Appendix A
Ecosystems Characteristics

Ecosystem	Region/ Class	Habitat	Characteristics
Freshwater Lacustrine			• Standing body of water located in a topographic depression that is not directly connected to the sea • Distinguished by relatively still waters, no ocean derived salts, and an absence of perennial emergent vegetation • Includes lacustrine wetlands
	Oligotrophic		• Low rates of primary productivity • Trophic State Index less than 40
	Mesotrophic		• Moderate rates of primary productivity • Trophic State Index between 40 and 50
	Eutrophic		• High rates of primary productivity • Trophic State Index greater than 50
		Littoral	• Extends waterward from ordinary high water to a depth of 2 meters below low water or the extent of annual emergent vegetation
		Profundal	• Deep water benthic habitat with no vegetation
Freshwater Riverine			• Long, linear interconnected networks, comprised of patterns and processes that occur in longitudinal, lateral, and vertical dimensions • Unidirectional flows terminating at the confluence of a larger stream or river, marine ecosystem, or lake • Gradient typically decreases with longitudinal distance downstream • Structure and variability of in-channel habitat determined by topography • Energy sources, community composition, and behavioral adaptations vary with increasing distance downstream • Includes riverine wetlands
		Low-gradient valley	• Slopes less than 0.1 percent with sand and gravel substrates • Channels commonly have multiple threads • Sediment supply is generally greater than the river's transport capacity.

Ecosystem	Region/ Class	Habitat	Characteristics
		Riffle-pool	• Alternating sequences of pools, bars, and riffles with gradients of 0.1 to 2 percent • Sinuous channels with a high ratio of reach to valley length • Pools typically created by scour; deposition occurs between pools in riffles, or adjacent to pools on bars • Substrate particle size comprised of gravel or cobble
Freshwater – Riverine, continued		Plane bed	• Gradients between 2 and 4 percent • Substrate particle size comprised of gravel or cobble
		Step-pool	• Gradients between 4 and 8 percent • Alternating sequences of relatively deep stream sections with flat, non-turbulent flow, and shallow, steep sections with turbulent flow • Pools formed by large boulders that restrict the flow of water, resulting in a backwater upstream of the restriction and a substantial drop in elevation downstream of the restriction
		Cascade	• Gradients greater than 8 percent • Beds comprised of large boulders with channels typically confined by valley walls • Movement of bed material is rare due to the large size of the dominant substrate and relatively shallow water depths
Saltwater Nearshore			• Depth less than 20 meters • Energy primarily derived from benthic vegetation and terrestrial sources • Benthic habitats within the photic zone • Vegetation has significant influence on species assemblages
	Coastal		• Unconsolidated habitat dominates; consolidated substrates found in scattered locations along the northern coast and rocky headlands in estuaries
	Inland		• Unconsolidated habitat dominates; consolidated habitat most common among the San Juan Islands and on rocky headlands in Puget Sound

Ecosystem	Region/ Class	Habitat	Characteristics
		Consolidated	• Intertidal and shallow subtidal areas dominated by bedrock or boulder • Biota includes macroscopic red, green, and brown algae; kelp beds used by sea otters; a variety of fish and invertebrate species; and benthic diatoms • Riparian area vegetated with overhanging shrubs and trees and adjacent herbaceous plants
		Unconsolidated	• Eelgrass meadows (approximately +0.3 meters to -10 meters—Mean Lower Low Water) used by a variety of fish and invertebrates for rearing, feeding and refuge • Flat areas of fine to coarse unconsolidated sediments near river and stream deltas and embayments not associated with freshwater systems • Biota includes drift seaweeds; infauna (worms, small crustaceans, and bivalves); shorebirds; abundant juvenile and adult fish; and recreationally and commercially important stocks of clams • Sub-estuaries characterized by variable salinity concentrations, riparian habitat, dune habitat, tidal marshes, seaweed assemblages, eelgrass meadows, and limited rocky shore habitat • Riparian area vegetated with overhanging shrubs and trees and adjacent herbaceous plants
		Water Column	• Greater than 10 meters above the bottom • Biota includes plankton (eggs, larvae, phytoplankton, and zooplankton), fish (herring, salmonids, smelt, spiny dogfish, sand lance, and rockfish), birds, and marine mammals
Saltwater Offshore			• Depth greater than 20 meters • Benthic habitat below the photic zone • Energy production derived from communities of water column phytoplankton • Dominated by unconsolidated sediments

