

Feature	Area Affected by Restoration	Type, Function, and Value
Lois Island Embayment Habitat Restoration	191 acres	Type: Tidal marsh habitat Function: Provide rearing habitat for ocean-type salmonids; increase detrital export Value: High

### **Project Description:**

**General Description:** The Corps, utilizing approximately 6.2 million cubic yards of dredged material from construction of the Columbia River Channel Improvement Project, will develop 191 acres of tidal marsh habitat in Lois Island embayment. Tidal marsh habitat will be predicated upon placement of dredged material to a design elevation of approximately 6.56' mean lower low water. The design elevation will be confirmed via elevation surveys of existing tidal marsh habitat adjacent to the restoration area prior to placement. Placement of dredged material will begin adjacent to Lois Island and extend southward in the embayment.

Dredged Material Management Plan – The Final Supplemental Environmental Impact Statement provides adequate documentation of the implementation plan including dredged material staging and placement.

### **Pre-Construction Monitoring Effort**

#### **a. Tidal marsh elevation survey**

1. Lois Island embayment marshes at Lois Island, Mott Island and South Tongue Point – 3 transects from lower tidal marsh vegetation line to tidal marsh-upland transition elevation. One survey per location will be conducted to establish target elevation for ecosystem restoration feature.
2. Control Site (East Lois Island tidal marsh) - 2 survey transects from lower tidal marsh vegetation line to tidal marsh-upland transition elevation.

- b. Juvenile Salmonid/Fisheries Use:** Juvenile salmonid use will be measured in the Lois Island east marsh, fringing marshes of Lois Island, Mott Island, and South Tongue Point and within the ecosystem restoration feature. Due to their intertidal location and vegetative cover, trap nets or other appropriate technologies would be used. A purse seine would be used to sample fisheries use in Lois Island embayment. Sampling and analytical protocol would follow that of **Hinton et al. (1990, 1992a, 1992b and/or 1995)**.

- c. Benthic Invertebrate Productivity:** Sampling locations, methodology and level of effort will be comparable to that described for post-construction monitoring. Sampling and analytical protocol would follow that of **Hinton et al. (1990, 1992a, 1992b and/or 1995)**.

- d. Tidal Marsh Primary Productivity:** Sampling locations, methodology and level of effort will be comparable to that described for post-construction monitoring.

### **Post-Construction Monitoring Effort**

**a. Tidal Marsh Plant Production:** Tidal marsh plant production would be assessed in a manner generally comparable to the methodology used for the **Columbia River Estuary Data Development Program (1984)**. Sampling would occur in late July and early August. Plant cover and species composition will be determined from 5 sample locations each at Lois Island east marsh and within the ecosystem restoration feature with another 5 sample locations distributed around the perimeter tidal marshes that abut Lois Island (n=3), Mott Island (n=1) and South Tongue Point (n=1). These sampling locations will be permanently staked plus their Global Positioning System location will be recorded to ensure that sample sites are reoccupied in subsequent years. Plant cover data will be recorded from five replicate 0.5m<sup>2</sup> quadrats randomly placed around each sampling location. Percent live biomass would be determined from nine randomly placed 0.1 m<sup>2</sup> clip-quadrats at each sampling location. The simple harvest method utilizing peak total standing crop measurements, including both live shoots and attached standing dead material of the same season's growth will be used to estimate primary production.

**b. Benthic Invertebrate Productivity:** Benthic invertebrate productivity will be measured per the methodology used by NOAA Fisheries in the Columbia River estuary (see **Hinton et al. (1990, 1992a, 1992b and/or 1995)**). The sampling timeframe would be Spring and Fall. Ten sampling stations would be established in the Lois Island east marsh and within the ecosystem restoration feature. Five of these 10 sampling stations would be paired with the tidal marsh plant production locations. Benthic invertebrate sampling locations would also be established in the Lois Island (n=5), Mott Island (n=3) and South Tongue Point (n=2) fringe marshes. Five of these sampling stations would be paired with tidal marsh plant sampling locations. These sampling locations will be permanently staked plus their Global Positioning System location will be recorded to ensure that sample sites are reoccupied in subsequent years.

