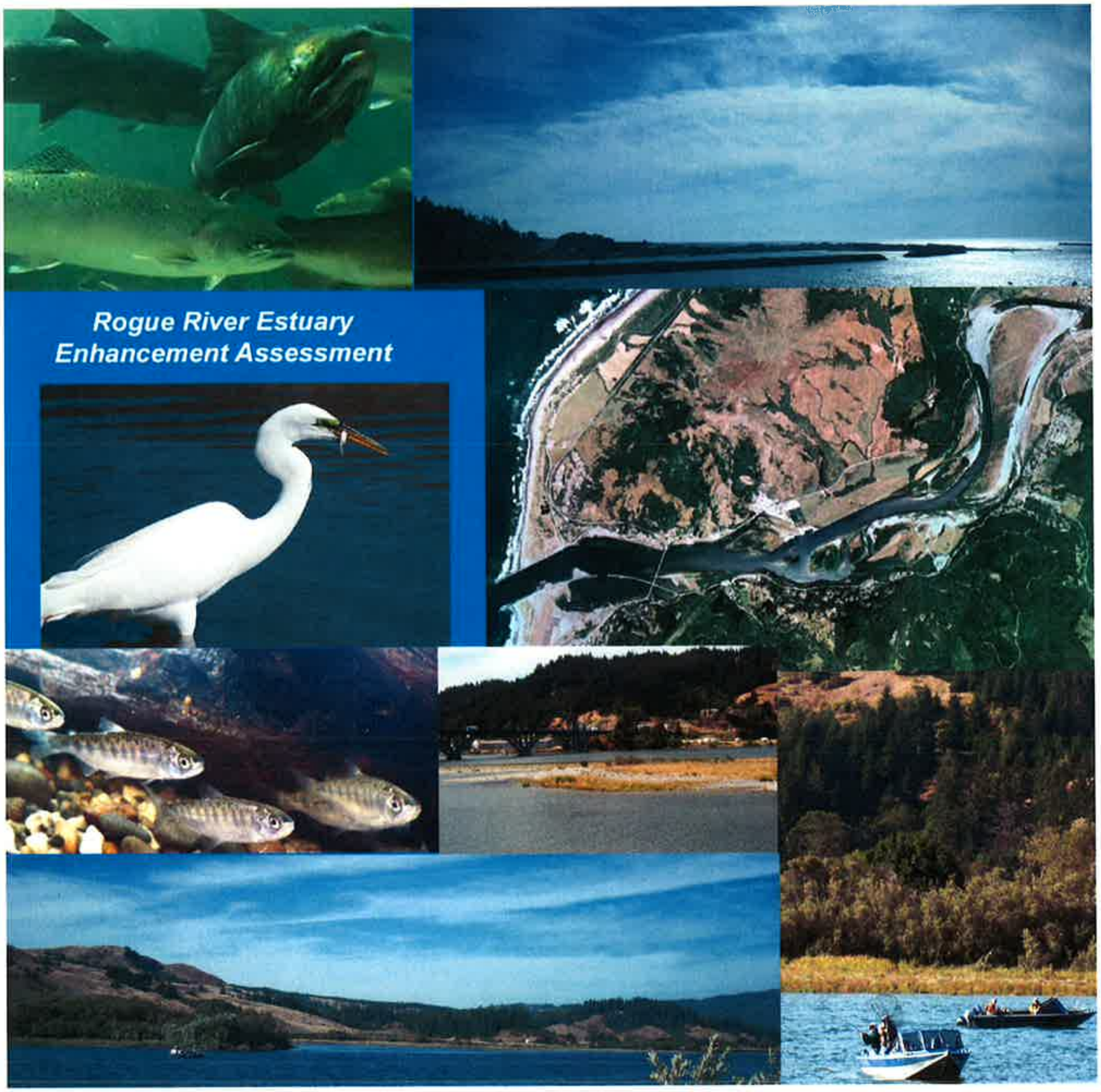
Lower Rogue River Sediment Study for Conceptual Fisheries, Wildlife and Recreational Enhancement Projects



Proposed Phased Approach By

River Docs

and

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Rogue Sediment Study Bullet Points

- The Rogue Watershed has a drainage area of 5,100 square miles.