Ecosystem	Region/ Class	Habitat	Characteristics
	Coastal		• Dominated by unconsolidated habitats; consolidated habitats are concentrated off the Olympic Peninsula coast, west and southwest of Willapa Bay, and off Cape Flattery
	Inland		• Unconsolidated habitats dominate; consolidated habitats are concentrated off the San Juan Islands the west coast of Whidbey Island and Admiralty Inlet, and the Tacoma Narrows
		Consolidated	• Substrate is comprised of rocks larger than cobble (265 millimeters in diameter), bedrock, and consolidated clays • In high- to moderate-energy regimes, biota includes encrusting invertebrates and plants, urchins, rockfish, gobies, lingcod, and sculpins; in low-energy regimes, biota includes glass sponges, serpulid polychaetes, planktivorous invertebrates, cup coral, rockfish, longfin sculpin, and gobies
		Unconsolidated	• Substrate consists of cobble, gravel, sand, mud and organic materials • In high-energy systems comprised of cobble and mixed-coarse substrates, biota includes mussels, barnacles, urchins, rock scallops, small bivalves, amphipods, and polychaetes; in low-energy systems with mud substrates, biota includes sea pens and whips, polychaetes, bivalves, amphipods, anemones, sea stars, urchins, and sea cucumbers
		Water Column	• Greater than 10 meters above the bottom • Biota includes plankton (eggs, larvae, phytoplankton, and zooplankton), fish (herring, salmonids, smelt, lamprey, spiny dogfish, cods, sand lance, and rockfish), birds, and marine mammals

Appendix B
Species Considered

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
Amphibians & Reptiles	Cascades frog (*Rana cascadae)*	FCo; SM	G3,G4; S3,S4	No	Watch	Not state or federally threatened or endangered; apparently secure; low potential for use authorizations to affect species; insufficient biological information	Exclude	Apparently secure; low potential to affect; insufficient biological information
	Coastal tailed frog (*Ascaphus truei)*	SM	G4; S4	No	Evaluation	Not state or federally threatened or endangered; apparently secure	Exclude	Apparently secure

[1] F = Federal (FE = Federal Endangered; FT = Federal Threatened; FCo = Federal Species of Concern; S = State (SE = State Endangered; ST = State Threatened; SC = State Candidate; SS = State Sensitive; SM = State Monitor; SX = possibly extinct or extirpated)

[2] Natural Heritage program ranks: G = Global; S = State; B = Breeding populations; N = Non-breeding populations; 1 = Critically imperiled; 2 = Imperiled; 3 = Rare locally or with a restricted range; 4 = Apparently secure; 5 = Demonstrably secure; H = Possibly extirpated. GNR = globally not ranked; SNR = State not ranked

[3]Species was included in spatial-temporal screening of potential effect analysis (see Table 3-1 in Washington DNR Aquatic Resources Program Habitat Conservation Plan Potential Effects and Expected Outcomes Technical Paper. Washington DNR, Olympia WA. August 2007). See also Washington DNR Aquatic Resources Program Habitat Conservation Plan Covered Species Technical Paper (Washington DNR, Olympia WA. August 2007).

[4]Designation based on results of Potential Effects Analysis (Washington DNR Aquatic Resources Program Habitat Conservation Plan Potential Effects and Expected Outcomes Technical Paper. Washington DNR, Olympia WA. August 2007); or based on input from species experts.

[5]Reasoning may be based on results of Potential Effects Analysis alone; based on additional unrelated reasons; or a combination of the two.

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Columbia spotted frog (*Rana luteiventris)*	SC	G4; S4	Yes	Covered	State candidate; high potential to affect; similar habitat requirements to other species	Include	Covered activities could have high potential effect on species, additionally other covered amphibians use similar habitat
	Leatherback sea turtle *(Dermochelys coriacea* pop. 1*)*	FE; SE	G2; SNR	No	Evaluation	State and federally endangered but unlikely to occur on state aquatic lands	Exclude	Unlikely that use authorizations potentially impacting turtles would occur on state-owned aquatic lands; any activities on state-owned aquatic lands in turtle-foraging areas would require an ESA Section 7 consultation
	Northern leopard frog (*Rana pipiens)*	FCo; SE	G5; S1	Yes	Covered	State endangered; highly dependent upon freshwater wetlands; extremely rare/critically	Include	Extremely rare/critically imperiled in Washington; similar habitat requirements to other covered amphibians

