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Feature	Area Affected by Restoration	Type, Function, and Value
Miller-Pillar Habitat Restoration	235 acres	Type: Tidal marsh habitat Function: Provide rearing habitat for ocean-type salmonids; increase detrital export Value: High

**Project Description:**

**General Description:** The Miller-Pillar restoration feature requires construction of a pile dike field. Three pile dikes would be constructed initially to implement the tidal marsh-intertidal flat habitat restoration; ultimately the restoration effort would consist of five pile dikes to hold material in place. The dredged material would be obtained from the maintenance of the deepened channel (approximately 15 years). This restoration feature would be accomplished with fill placed to the target elevation derived from the adjacent tidal marsh-intertidal flat habitat immediately upstream of Miller Sands Island and abutting a portion of the restoration area. The restoration action would be phased, beginning at the downstream border and moving upstream. Fill would be placed initially in the cell between the first and second pile dikes until the target depths for tidal marsh-intertidal flat habitat are reached. At that time, the downstream cell would no longer receive dredged material and monitoring for tidal marsh plant establishment and productivity would begin. Subsequently, dredged material would be placed between the second and third pile dikes until target depths are reached and this segment was complete. Monitoring would then be initiated to evaluate productivity of this section.

Results of the monitoring effort will be reviewed by an Adaptive Management Team (AMT), composed of interagency representatives, who will determine if modifications of the restoration effort are required to attain tidal marsh-intertidal flat habitat. The construction of this feature would continue incrementally, with modification if deemed necessary, until the entire 235 acres of tidal marsh-intertidal flat habitat was created. This approach creates tidal marsh-intertidal flat habitat that would be available to salmonids and other aquatic species and more importantly, generates detrital export to the estuary, which provides a forage base for benthic invertebrates, an important prey resource for juvenile salmonids and other aquatic species. The timeframe to accomplish this restoration depends on the volume of maintenance material that accumulates in the navigation channel, but is currently estimated to be approximately 15 years. Once this ecosystem restoration feature is completed, no further dredged material would be placed at this location. Bird excluders would be placed on top of the pilings and spreaders comprising the pile dikes to preclude fish-eating birds from perching there.

The Corps, utilizing approximately 5.5 million cubic yards of dredged material from Operation and Maintenance of the Columbia River Channel Improvement Project, would ultimately develop 235 acres of tidal marsh habitat at Miller-Pillar. Tidal marsh habitat establishment will be predicated upon placement of dredged material to a design elevation comparable to that of the adjacent natural tidal marsh habitat at the upstream end of Miller Sands Island. A pile dike field

comprised of 5 pile dikes will be constructed to hold material in place. Initially, three of the five pile dikes will be constructed and monitoring will be implemented upon completion of fill in the first cell to determine results. Construction of the two remaining pile dikes will be contingent upon monitoring results. Placement of dredged material will begin at the downstream end of the ecosystem restoration feature between the first set of pile dikes and extend upstream between the other pile dikes as material becomes available.

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

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

1. Tidal marsh at the upstream end of Miller Sands Island will be surveyed to determine the target elevation for the Miller-Pillar ecosystem restoration feature.

#### **b. Juvenile Salmonid/Fisheries Use:** Juvenile salmonid use will be measured in the tidal marsh at the upstream end of Miller Sands Island and within the ecosystem restoration feature. Due to their intertidal location and vegetative cover, trap nets or other appropriate technology would be used in the tidal marsh habitat. A purse seine would be used to sample fisheries use in the Miller-Pillar restoration area. 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. 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)**.

### **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 Miller Sands Island upstream tidal marshland within the ecosystem restoration feature (Cell 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 each would be established in the Miller Sands Island upstream tidal marsh and within the ecosystem restoration feature (Cell 1). Five of these 10 sampling stations would be paired with the tidal marsh plant production locations in each sampling area. 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 Miller Sands Island upstream tidal marsh and within the ecosystem restoration feature (Cell 1). Due to their intertidal location and vegetative cover, trap nets or other appropriate technology would be used. A purse seine would be used to sample fisheries use in that portion of Miller-Pillar 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 Operation and Maintenance years 1, 3, 5, 7 and 10. 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 5, 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.**

<b>Elevation Survey</b>	<b>O&amp;M Year 1</b>	<b>O&amp;M Year 3</b>	<b>O&amp;M Year 5</b>	<b>O&amp;M Year 7</b>	<b>O&amp;M Year 10</b>
a. Miller Sands Island East Marsh Natural Substrate	2 transects	N/A	N/A	N/A	N/A
b. Miller-Pillar ERF	N/A	Cell 1	Cell 2	N/A	N/A
<b>Tidal Marsh Primary Productivity</b>					
a. Miller Sands Island East Marsh Natural Substrate	2 sampling stations				
b. Miller-Pillar ERF	2 sampling stations				
<b>Benthic Invertebrate Productivity</b>					
a. Miller Sands Island East Marsh Natural Substrate	10 Sampling Stations; 11 cores/station				
b. Miller-Pillar ERF	10 Sampling Stations; 11 cores/station				
c. Miller-Pillar Subtidal	10 Sampling Stations; 11 cores/station				
<b>Juvenile Salmonid Use</b>					
a. Miller Sands Island East Marsh Natural Substrate	3 trap net locations				
b. Miller-Pillar ERF	Purse seine	3 trap net locations			
c. Miller-Pillar Subtidal	Purse seine				