**c. Juvenile Salmonid/Fisheries Use:** Juvenile salmonid use will be measured in the Lois Island east marsh, fringing marshes of Lois Island, Mott Island, and South Tongue Point and within the ecosystem restoration feature. Due to their intertidal location and vegetative cover, trap or other appropriate technologies would be used. A purse seine would be used to sample fisheries use in that portion of Lois Island embayment not used for development of the ecosystem restoration feature. The sampling timeframe would be Spring and Fall. Sampling and analytical protocol would follow that of **Hinton et al. (1990, 1992a, 1992b and/or 1995)**.

**Monitoring Schedule:** Monitoring efforts would occur in construction years 1 and 2 and years 2, 6 and 10 during Operations and Maintenance. Photographs will be obtained at each sampling location to document control and ecosystem restoration feature conditions.

**Correspondence:** NOAA Fisheries and the U.S. Fish and Wildlife Service will be notified of contractors employed to accomplish these actions, dates of their notices to proceed and when

final reports are due. Each agency will be furnished final reports on each monitoring action as they are received.

**Adaptive Management Actions:** If tidal marsh sampling results indicate that vegetation establishment has not attained a level of 25% ground cover by O&M year 2, then actions to harvest seeds and propagules for planting in the ecosystem restoration feature will be evaluated and implemented if necessary.

**Progress Report:** Monitoring reports for each pre- and post-construction monitoring action will be provided by December 1 of each monitoring year. These reports will discuss results to date, provide recommendations on potential methods to improve the specific restoration feature.

**Literature Cited:**

**Columbia River Estuary Data Development Program. 1984. Tidal marsh plant production in the Columbia River estuary. Final Report on the Emergent Plant Primary Production Work Unit of the Columbia River Estuary Data Development Program. Woodward-Clyde Consultants.**

**Hinton, S. A., R. L. Emmett, and G. T. McCabe, Jr. 1992a. Fishes, shrimp, benthic invertebrates, and sediment characteristics in intertidal and subtidal habitats at Rice Island and Miller Sands, Columbia River estuary, 1991. Report to the U.S. Army Corps of Engineers, Contract E96910025, 44 p. plus appendix. (Available from Northwest Fisheries Center, 2725 Montlake Blvd. E., Seattle, WA 98112).**

**Hinton, S. A., R. L. Emmett, and G. T. McCabe, Jr. 1992b. Benthic invertebrates and sediment characteristics in subtidal habitats at Rice Island, Columbia River estuary, December 1991 and March 1992. Report to the U.S. Army Corps of Engineers, Contract E96920018, 14 p. plus appendix. (Available from Northwest Fisheries Center, 2725 Montlake Blvd. E., Seattle, WA 98112).**

**Hinton, S. A., G. T. McCabe, Jr. and R. L. Emmett. 1990. Fishes, benthic invertebrates and sediment characteristics in intertidal and subtidal habitats at five areas in the Columbia River estuary. Report to the U.S. Army Corps of Engineers, Contracts E86880158, E8680107, E86900048, 92 p. plus appendix. (Available from Northwest Fisheries Center, 2725 Montlake Blvd. E., Seattle, WA 98112).**

**Hinton, S. A., G. T. McCabe, Jr. and R. L. Emmett. 1995. In-water restoration between Miller Sands and Pillar Rock Island, Columbia River: Environmental Surveys, 1992-93.**