- The ***Rogue's salmon population represents an economic powerhouse for the region***, with a 2009 EcoNorthwest Study showing the following annual salmon values for the Rogue: Commercial fishing = $1.4 million, Sport fishing = $16 million, Salmon "Non-Use" Values including aesthetics, appreciation, willingness to pay to save salmon and more = $1.5 billion annually.

- To Oregonians, the value of these fish and what they mean to the people of this state is incalculable.

- The Rogue Estuary is one of the smallest for a river of this size in Oregon and it has been substantially altered by development, with the most profound impact to natural function being the construction of the jetties in 1960.

- Due to a variety of contributing factors the river is now unable to adequately discharge the vast amounts of sediment moving through the lower river system, impacting fisheries, navigation and recreation. USGS further believes ***the sediment supply at Wedderburn Bar is now exceeding the river's transport capacity.***

- We believe these ***sediment impacts (including the infilling of pools and deeper runs, along with subsequent disconnection from holding, feeding and overwinter areas), severely limit Rogue estuarine habitat, adversely impacting and limiting the production of Rogue Pacific Salmon species.***

- A healthy ***Rogue estuary plays a vital role in the growth and survival of outmigrating juvenile salmonids***. The newest anadromous studies confirm the crucial need for this type of formerly healthy, diverse fresh to saltwater salmon habitat that has infilled with sediment along the lower Rogue. Our best available fisheries science shows maintaining this diverse habitat in the lower, tidally influenced portion of a river system prior to marine salmonid navigation, has a direct positive correlation with a salmon's body mass, growth rate, survival and return.

- USGS recommends ***a detailed investigation*** be conducted that looks at ***bed-material transport rates, bar stability, channel morphology, sediment supply and transport capacity in the lower Rogue.***

- A full assessment must be completed, defining sediment loading and routing, hydrologic changes and their relationship to wetland functions (and limiting biologic factors for out-migrating juvenile salmonids); ***prioritizing sites for a phased restoration and conservation actions to guarantee the future of our magnificent Rogue salmon.*** That is why House Bill 2496 is critical to the continued health and productivity of Oregon's legendary Rogue for the people of our state.

"Deep and dark green, swift and clear, icy cold and as pure as the snows from which it sprang, the river had its source in the mountain under Crater Lake. It was a river at its birth; and it glided away through the Oregon forest, with hurrying momentum, as if eager to begin the long leap down through the Siskiyous."

Rogue River Feud, Zane Grey - 1929

THE RIVER

Executive Summary

The spectacular Rogue River watershed has a drainage area of 5,100 square miles and is one of the most productive for Pacific salmon on the Oregon Coast. The Rogue holds a special place in the heart of each Oregonian and every visitor from across the globe. It has been recognized as a "Salmon Stronghold" with an estimated annual economic development benefit of over $30 million alone in terms of commercial/sport fishing and other, non-consumptive values (ECONorthwest, 2009). To Oregonians, though…the river has a value far beyond any price that can be attached to it.

The Rogue River estuary is one of the smallest for a river of its size in Oregon and it has been substantially altered by development. There is serious concern that lack of Rogue estuarine habitat may be limiting production of some fish, especially our Pacific salmon species. For a number of years, sediment has been accumulating in the Lower Rogue due to a variety of factors and the river now seems unable to discharge the volume of material that moves through the lower system. Salmon and steelhead from throughout the Rogue River watershed utilize the lower river and estuary during various life history stages, so a restoration to restore habitat and return as much natural function as possible (given its physical confines) would directly benefit anadromous stocks.

To secure the type of support necessary for remediation projects to bring critical estuary habitat back to a healthy state for salmon, an assessment must be completed that better defines sediment loading and routing, hydrologic changes and their relationship to wetland functions and limiting biologic factors for out-migrating salmonid juveniles. For these reasons, River Docs recommends convening a science team to conduct a full assessment of the Rogue River's estuary. A team committed to examining all possibilities for improved habitat for salmon, wildlife, and recreational use.