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
						imperiled in Washington		
	Northern red-legged frog (*Rana aurora aurora)*	FCo	G4; S4	No	Watch	Not state or federally threatened or endangered; apparently secure; insufficient biological information	Exclude	Apparently secure; insufficient biological information
	Oregon spotted frog (*Rana pretiosa)*	FC; SE	G2; S1	Yes	Evaluation	State endangered; low potential to affect; little to no overlap with authorized activities	Include	Occurs on state lands; critically imperiled in Washington; similar habitat requirements to other covered amphibians

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
	Rocky Mountain tailed-frog (*Ascaphus montanus)*	FCo; SC	G4; S2	No	Watch	Not state or federally threatened or endangered; apparently secure; low potential to affect; insufficient biological information	Exclude	Apparently secure; low potential to affect; insufficient biological information
	Western toad (*Bufo boreas (*spp. A))	FCo; SC	G4; S3	Yes	Covered	Species of concern; medium potential to affect; declining populations; heightened sensitivity to anthropogenic effects	Include	Medium potential to affect; declining populations; heightened sensitivity to anthropogenic effects; similar habitat requirements to other covered amphibians,

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening**[3]	**Species Designation**[4]	**Reasoning**[5]		
	Western pond turtle (*Actinemys marmorata)*	FCo; SE	G3G4; S1	Yes	Covered	State endangered; declining populations; heightened sensitivity to anthropogenic affects	Include	Declining populations; heightened sensitivity to anthropogenic affects
Birds	American white pelican (*Pelecanus erythrorhynchos)*	SE	G4; S1B	No	Evaluation	Not federally threatened or endangered; low potential to affect; insufficient biological information	Exclude	Low potential to affect; insufficient biological information
	Bald eagle (*Haliaeetus leucocephalus)*	Federally Delisted	G5; S4	Yes	Covered	High potential to affect	Exclude	Federally delisted

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
	Black tern (*Chlidonias niger)*	FCo; SM	G4; S4B	Yes	Covered	Species of concern; low potential to affect; highly dependent upon freshwater wetlands; populations decreasing, with non-breeding adults ranked as imperiled with a “high” risk of extirpation.	Include	Species of concern; populations decreasing, with non-breeding adults ranked as imperiled with a “high” risk of extirpation
	Brandt's cormorant (*Phalacrocorax penicillatus)*	SC	G5; S3BS4N	No	Watch	Not state or federally threatened or endangered; low potential for affects; insufficient biological information	Exclude	Low potential for affects; insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Brown pelican (*Pelecanus occidentalis)*	Federally Delisted; SE	G4; S3N	Yes	Evaluation	Federally delisted; but state endangered; high species/activity overlap rank for non-breeding birds	Exclude	Federally delisted.
	Cassin's auklet (*Ptychoramphus aleuticus)*	FCo; SC	G4; S3	No	Evaluation	Not state or federally threatened or endangered; apparently secure; low potential to affect; insufficient population information	Exclude	Apparently secure; low potential to affect; insufficient population information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Clark's grebe (*Aechmophorus clarkii)*	SC	G5; S2B	No	Watch	Not state or federally threatened or endangered; apparently secure; low potential to affect; insufficient population information	Exclude	Apparently secure; low potential to affect; insufficient population information
	Common loon (*Gavia immer)*	SS	G5; S2BS4N	Yes	Covered	State sensitive; medium potential to affect; populations decreasing globally and breeding adults are listed as imperiled within Washington	Include	Medium potential to affect; protection of nesting habitat particularly important; populations decreasing globally and breeding adults are listed as imperiled within Washington

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Common murre (*Uria aalge)*	SC	G5; S4BS5N	Yes	Evaluation	Not state or federally threatened or endangered; species nests on cliff tops; five of the six murre colonies in Washington are located in marine sanctuaries offering a high level of protection	Exclude	Species nests on cliff tops; five of the six murre colonies in Washington are located in marine sanctuaries offering a high level of protection
	Eared grebe (*Podiceps nigricollis)*	None	G5; S3B, S4N	No	Evaluation	No spatial overlap of habitat with state-owned aquatic lands.	Exclude	No spatial overlap with covered activities