ERF 1

<b>Elevation Survey</b>	<b>Construction Year 1 (Baseline)</b>	<b>Construction Year 2</b>	<b>O&amp;M Year 2</b>	<b>O&amp;M Year 6</b>	<b>O&amp;M Year 10</b>
a. Lois Island East Marsh Natural Substrate	2 transects	N/A	N/A	N/A	N/A
b. Lois/Mott/S. Tongue Pt. Fringing Marsh - Old Dredged Material	3 transects	N/A	N/A	N/A	N/A
c. Lois Island Embayment ERF	N/A	General Survey	N/A	N/A	N/A
<b>Tidal Marsh Primary Productivity</b>					
a. Lois Island East Marsh Natural Substrate	5 sampling stations				
b. Lois/Mott/S. Tongue Pt. Fringing Marsh - Old Dredged Material	5 sampling stations				
c. Lois Island Embayment ERF	5 sampling stations				
<b>Benthic Invertebrate Productivity</b>					
a. Lois Island East Marsh Natural Substrate	10 Sampling Stations; 11 cores/station				
b. Lois/Mott/S. Tongue Pt. Fringing Marsh - Old Dredged Material	10 Sampling Stations; 11 cores/station				
c. Lois Island Embayment ERF	10 Sampling Stations; 11 cores/station				

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<b>Lois Island Embayment</b>	<b>Construction Year 1 (Baseline)</b>	<b>Construction Year 2</b>	<b>O&amp;M Year 2</b>	<b>O&amp;M Year 6</b>	<b>O&amp;M Year 10</b>
d. Lois Island Embayment Subtidal	10 Sampling Stations; 11 cores/station				
<b>Juvenile Salmonid Use</b>					
a. Lois Island East Marsh Natural Substrate	3 trap net locations				
b. Lois/Mott/S. Tongue Pt. Fringing Marsh - Old Dredged Material	3 trap net locations				
c. Lois Island Embayment ERF	Purse seine	3 trap net locations			
d. Lois Island Embayment Subtidal	Purse seine				
<b>Point Photography</b>					
a. Lois Island East Marsh Natural Substrate	Two photos/Veg. Sampling Stn.				
b. Lois/Mott/S. Tongue Pt. Fringing Marsh - Old Dredged Material	Two photos/Veg. Sampling Stn.				
c. Lois Island Embayment ERF	Two photos/Veg. Sampling Stn.				
<b>Monitoring Report</b>	1-Dec	1-Dec	1-Dec	1-Dec	1-Dec

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## **Plan Elements for Restoration of Tidal Marsh Habitat at Lois Island Embayment Columbia River Channel Improvement Project**

### **Response to Oregon Division of State Lands**

Collection of baseline (pre-construction) data for the Lois Island embayment restoration location is covered in more detail in the implementation plan for the NOAA Fisheries Service/U.S. Fish and Wildlife Service terms and conditions, CRCIP BiOp. The Corps has outlined the location (e.g. Lois Island east marsh (natural marsh), fringing tidal marshes at Lois Island, Mott Island and South Tongue Point (dredged material established marsh), and within the restoration feature (embayment) where juvenile salmonid fisheries, benthic invertebrate productivity and tidal marsh productivity would be measured pre- and post-construction. Sampling methodology would follow that of CREDDP (tidal marsh) and NOAA Fisheries (fisheries/benthic invertebrates) used previously in the Columbia River Estuary. Use of their methodology will allow for comparison to historical/recent studies.

The pre-construction surveys would assess the baseline condition for the identified locations. Tidal marsh elevation data would be determined for the established fringing marshes at Lois Island, Mott Island and South Tongue Point. The elevation information obtained at these locations would provide the target elevation for tidal marsh development in the embayment. These reference locations are subject to the same tidal and river stage levels as the restoration location. They have an established tidal marsh community on dredged material, thus validating their use for the tidal marsh construction target elevation. They also provide a reference location to establish plant community and fisheries/benthic invertebrate objectives for the restoration feature.

Bathymetry data for Lois Island embayment was obtained in 2002 (Figure 1). The sediment type at Lois Island embayment is very fine material. Sediment samples taken associated with the Tongue Point Monitoring Program 1989-1992 provide confirmation of sediment characteristics in the Lois Island embayment. Bottom sediment information will be again characterized pre-construction based on grab samples and/or an extra core sample obtained from each benthic invertebrate sample location.