<b>Miller-Pillar</b>	<b>O&amp;M Year 1</b>	<b>O&amp;M Year 3</b>	<b>O&amp;M Year 5</b>	<b>O&amp;M Year 7</b>	<b>O&amp;M Year 10</b>
<b>Point Photography</b>					
a. Miller Sands Island East Marsh Natural Substrate	Two photos/Veg. Sampling Stn.				
b. Miller-Pillar ERF	Two photos/Veg. Sampling Stn.				
<b>Monitoring Report</b>	1-Dec	1-Dec	1-Dec	1-Dec	1-Dec

### Miller-Pillar Ecosystem Restoration Feature Implementation Plan

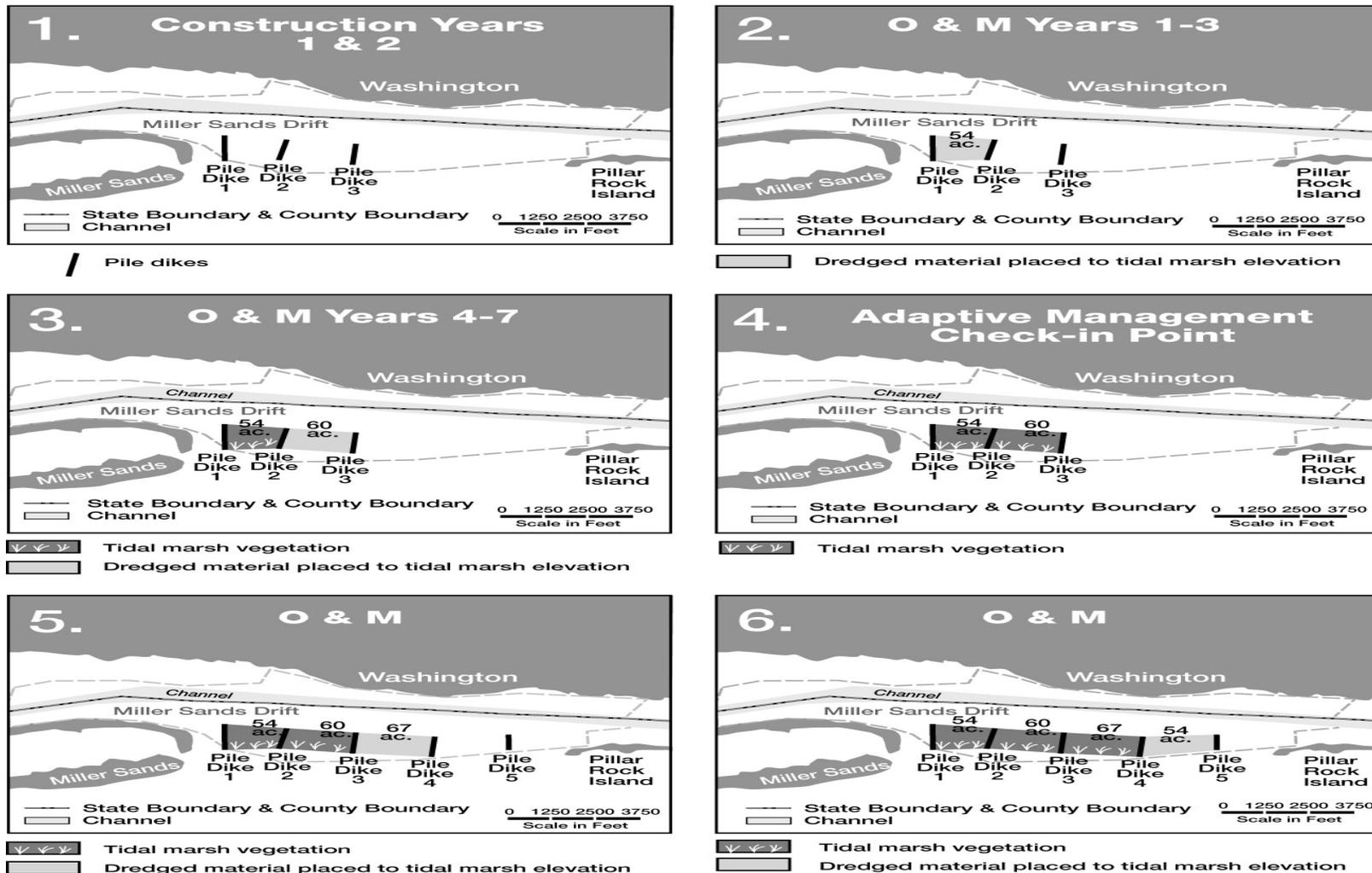


Figure S4-5 Miller-Pillar Ecosystem Restoration Feature Implementation Plan

Final SEIS