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Harlequin duck (*Histrionicus histrionicus)*	None	G4; S2BS3N	Yes	Covered	Not state or federally threatened or endangered; medium potential to affect; utilizes most aquatic habitat types in the state of Washington and listed as imperiled due to small populations	Include	Medium potential to affect; utilizes most aquatic habitat types in the state of Washington and listed as imperiled due to small populations
	Marbled murrelet (*Brachyramphus marmoratus)*	FT; ST	G3G4; S2	Yes	Covered	State and federally threatened; high potential to affect	Include	Forages exclusively in saltwater ecosystems, relying on nearshore and offshore habitat (one known exception: Lake Quinault)
	Peregrine falcon (*Falco peregrinus)*	FCo; SS	G4; S2BS3N	No	Watch	Not state or federally threatened or endangered; medium potential to affect	Exclude	

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
	Purple martin (*Progne subis)*	SC	G5; S3B	No	Watch	Not state or federally threatened or endangered; apparently secure; low potential to affect	Exclude	Apparently secure; low potential to affect
	Streaked horned lark *(Eremophila alpestris stigmata)*	FT; SE	G5; S1B	No	Evaluation	Federally threatened and state endangered; habitat unlikely to overlap with state aquatic lands.	Exclude	Habitat not found on state-owned aquatic lands.

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Tufted puffin (*Fratercula cirrhata)*	FCo; SC	G5; S3S4B, S4N	Yes	Evaluation	Not state or federally threatened or endangered; low potential to affect; nests on the outer coast or within the Strait of Juan de Fuca and rarely ventures inland; potential effects primarily involve prey abundance	Exclude	Low potential to affect; nests on the outer coast or within the Strait of Juan de Fuca and rarely ventures inland; potential effects primarily involve prey abundance

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
	Western snowy plover (*Charadrius nivosus nivosus)*	FT; SE	G3; S1	Yes	Covered	Federally threatened and state endangered; spatial overlap with authorized activities minimal, but 92 percent of habitat may be affected	Include	Spatial overlap with authorized activities minimal, but 92 percent of habitat may be affected
Fish	Black rockfish (*Sebastes melanops)*	SC	GNR; SNR	No	Evaluation	Not federally threatened or endangered; state candidate species; insufficient biological information	Exclude	Not federally threatened or endangered insufficient biological information
	Bocaccio rockfish (*Sebastes paucispinis)*	FE; SC	G4; SNR		Evaluation	Federally listed as endangered; state candidate species	Include	Federally endangered; potential use of eelgrass and kelp by juveniles.
	Brown rockfish	SC	GNR;	Yes	Evaluation	Federal	Exclude	Little direct effects

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	(*Sebastes auriculatus)*		SNR			species of concern; state candidate; little direct effects associated with covered activities; indirect effects encompass a relatively small percentage of available habitat		associated with covered activities; indirect effects encompass a relatively small percentage of available habitat
	Bull trout/Dolly Varden (*Salvelinus confluentus)*	FT; SC	G4; S3	Yes	Covered	Federally listed as threatened; state candidate; high potential to affect two of three life stages	Include	High potential to affect two of three life stages

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Canary rockfish (*Sebastes pinniger)*	FT;SC	GNR; SNR	No	Evaluation	Federally listed as threatened; state candidate; low potential for effects	Include	Federally threatened; potential use of shallow nearshore habitats by juveniles.
	China rockfish (*Sebastes nebulosus)*	SC	GNR; SNR	No	Evaluation	Not federally listed; state candidate; insufficient biological information	Exclude	Insufficient biological information
	Chinook salmon (*Oncorhynchus tshawytscha)*	FT/FE; SC	G5; S3S4	Yes	Covered	Federally threatened or endangered; state candidate; high potential to affect two of three life stages	Include	High potential to affect two of three life stages

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Chum salmon (*Oncorhynchus keta)*	FT; SC	G5; S3	Yes	Covered	Federally threatened; state candidate; high potential to affect two of three life stages	Include	High potential to affect two of three life stages
	Coastal cutthroat (*Oncorhynchus clarki clarki)*	FCo	G4; SNR	Yes	Covered	Not state or federally threatened or endangered; high potential to affect two of three life stages; similar habitat requirements to other salmonids, therefore little to no additional conservation cost or effort	Include	High potential to affect two of three life stages; similar habitat requirements to other salmonids, therefore little to no additional conservation cost or effort