Avian use of the open water of Lois Island embayments is relatively minor compared to the other areas of the Columbia River Estuary, particularly tidal marsh, shallow bays (Miller Sands Lagoon), or productive shallow habitat (North of Rice Island). Small numbers of diving ducks (scaup, bufflehead, ruddy ducks) make use of the embayments' open water. Similarly, small numbers of western grebes, double-crested cormorants, other grebe species and loons are observed on these open waters. Waterfowl, specifically dabbling ducks and western Canada geese frequent the tidal marsh abutting the lagoon. Shorebird use is nil given the absence of intertidal mudflat habitat. Bald eagles are the predominant raptor, with nesting and foraging territories abutting the embayment. Osprey are present and other raptor species frequent adjacent habitat. Gulls and Caspian terns are present in small numbers foraging over the open waters of the embayment. Use by other avian species, except foraging by swallow species, is nil.

Mammal use of the embayment is also considered negligible. California sea lions and harbor seals are occasionally present although they are most commonly observed in the main river. Nutria, beaver, muskrat, river otter and mink are present although their use/presence is more closely associated with the riparian forest – tidal marsh – embayment edges. Their presence in the open waters of the embayment

would be characterized as transitory in nature. Land based mammal use of the embayment would be considered nil.

The sump location (Figure 2) adjacent to the channel would also be characterized for bathymetric, fisheries, benthic invertebrate, current and velocity, bottom sediment, birds and mammals prior to construction. Bathymetric data is available from the Corps' annual crossline surveys that cover the area. Current and velocity data would be ascertained from recent modeling efforts. Fisheries and benthic invertebrate data will be characterized based on information obtained from comparable locations in the estuary and/or navigation channel. Should inadequate benthic and fisheries data be available from a comparable location, then pre-construction sampling at the sump location would be initiated using normal NOAA Fisheries sampling protocol.

Avian use of the sump location can be characterized as minimal. Gulls and Caspian terns would be the principal users. Gull presence would be most noticeable during smelt runs and even the relatively transitory. Caspian tern use is seasonal and related to their foraging on salmon smolts. Use by other avian species is generally minimal. A few surf scoters and diving ducks, western grebes and double-crested cormorants occur in the area. Bald eagle use is transitory in nature as they travel from the Oregon shoreline to Taylor Sands.

Marine mammal use, principally California sea lion and harbor seal, is also transitory as they follow fisheries runs into the river. No cetaceans typically occur this far up the river. Other mammal use of the embayment is negligible.

The specific reference sites for tidal marsh developments at Lois Island embayment are located in the existing tidal marsh habitat fringing Lois Island, Mott Island and South Tongue Point. These locations are adjacent to the embayment as fringing marshes at the two islands and exterior to the embayment incur a more extreme wave and wind energy environment, thus are not comparable. An additional reference location will be located in the naturally established marsh habitat east of Lois Island.

These reference locations will provide the target elevation for construction of tidal marsh habitat in the embayment. Target elevation will be based on the elevation surveys extending from intertidal flat-marsh to the marsh-riparian transition line. This will provide a range of elevations in which tidal marsh is known to occur. The construction target elevation would be predicated upon "high" tidal marsh although construction acceptability would fall with the range of elevation that tidal marsh occurs at the reference location. This would provide some construction flexibility plus allow for diversity within the tidal marsh.

Reference sites for tidal marsh plant production, fisheries and benthic invertebrates will be permanently marked (staked) and their GPS location recorded to assure they are reoccupied during subsequent monitoring efforts.

The overall goal of the Lois Island ecosystem restoration feature is the establishment of a tidal marsh plant community comparable in elevation, fisheries, benthic invertebrate and plant community composition, density and/or productivity to the reference fringing tidal marshes at the embayment. The reference natural marsh east of Lois Island would provide an optimum scenario for restoration although it is not the stated goal of the effort.

## ERF 1

The initial objective for the tidal marsh restoration is construction placement of dredged material to the target elevation derived from the reference location. Thereafter, objectives for the tidal marsh is the development of a tidal marsh, benthic invertebrate and fisheries community with comparable species composition, density, productivity and/or use level to that identified for the reference locations during concurrent sampling efforts.