Rogue River Estuary Characteristics and Conditions

The headwaters of the Rogue are in the high Cascade Range and the river flows west through the Klamath-Siskiyou Mountains and finally through a steep narrow band of the Coast Range before reaching its estuary. Consequently, the Rogue River enters the Pacific Ocean at a much higher gradient than most other Oregon rivers and even prior to disturbance had a small, relatively confined estuary with limited surrounding wetland areas. The Rogue River estuary attains a maximum volume of 1,880 acres during winter flows, and extends roughly 4.5 miles upstream to just above or below Edson Creek, depending on the height of the tide (Figure 1).

The mean Rogue River estuary high tide is 4.9 feet and causes tidal influence to extend approximately 4 miles from the mouth to a riffle below Edson Creek, while the highest tides (of 6.7 ft.) that occur during summer cause an expansion to river mile 4.5 just above the creek near the old Champion sawmill. During high river flows, the volume of incoming water during a tidal cycle is several times greater than the tidal prism. Even summer flows produce a volume nearly as large as the tidal prism, which is unusual for most Oregon estuaries. The tidal prism can be defined as the volume of water covering an area, such as a wetland, between a low tide and the subsequent high tide. There are correlations between the size of the tidal prism and the amount of sediment deposited and exported in an estuary. Estuaries with small tidal prisms have too little power to remove sand deposited from adjacent shores. Before development, the estuary occasionally formed a bar and lagoon (USFS 2000) that would have been connected to wetlands and the mouths of estuarine tributaries. Early settlers removed large wood jams from the estuary and developed canneries and sawmills on flat areas near the estuary in areas that were formerly tidal marshes and swamps.

Figure 1. The Rogue River estuary has an engineered ocean entrance associated with the Gold Beach boat basin at left and the top of tidal influence is at upper right in the photo above and below the mouth of Edson Creek. Image from Google Earth.

Probably the most profound impact to the estuary was the construction of jetties in 1960 to maintain navigability that created a boat basin and accelerated currents (Hicks 2005). Other dikes have been constructed higher in the estuary for flood control that similarly decreased floodplain connectivity and changed sediment transport and hydrodynamics.

The high energy of the Rogue River during winter storms transports a huge amount of bedload that in fill pools in the estuary, cause bar formation, disconnect wetland areas and reduced tidal flux. According to the Lower Rogue Watershed Assessment (LRWC 2005), the U.S. Army Corps of Engineers noted in 1975 that shoaling was a problem and that an average of 112,000 cubic yards of sediment per year was dredged at that time. The report estimated that winter floods up to 400,000 cfs could transport 1 million cubic yards of sand and gravel. A more recent dredging survey estimated that on average approximately 200,000 cubic yards of sand and gravel enter the estuary annually. USGS further notes (2011) that the sediment supply at Wedderburn (tidal reach) bar likely exceeds transport capacity. USGS also notes empirical evidence leads them to believe the Rogue transports a greater volume of material than its sediment and gravel rich neighbor to the north, the Umpqua (also citing the fact that the Rogue has a much shorter tidal reach (6.7 km) compared to the Umpqua (40 km). Sediment dynamics related to gravel operation are recognized as sometimes changing erosional and depositional patterns within the estuary. The harbor at the Port of Gold Beach also tends to accumulate river sediments, although it has small patches of functional estuarine habitat within it. A further detailed investigation of the lower Rogue that looks at bed-material transport rates, bar stability, channel morphology, sediment supply and transport capacity (including Lobster Creek and the river's tidal reaches) has been recommended by USGS (2011) in their conclusions of the Preliminary assessment of channel stability and bed-material transport in the Rogue Basin, southwest Oregon Report.

While there have been some reconnaissance level studies of Rogue River estuary wetlands, such as the U.S. Fish and Wildlife Service (USFWS) National Wetlands Inventory (NWI) (Figure 2) and Scranton (2004), detailed information on wetlands is not available. Furthermore, no one has used historical maps from the era prior to development to estimate the original footprint of wetlands within the Rogue River estuary, although early development is known to have diminished them as noted above. Wetlands are known to contribute substantially to estuarine production and there are recognized associations between them and some species of Pacific salmon (Bottom et al. 2005).