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	**Name**			**Included in Potential Effects Analysis Screening[3]**	**Species Designation[4]**	**Reasoning[5]**		
	Coho salmon (*Oncorhynchus kisutch)*	FT/FCo	G4; S3	Yes	Covered	Federally threatened; high potential to affect two of three life stages	Include	High potential to affect two of three life stages
	Copper rockfish (*Sebastes caurinus)*	SC	GNR; SNR	Yes	Evaluation	Federal species of concern and state candidate; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Exclude	Little direct effects associated with covered activities; indirect effects encompass a relatively small percentage of available habitat

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Eulachon (*Thaleichthys pacificus)*	FT; SC	G5; S4	No	Evaluation	Federally threatened; state candidate; insufficient biological information	Include	Candidate species; important prey species; protected under HCP programmatic forage fish strategy
	Green sturgeon (*Acipenser medirostris)*	FT (Southe rn DPS)	G3; S2N	No	Evaluation	Federally threatened; minimal distribution data	Include	Southern Distinct Population listed; forage in Willapa & Grays Harbor; potential impacts to prey resources associated with shellfish aquaculture
	Greenstriped rockfish (*Sebastes elongatus)*	SC	GNR; SNR	No	Evaluation	Not state or federally threatened or endangered; apparently secure; insufficient biological information	Exclude	Apparently secure; insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Leopard dace (*Rhinichthys falcatus)*	SC	G4; S2S3	No	Evaluation	Not state or federally threatened or endangered;; insufficient biological information	Exclude	Insufficient biological information
	Margined sculpin (*Cottus marginatus)*	FCo; SS	G3; S1?	No	Watch	Not state or federally threatened or endangered; occurs in higher-order streams; low potential to affect	Exclude	Occurs in higher-order streams; low potential to affect
	Olympic mudminnow (*Novumbra hubbsi)*	SS	G3; S2S3	No	Evaluation	Not state or federally threatened or endangered; no spatial overlap	Exclude	No spatial overlap

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Pacific cod (*Gadus macrocephalus)*	FCo; SC	G4; S2S3	Yes	Evaluation	Not state or federally threatened or endangered low potential to affect; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Exclude	Low potential to affect; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Pacific hake (*Merluccius productus)*	FCo; SC	G5; S2S3	Yes	Evaluation	Not state or federally threatened or endangered low potential to affect; little direct take associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Exclude	Low potential to affect; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Pacific herring (*Clupea pallasi)*	FCo; SC	GNR; SNR	Yes	Evaluation	Federal species of concern; state candidate; high potential to affect; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Include	High potential to affect; important prey species for higher trophic levels; protected under HCP programmatic forage fish strategy
	Pacific lamprey (*Lampetra tridentate)*	FCo; SM	G4G5; S1	No	Evaluation	Federal species of concern; state monitored; not enough information for inclusion in initial potential effects analysis	Include	Recent studies confirm species directly utilizes state-owned aquatic lands during amoecyte phase of life history; populations declining

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Pink salmon (*Oncorhynchus gorbuscha)*	None	G5; S3	Yes	Covered	Not state or federally threatened or endangered; high potential to affect two of three life stages; similar habitat requirements to other salmonids, therefore little to no additional conservation cost or effort	Include	Not listed; high potential to affect two of three life stages; similar habitat requirements to other covered salmonids,
	Pacific sand lance (*Ammodytes hexapterus*)	None	G5; SNR	No	Covered	Not state or federally threatened or endangered; populations appear stable; important prey species for higher trophic levels; protected under HCP programmatic forage fish strategy	Include	Important prey species for higher trophic levels; protected under HCP programmatic forage fish strategy
	Pygmy whitefish (*Prosopium coulteri)*	FCo; SS	G5; S1S2	No	Evaluation	Not state or federally threatened or endangered	Exclude	Not state or federally threatened or endangered

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Quillback rockfish (*Sebastes maliger)*	SC	GNR; SNR	Yes	Evaluation	Not state or federally threatened or endangered	Exclude	Not state or federally threatened or endangered
	Redstripe rockfish (*Sebastes proriger)*	SC	GNR; SNR	No	Evaluation	Not state or federally threatened or endangered; apparently secure; insufficient biological information	Exclude	Not state or federally threatened or endangered; apparently secure; insufficient biological information
	River lamprey (*Lampetra ayresi)*	FCo; SC	G4; S2	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Not state or federally threatened or endangered; insufficient biological information
	Sockeye/Kokanee (*Oncorhynchus nerka)*	FT/FE; SC	G5; S2S3	Yes	Covered	Federally threatened or endangered; state candidate; high potential to affect two of three life stages	Include	High potential to affect two of three life stages