The initial success criteria pertain to the post-construction elevation of the material placed for tidal marsh development. The Corps will examine post-construction surveys conducted by the contractor to establish that the correct elevation has been attained. Tidal marsh plant community, benthic invertebrate and juvenile salmonid parameters for reference and restoration feature sampling locations will be obtained in construction years 1 and 2 plus O&M years 2, 6 and 10. It is anticipated that no monitoring would be conducted after O&M year 10 unless contingency plans had to be implemented.

The specific project boundaries will be effectively based on the volume of material available and the volume required to attain the target elevation for tidal marsh establishment. The Corps estimates that 191 acres would be filled with material derived from the two-year construction period. To fill out to the 357-acre increment, dredged material placement over a 15-20 year time period of channel maintenance would be required to provide sufficient volume of material. Boundaries for the tidal marsh restoration area can be simply established through survey and establishment of GPS coordinates. This information would be furnished to the dredge contractor and the Corps construction inspector.

The construction concept envisions material placed against the fringing marsh on the east side of the embayment first with fill extending westward as the target elevation is attained. Dredged material would be placed via floating pipeline with the discharge end of the pipeline moved or shortened as the target elevation is reached. The width of each increment would be based upon the most efficient construction method as determined by the contractor.

Post-project elevations will be based upon actual elevations established via survey from the adjacent fringing tidal marsh. Tidal marsh habitat occurs over a range of elevations, actually a relatively narrow zone. The Corps will establish this range of elevations as the acceptable limits with a specific mid-point tidal marsh elevation as the principal target. A range of elevations will allow for more diversity in the tidal marsh plant community. Post-placement of dredged material, the contractor will be required to furnish a survey depicting final elevations.

No retaining walls, bulkheads, rip-rap or other structural features will be used to hold the dredged material in place in the Lois Island embayment. No planting are initially anticipated. Rather, we will rely upon the extensive natural marshes in the Cathlamet Bay region to provide seeds and other propagules to establish the tidal marsh plant community. All similar tidal marsh plant communities associated with dredged material islands in the Columbia River estuary have established via this natural process.

Tidal channel development is anticipated to occur naturally over time in the constructed tidal marsh habitat. Grading, if determined necessary based upon post-construction observation and if physically possible, will be employed to establish tidal channels. Sideslope adjustment will occur on the edges of the constructed marsh as the slope stabilizes. This will result in some material feathering out onto the