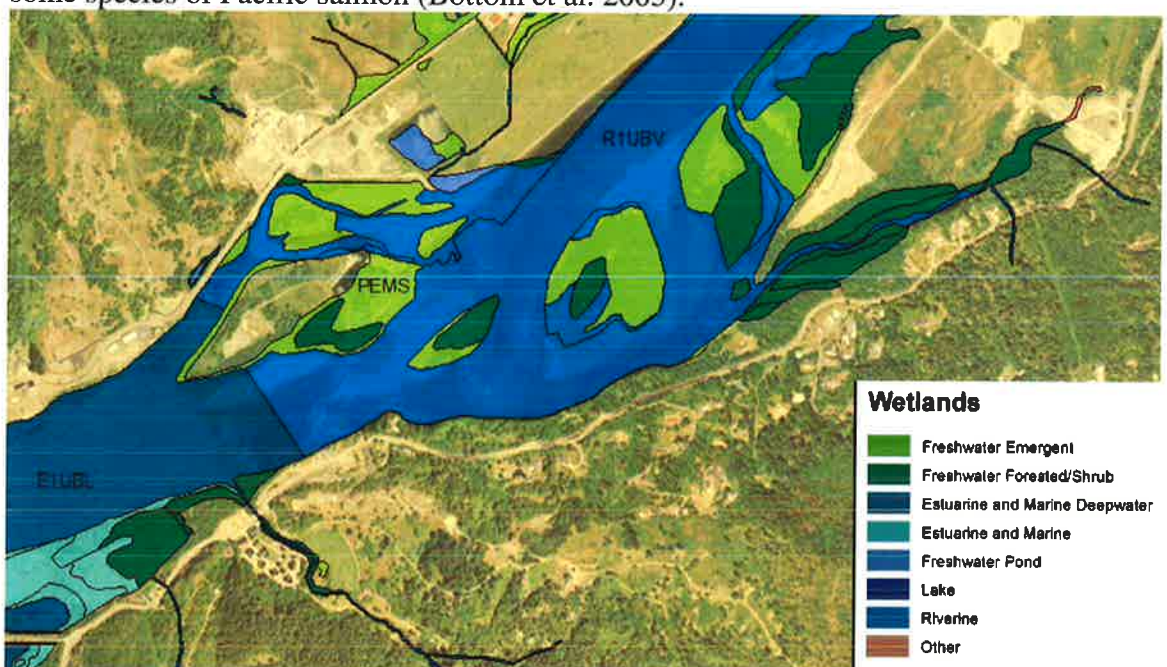

Figure 2. Example of National Wetlands Inventory (NWI) maps showing estuarine wetland habitat in the middle reach of the Rogue River estuary. Data from USFWS.

Overall the long-term trend has been a reduction of Rogue River estuary depth and complexity and a diminishment of connected wetlands. We believe this trend has likely been accompanied by reduced carrying capacity for juvenile salmonids that in turn translates into diminished basin-wide productivity.

How Pacific Salmon Use Oregon Estuaries

There is a growing body of evidence that healthy estuaries play a critical role in the growth and survival of a number of Pacific salmon species that inhabit the rivers of the Oregon. Reimers (1973) found a strong relationship between the time juvenile Chinook salmon spent in the Sixes River estuary and their survival to adulthood in the ocean. On the north coast of Oregon, Bottom et al. (2005) found extended use of the Salmon River estuary by Chinook salmon juveniles. Fish entered the upper estuary in late winter and spring, fed extensively in estuarine wetlands, and migrated out of the estuary into the ocean beginning in July and through the fall. These juvenile Chinook increased substantially in size as a result of their extended rearing in the estuary and their ocean survival was thought to be substantially enhanced.

Nicholas and Hankin (1988) reported the size of juvenile Chinook salmon in the Rogue River estuary and found that they were smaller than those found in many other Oregon estuaries, suggesting that fish may be entering the ocean at a sub-optimal size. Hicks (2005) raises questions about predation upon juvenile salmonids in the simplified Rogue River estuary.

Oregon coastal estuarine research has lead to awareness that Coho salmon juveniles use habitat there. Studies in the sloughs of Coos Bay (Miller and Sadro 2003, Koehler and Miller 2003) show a life history pattern of juvenile Coho that come downstream as fry, rear in estuarine sloughs, and then swim back upstream to over-winter. Koski (2009) documented similar Coho salmon behavior in British Columbia estuaries and dubbed Coho fry exhibiting this opportunistic behavior as nomads: "The nomad estuarine-rearing life-history strategy is one of the means or attributes that Coho have evolved to cope with environmental uncertainties, providing an increased capacity for survival and success."