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Steelhead (*Oncorhynchus mykiss)*	FT/FE; SC	G5; S5	Yes	Covered	Federally threatened or endangered; state candidate; high potential to affect two of three life stages	Include	High potential to affect two of three life stages
	Surf smelt (*Hypomesus pretinosus)*	None	G5; SNR	No	Watch	Not state or federally threatened or endangered; insufficient biological information	Include	Important prey species for higher trophic levels; protected under HCP programmatic forage fish strategy
	Tiger rockfish (*Sebastes nigrocinctus)*	SC	G4; S2GNR; SNR	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Not state or federally threatened or endangered; insufficient biological information
	Umatilla dace (*Rhinichthys umatilla)*	SC	G41; S21	No	Evaluation	Not state or federally threatened or endangered;; insufficient biological information	Exclude	Not state or federally threatened or endangered; insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Vermillion rockfish (*Sebastes miniatus)*	None	GNR;	No	Watch	Not state or federally threatened or endangered; insufficient biological information	Exclude	Not state or federally threatened or endangered; insufficient biological information
	Walleye pollock (*Theragra chalcogramma)*	FCo; SC	GNR; SNR	Yes	Evaluation	Not state or federally threatened or endangered; little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Exclude	Little direct effect associated with covered activities; indirect effects encompass a relatively small percentage of available habitat
	Westslope cutthroat (*Oncorhynchus clarkii lewisi)*	FCo	G4T3; SNR	No	Watch	Not state or federally threatened or endangered; occurs in higher-order streams; low potential to affect	Exclude	Occurs in higher-order streams; low potential to affect

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	White sturgeon (*Acipenser transmontanus)*	None	G4; S3BS4N	Yes	Evaluation	Not state or federally threatened or endangered	Include	Similar habitat requirements to green sturgeon, therefore inclusion provides benefit with little to no additional conservation cost or effort
	Widow rockfish (*Sebastes entomelas)*	SC	GNR; SNR	No	Evaluation	Not state or federally threatened or endangered; low potential to affect	Exclude	Low potential to affect
	Yelloweye rockfish (*Sebastes ruberrimus)*	FT; SC	G4; SUGNR; SNR	No	Evaluation	Federally listed as threatened; state species of concern; insufficient biological information	Include	Insufficient biological information
	Yellowtail rockfish (*Sebastes flavidus)*	SC	G4; S3GNR; SNR	No	Evaluation	Not state or federally threatened or endangered; apparently secure	Exclude	Apparently secure
	Blue whale (*Balaenoptera musculus)*	FE; SE	G3G42; S1S2SNR	No	Watch	No spatial overlap with authorized activities; insufficient biological information	Exclude	No spatial overlap with authorized activities