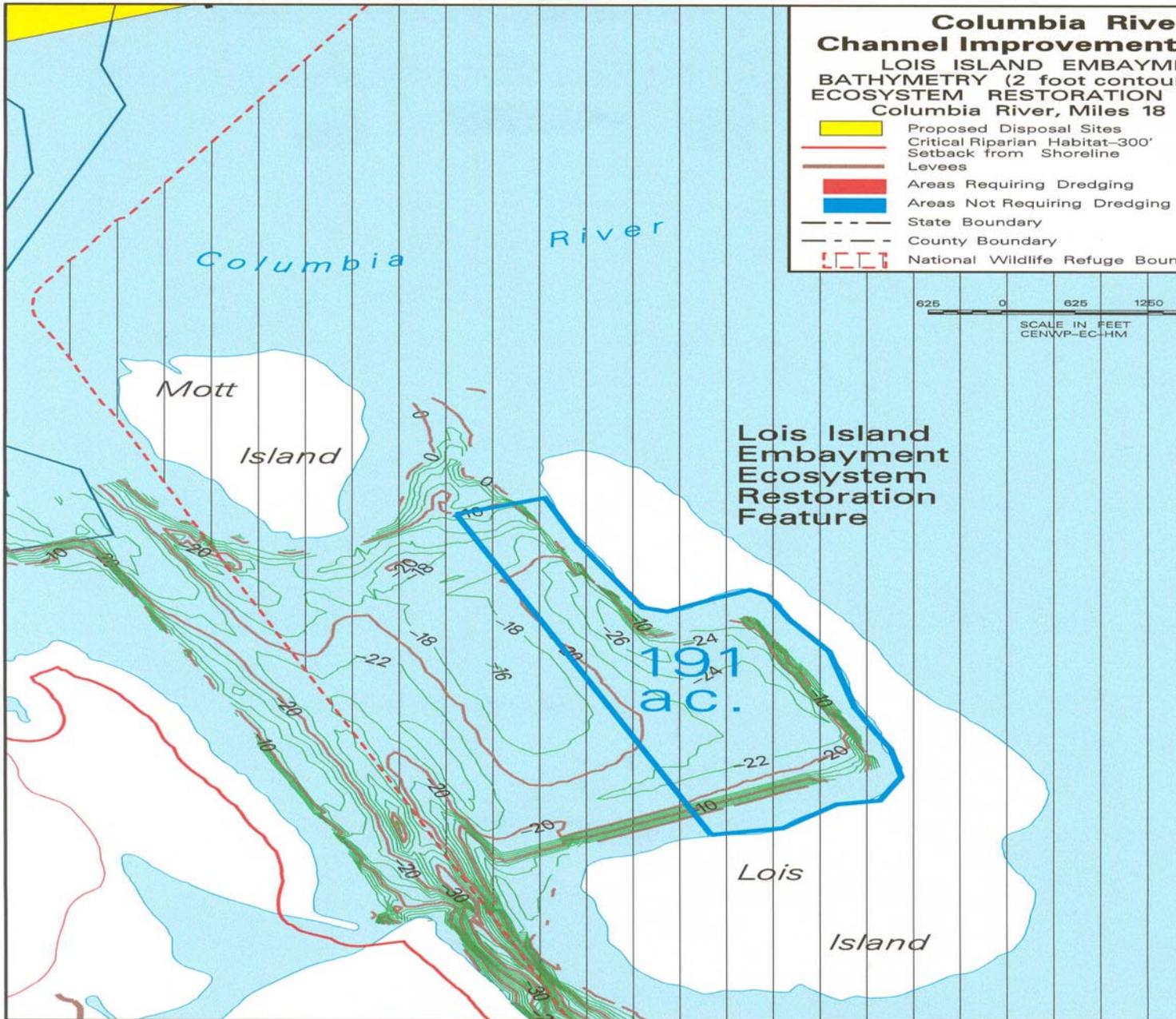
adjacent subtidal habitat. Tidal channel establishment will result in the discharge of material offsite as the channels incise into the substrate.

Placement of dredged material in the embayment to form tidal marsh habitat would occur during the inwater work period – November 1 – February 28. Dredged material derived from the navigation channel would be initially placed in the sump (Figure 1), between Columbia River mile 18-20 and adjacent to the channel. Placement of material in the sump would occur 1-2 months prior to the inwater work period to charge the sump with material and during the inwater work period to maintain a stockpile of material for the pipeline dredge. Recharge of the sump after the first inwater period and during construction would occur at the contractor's convenience. Placement of dredged material in the sump during the O&M phase of the project would most likely occur during the normal summertime dredging period. Removal of material from the sump would be dependent upon volume of material obtained from the channel, thus the periodicity of sump dredging and tidal marsh establishment would vary over the estimated period of 15-20 years required to obtain enough material to reach the 357 acre limit.