Weybright and Giannico's (2017) paper (Juvenile Coho movement, growth and survival within a coastal basin of southern Oregon) further confirms the critical need for the type of diverse fresh to saltwater habitat that has infilled with sediment along the lower Rogue. "Our research identified complex movement patterns that reflect phenotypic and life history variation, and underscores the importance of maintaining diverse freshwater and estuarine habitats that support juvenile Coho salmon before marine migration." Having diverse habitat available in the lower, tidally influenced portion of a river system prior to marine migration has a direct positive correlation with body mass, growth rates and survival. All principle health keys to adult return.

Hillemeir et al. (2009) also found extensive use by Coho salmon juveniles of Junior Pond within the Waukell Creek watershed that enters the Klamath River near the top of the estuary at the upper extent of tidal influence. Coho juveniles from throughout the Klamath River basin chose to enter Junior Pond for over-wintering and as a result their size at the time of out-migration in spring was increased considerably. Ponds or off-channel rearing habitat created or restored adjacent to the Rogue River estuary might accrue similar benefits for Coho salmon from throughout the watershed.

Some of the most recent study work being conducted through the Oregon Hatchery Research Center (Berdahl 2016-17) also indicates that outmigrating salmonids who stay together (foraging and rearing in groups) as they outmigrate, will stay together in the open ocean and have greater navigation success as a group; improving chances of returning to their natal streams (hence the need for in-river and estuarine off-channel habitat that keeps outmigrating salmonid groups together).

Weitkamp (2010) compiled all available information about use by Pacific salmon species of all West Coast estuaries and noted that steelhead trout, coastal cutthroat trout, pink salmon and chum salmon may also utilize rearing habitat there.

Pacific salmon species have limited ability to tolerate warm water (McCullough 1999) and the Rogue River is recognized as temperature impaired (ODEQ 2002, 2008). Juvenile salmonids migrating downstream in summer may encounter stressful or lethal conditions and availability of cold water islands or refugia are critical to their survival as noted regionally by U.S. EPA (2003). Klamath River studies (Hillemeir et al. 2009) show Coho salmon juveniles use the mouths of small cold water tributaries as refugia when the mainstem exceeds their thermal tolerances. Consequently, a thermal study of the Rogue River estuary should be conducted as part of the assessment recommended herein to detect any refugia that need protection or that need to be factored into restoration plans. Again, the infilling and disconnection of critical habitat pools is a factor in Coho and other juvenile salmonids health.

Phase I. Rogue River Estuarine Assessment

The information provided above presents a compelling case for examining more closely the condition of the Rogue River estuary and potential for increasing the carrying capacity for salmonids. Given the findings of Bottom et al. (2005), it would also seem desirable to restore wetlands adjacent to the estuary where possible and to provide for connectivity for access by juvenile salmonids.

This Rogue River estuary assessment would roughly follow guidelines provided by Brophy (2007) as part of the Oregon Watershed Assessment Manual with additional data collection and analysis pertaining to water temperature and bedload transport. Wetland habitat analysis conducted as part of the assessment will also take into consideration the methods recommended by Adamus (2005a, 2005b) for current and former wetlands and areas under consideration for restoration. Adamus (2005a) designed a system of wetland community analysis for evaluating Oregon coastal tidal wetland restoration projects, prioritizing tidal wetlands based on their condition (level of degradation or integrity), and providing a measure of ecological function. The following are the tasks for performing a Rogue River estuary assessment.

Task 1. *Assimilate all existing electronic mapping data, bibliographic resources and data needed for analysis.*

Brophy (2007) points out a number of useful electronic mapping data layers that are available for analysis. These data and other geographic information system (GIS) data need to be acquired for the Rogue River estuary assessment and assimilated into a project that will be of lasting value for use in adaptive management. For example, aerial and land-based photographs, bathymetry records and maps showing the estuary and its floodplain at present and historically would be acquired and geo-positioned for in ARC 9.0 to assist with trend analysis. Data sources would include USFWS, Curry County, ACOE, City of Gold Beach, and NRCS. The latter agency provides high resolution color aerial photos as part of the National Agriculture Imagery Program (NAIP) that will be very useful in the assessment and in restoration planning. Curry County could provide ownership data and land use designations useful for restoration planning. Coarse wetland data from Scranton (2004), which was referred to as hydrogeomorphic or HGM classification by Brophy (2007), and from the USFWS NWIS, will provide a good reference system as more detailed field data are collected.