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
Marine Mammals	Bowhead whale (*Balaena mysticetus)*	FE	G32; S1S2SNR	No	Watch	No spatial overlap with authorized activities; insufficient biological information	Exclude	No spatial overlap with authorized activities
	Gray whale (*Eschrichtius robustus)*	SS	G3G4; SNRZ	No	Watch	Not state or federally listed; apparently secure	Exclude	Apparently secure
	Humpback whale (*Megaptera novaeangliae)*	FE; SE	G43; S2NR	Yes	Evaluation	State and federally endangered; low potential to affect; little direct take associated with covered activities; indirect effects encompass a relatively small percentage of available habitat	Exclude	Low potential to affect; little direct take associated with covered activities; indirect effects encompass a relatively small percentage of available habitat
	Northern sea otter (*Enhydra lutris kenyoni)*	FCo; SE	G3G4; S2S3	Yes	Evaluation	State endangered; federal species of concern; low potential to affect	Exclude	Low potential to affect
	North Pacific right whale *Eubalaena japonica)*	FE	G4G5;G1;SNR S1S2	No	Watch	Federally endangered; no spatial overlap with authorized activities; insufficient biological information	Exclude	No spatial overlap with authorized activities; insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Southern resident killer whale (orca) (*Orcinus orca*)	FE; SE	G43G54 ; SZSNR	Yes	Covered	Federally and state listed as endangered; high potential to affect	Include	Low to trace effects;
	Steller sea lion (*Eumetopias jubatus)*	FT; ST	G31; SUS2N	No	Evaluation	State and federally threatened; low potential to affect; insufficient biological information	Exclude	Low potential to affect; insufficient biological information
	Columbia pebblesnail (*Fluminicola columbiana)*	None		No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
Molluscs	California floater (*Anodonta californiensis)*	FCo; SC	G3; S1S2	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Giant Columbia spire snail (*Fluminicola columbiana)*	FCo; SC	G3; S1S2	No	None	Not state or federally threatened or endangered; insufficient information	Exclude	Insufficient biological information
	Idaho springsnail (*Pyrgulopsis idahoensis)*	None	G1	No	Watch	Not state or federally threatened or endangered; low potential for effects;	Exclude	Insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
						insufficient biological information		
	Lynn's clubtail (*Gomphus lynnae)*	FCo; SC	G12; S1S2	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Masked duskysnail (*Lyogyrus* sp. 2*)*	None	G1G2; S1	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Nerite Rams-Horn *(Vorticiflex neritoides)*	None	G1Q; S1	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Newcomb's littorine snail (*Algamorda subrotundata)*	FCo; SC	G1G2; SNR	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Olympia Oyster (*Ostrea luridaconchaphila)*	SC	G5; SNR	Yes	Evaluation	Not federally listed; state species of concern; direct effects unlikely; indirect affects	Exclude	Direct effects unlikely; indirect affects encompass a

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
						encompass a relatively small percentage of available habitat		relatively small percentage of available habitat
	Olympia pebblesnail (*Fluminicola virens)*	None	G2; S?	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Northern abalone (pinto abalone) (*Haliotis kamtschatkana)*	FCo; SC	G3G4; S2SNR	Yes	Covered	Not state or federally threatened or endangered; high potential effect from authorized activities	Exclude	Primary threat poaching/overhar vest; minimal spatial overlap with authorized activities
	Shortface Lanx (*Fisherola nuttalli)*	SC	G2;S2	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Washington duskysnail (*Amnicola* sp. 2*)*	None	G1; S1	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		
	Western ridged mussel (*Gonidea angulata)*	None	G3; S21S32	No	Evaluation	Not state or federally threatened or endangered; insufficient biological information	Exclude	Insufficient biological information
	Kalm's lobelia (*Lobelia kalmii)*	SE	G5; S1	No	Watch	State endangered, but not federally listed; no spatial overlap	Exclude	No spatial overlap
Plants	Persistent sepal yellowcress (*Rorippa calycina)*	FCo; SE	G3; S1S2	Yes	Evaluation	State endangered, federal species of concern; not documented in Washington	Exclude	Not documented in Washington
	Pygmy water-lily (*Nymphaea tetragona)*	SX	G5; SH	No	Watch	Extirpated; Does not occur on state-owned aquatic lands; insufficient biological information	Exclude	Does not occur on state-owned aquatic lands
	Water howellia (*Howellia aquatilis)*	FT; ST	G3; S2S3	Yes	Evaluation	Federally and state threatened; no spatial overlap with authorized activities	Exclude	No spatial overlap with authorized activities
	Water lobelia (*Lobelia dortmanna)*	ST	G4G5; S2	Yes	Evaluation	State threatened; not federally listed	Exclude	Insufficient biological information

Species		Listing Status[1]	Natural Heritage Rank[2]				Final Recommendation	Reasoning
Group	Name			Included in Potential Effects Analysis Screening[3]	Species Designation[4]	Reasoning[5]		

Appendix C
Proposed List
of Protected Vegetation

Appendix C
Proposed List of Protected Vegetation

Plant Species Review

The Aquatic Lands Habitat Conservation Plan defines potentially protected vegetation as native photosynthetic plants or algae that are either attached to, or rooted in, the substrate on state-owned aquatic lands. Four groups of native aquatic vegetation are referenced in the habitat conservation plan:

- Saltwater plants (such as seagrass and saltmarsh plants)
- Kelps (algae in the order Laminariales)
- Complex freshwater algae (such as stoneworts and brittle worts)
- Rooted freshwater plants (submerged, floating, and emergent types).

To be protected under this habitat conservation plan, there needs to be evidence that a vegetation type provides important habitat for any of the species covered under the Aquatic Lands HCP during a portion of their life history.