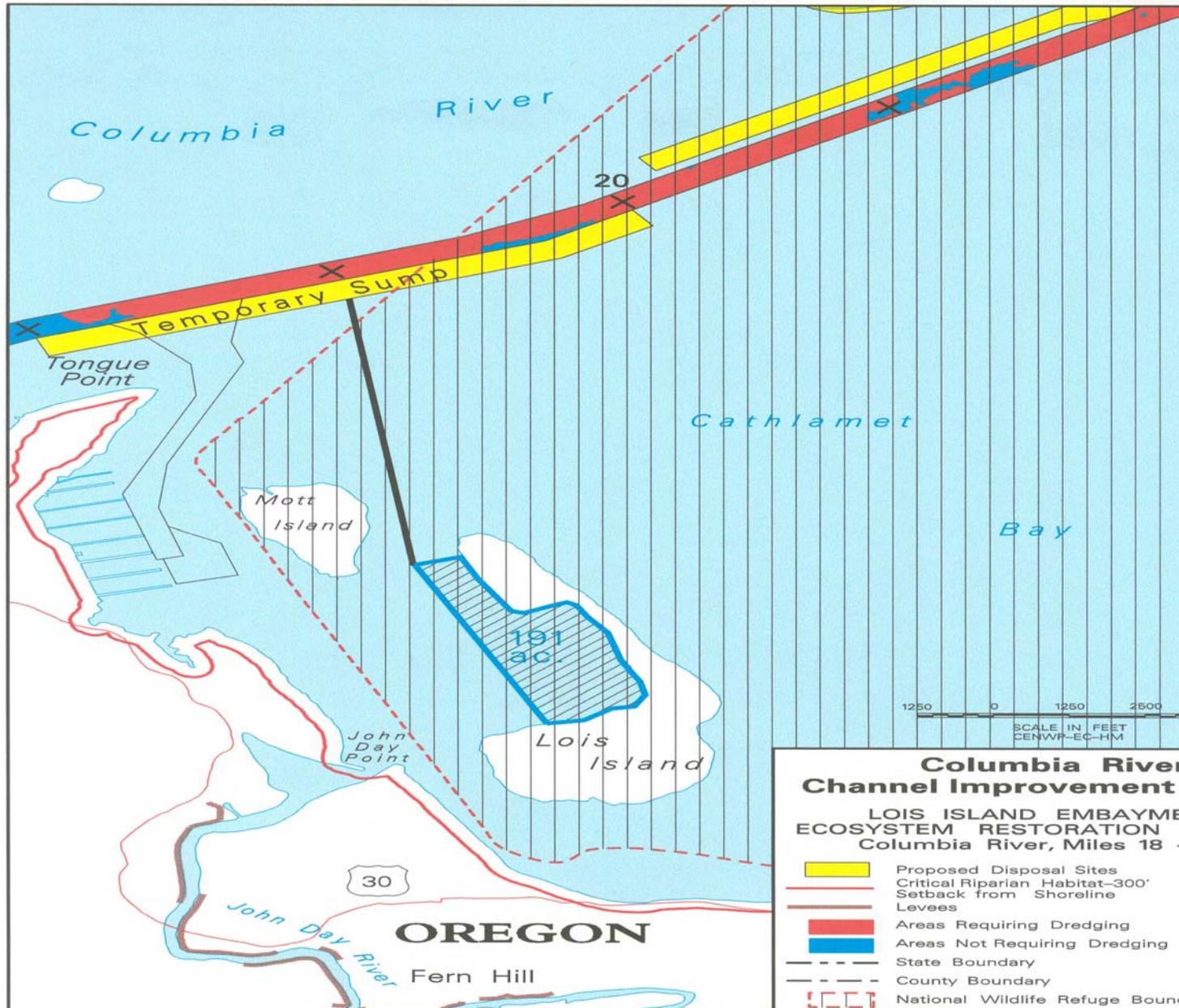
The monitoring effort for the tidal marsh habitat development and reference locations would begin in construction year 1 (prior to construction to establish a baseline), and then reoccur in construction year 2 and O&M years 2, 6, and 10. The monitoring effort for tidal marsh plant, benthic invertebrate and fisheries communities, including sampling methods, is provided in the attached monitoring plan. Monitoring reports will be provided at the conclusion of each monitoring year. These reports will be provided to the three principal federal agencies, members of the Adaptive Management Team and the Consultatory agencies.

Should the 25% plant coverage not be attained by the second year of project O&M, then the issue of whether to proceed with plantings will be addressed before the Adaptive Management Team and suitable contingency plans developed as determined necessary by the members of the Adaptive Management Team. Implementation of contingency efforts would be the responsibility of the Corps and sponsor ports. Tidal marsh plant seeds and propagules would be obtained from adjacent tidal marsh plant communities to planting efforts.

Settling of dredged material, such that the surface elevation falls below the target elevation (e.g. lowest elevation of tidal marsh as established from the reference tidal marsh habitats) would be resolved by placement of additional material on the constructed marsh to attain the proper elevation. Placement of material and associated grading, if necessary and physically possible, would occur during subsequent inwater work periods. Subsidence should be evident by the second year of construction and would be determined by survey.



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