Water temperature data would also be captured from all sources for the estuary and its tributaries and utilized in the assessment. ODFW fisheries data related to use of the estuary, such as species, size and age of salmonids collected in previous samples, will be sought and utilized, if available.

Many bibliographic resources useful for this analysis are readily available on the internet (i.e. OWEB), but site addresses may change over time or documents may even become unavailable. To maintain access to these documents for current and future analysts, they will be captured, archived and a file with web links built so that all reference documents are readily accessible. Important agency file memos or historic documents or other papers not currently available in electronic form will be scanned with optical character recognition so that they can also be accessed into the future.

Task 2. *Determine the full historic extent of tidal wetlands within the estuary study area and identify historic and recent alterations to them.*

Determining the historic wetland foot print would be carried out with methods as described by Brody (2007) using mid-1800s General Land Office (GLO) survey records as captured by the Oregon Natural Heritage Program historic vegetation mapping project (Hawes et al. 2002). These data are key for examining opportunities for restoring tidal marsh and swamps that may have historically lined the Rogue River estuary. Brody (2007) recommends HGM and/or NWIS current wetland data be compared to historic conditions (Hawes 2002) to understand changes over time and to discover potential restoration opportunities.

Task 3. *Collect detailed field data on Rogue River estuary temperatures, wetlands and areas with wetland restoration potential.*

Automated temperature probes now allow collection of data at short intervals throughout the day that extend for several months. Probes will be placed to ascertain whether there are cold water refugia within the Rogue River estuary. This may include surface or sub-surface flows from tributaries, areas adjacent to wetlands or places where surface and groundwater connection lead to localized refugia in or adjacent to the estuary. Since salmonids rely on cold water and elevated mainstem Rogue River water temperatures are a major limiting factor, it stands to reason that identifying cold water areas and improving the extent and complexity of habitat with which they are associated would increase salmonid juvenile growth and survival. Because all anadromous Pacific salmon of all species must pass through the Rogue River estuary, increased juvenile survival has the potential to increase survival of all stocks.

Wetland data will be collected using field inventory techniques recommended by Adamus (2005a, 2005b), which are based on previously recognized ACOE guidelines. Metrics include wetland plant richness, soil and water salinity, relative elevation within a marsh, marsh size, and risk indices. These data allow for ranking the health of wetlands and understanding restoration potential of various sites. Geo-positioning data (GPS) will be collected for all sites inventoried so that information can be used as part of the assessment GIS.

Task 4. *Stratify the estuary into areas of analysis or sites*

This step is recommended by Brophy (2007). Data will be analyzed and site categories ("areas of analysis") based on such factors as elevation, habitat condition, and selected HGM classes (Scranton 2004). Brophy (2007) defines areas of analysis or sites as "a contiguous wetland area characterized by an internally consistent level of alteration (or lack of alteration). Sites can be either conservation sites (with few or no onsite alterations) or restoration sites (with alterations)." Interconnected, contiguous tidal wetlands that incorporate a range of elevations are the highest value restoration targets, but can only be recognized as a contiguous site if alteration is similar across the transect. Flood terraces suitable for off-channel rearing habitat, or existing ponds with connectivity to the estuary, also need consideration as a separate category.

Task 5. *Identify erosion sites in or adjacent to estuary in need of immediate riparian restoration and stabilization*

Identify erosion sites in the estuary where immediate bioengineering intervention would be appropriate. The purpose of the intervention would be to re-establish riparian vegetation, prevent further sediment contribution to the estuary, and provide demonstration sites for further channel restoration planning. Include specific location, photographic record and length of needed treatment. All bank erosion sources will be identified and prioritized for treatment. If the margins of the estuary were expanded as part of restoration actions, then bioengineering could be used to define the new margins and to act as a barrier to floods instead of rip-rap that was used in the past.

Task 6. *Identify and characterize conservation and restoration sites.*

Brophy (2007) recommends sites with fully functional wetland habitats be designated conservation sites and that they become priorities for protection, similar to the recommendation of Hawes et al. (2002). In addition, conservation sites can also function as experimental controls for use in assessing trends as restored sites increase in ecological function. Methodology for restoration site selection provided by Brophy (2007) would also be used in this assessment. Additional information, such as newly collected water temperature and bank erosion source data will also be considered. Given the information about the value of off-channel and pond rearing habitat for Coho salmon juveniles from Hillemeier et al. (2009), locations with potential for establishment of such features should be identified as high priority restoration targets.

Task 7. *Obtain flood data and detailed elevation data (LiDAR) to support flood risk analysis model*

These data are necessary for assessing the flood risk to areas under consideration for restoration and to make initial assessments of changes in currents and sediment transport associated with restoration projects. Federal Emergency Management Agency (FEMA) and Oregon Department of Geology and Mineral Industries (DOGAMI) data will be acquired pertaining to flood levels and the designated floodway in digital format and assimilated into the project GIS. LiDAR survey data will also be acquired and analyzed to derive the longitudinal profile of the channel thalweg. LiDAR topographic information is also suitable for running a 2-dimensional hydrodynamic model of the estuary and may prove very useful in other phases of the assessment.

Task 8. *Consider feasibility and utility of constructing a 2-D hydrodynamic river model with sediment transport module*

Assess how a hydrodynamic river model could assist restoration and conservation design. Review existing sediment transport studies and data pertaining at the scale of the lower Rogue River and at a basin-wide scale. Assess whether a sediment transport module, built on the river model, could assist in predicting sediment transport in the estuary, and whether it would require data from the river above the tidal limit.

Task 9. *Prioritize sites for restoration and conservation actions.*

Prioritization will use methods as recommended by Brophy (2007) with water temperature data and erosion site information also considered. In addition, Oregon Department of Fish and Wildlife (ODFW 2005) management recommendations for the Rogue River estuary need consideration.

Conclusion/Summary

The studies from the Salmon River indicate that Chinook salmon juveniles began to express different life histories and very good growth rates as wetland connectivity increased. This suggests that expansion of connected wetlands in the Rogue River estuary would have similar benefits. We believe threatened Oregon Coastal Coho salmon would also benefit significantly from estuarine restoration, especially if off-channel ponds or side channels can provide over-wintering habitat. While the Rogue River estuary cannot be returned to its original condition, reconnection of wetlands and other strategic conservation and restoration actions would benefit Pacific salmon species across the entire watershed.

The Rogue is a legendary river that uniquely speaks to each of us across the amazing bounty of beauty and benefit it provides to each Oregonian. From biologic and resource, to recreational and spiritual…these benefits are intrinsic to our being. It is time to repair and protect this river's estuary, giving back a small portion of the countless blessings it provides each day of our lives, insuring the future of its magnificent salmon for generations to come.

Lower Rogue River
Timeline to Restoration and Beginning of Recovery Activities
IV-Phase Strategy

Phase I 18 months	Investigational Study and Design Approach	July 1, 2017 – December 31, 2018
Phase II** 12 months	Modeling	January 1, 2019 – December 31, 2019
Phase III** 18 months	Engineering & Permits Site Preparation	January 1, 2019 – June 30, 2020
Phase IV	Begin Restoration & Recovery Activities @ Demonstration and Prioritized Sites	July 1, 2020*

** overlapping

*per regulatory approval

Lower Rogue River Investigational Study
Phase I: 18-Month Implementation Budget
Prepared: 3/1/17

Data collection & Analysis; Mapping	$ 51,250
Flood, LIDAR, Sediment Transport Evaluation; & Model Development	$ 47,500
Field Surveys; Site investigation & evaluation	$ 98,000
Technical Team Development; Stakeholder & Public Outreach & Meetings; Partnership Development & Resource Leveraging Phase II & III Funds Development	$ 92,800
Final Report w/ proposed Designs & Demonstration Projects	$ 66,250
Project Administration, Management & Reporting	$ 58,000
Misc. Expenses; Travel & Supplies	$ 18,590
Contingency for expert consultations; tbd	$ 20,000
Total Project Budget	$ 452,390

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