The following is a list of freshwater and marine and estuarine plant species that will be evaluated on a site-by-site and situational basis for protection on state-owned aquatic lands. While all species within the four groups are potentially protected, the list is limited to species that occur in areas with a high likelihood of receiving project proposals to use state-owned aquatic lands. This list does not warrant protection of the listed plant species; instead, it is a tool to assist with further evaluation and investigation to better determine plant species protection on state-owned aquatic lands.

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
Alisma gramineum	Narrowleaf water plantain	Alismataceae	Lakes; shoreline (rarely submersed); found throughout WA	Food and habitat for waterfowl and fish	
Alisma triviale	Northern water plantain	Alismataceae	Lakes; shoreline (rarely submersed); found throughout WA	Food and habitat for waterfowl and fish	
Alopecurus spp. (various)	Foxtail	Poaceae	Lakes; rivers; Shoreline; found throughout WA	Nutritious and palatable for wildlife	Some non-native species in WA; Alopecurus myosuroides is on the WA noxious weed list
Brasenia schreberi	Watershield	Cambomaceae	Lakes; floating (rooted 0.5–3 meters (1.6–10 feet) deep); found throughout WA	Habitat for fish and aquatic insects; seeds eaten by waterfowl; leaves provide roosts for organisms	
Callitriche spp. (various)	Water-starwort	Callitrichaceae	Lakes; rivers (margins and slow water); free floating; found throughout WA	Forage and habitat for aquatic insects and fish; ducks eat foliage and seeds; leaves can keep soil moist in a drawdown; filters and absorbs toxins	Not required to identify to species level, which requires a 10-20x magnification of the fruit; some species are introduced but still provide habitat
Carex spp. (various)	Sedge	Cyperaceae	Lakes; rivers; shoreline; found throughout WA	Seeds eaten by birds; browsed by deer, elk and moose; shoreline stabilizer	Tolerant of brackish conditions
Ceratophyllum demersum	Coon's tail	Ceratophyllaceae	Lakes; rivers (still and slow water);	Habitat for juvenile fish, small aquatic animals, and aquatic	Common in WA and can be seen as a native weed

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
			floating (rootless but modified leaves can attach to sediment); found throughout WA	insects; waterfowl eat seeds and foliage	
Ceratophyllum echinatum	Spineless hornwort	Ceratophyllaceae	Lakes; rivers (still and slow water); floating (rootless but modified leaves that can attach); found throughout WA	Habitat for juvenile fish, small aquatic animals, and aquatic insects; waterfowl eat seeds and foliage	Rare plant list
Chara spp. (various)	Stonewort, muskgrass, muskwort	Characeae	Lakes; shoreline to deep water (about 0.05–20 meters (0.2–66 feet); found throughout WA	Food source for waterfowl, especially ducks; provides protection for juvenile fish and invertebrates	A plant-like algae that uses root-like structures called holdfasts to attach to sediment
Comarum palustre	Marsh cinquefoil, purple marshlocks	Rosaceae	Lakes; rivers (margin); shoreline; found throughout WA	Leaves and seeds eaten by wildlife, especially waterfowl	
Cyperus spp. (various)	Flatsedge	Cyperaceae	Lakes; rivers; shoreline; found throughout WA	Food source for wildlife and birds	Cyperus eragrostis and C. esculentus are on the WA noxious weed list
Dulichium arundinaceum	Threeway sedge	Cyperaceae	Lakes; rivers (slow and still water);	Food for waterfowl	

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
			shoreline (margin); found throughout WA		
Elatine spp. (various)	Waterwort	Elatinaceae	Lakes; rivers (slow and still water); shoreline; found throughout WA	Stabilizes the shoreline; very few known locations In WA	
Eleocharis spp. (various)	Spike rushes	Cyperaceae	Lakes; rivers; shoreline; found throughout WA	Shoreline stabilizer if it covers a large area and many are present	Tolerant of brackish conditions
Elodea canadensis	Canadian waterweed	Hydrocharitaceae	Lakes; rivers; shoreline (submersed); found throughout WA	Food and habitat for fish, waterfowl, and wildlife	Tolerant of brackish conditions
Elodea nuttallii	Western waterweed	Hydrocharitaceae	Lakes; rivers; shoreline (submersed); found throughout WA	Food and habitat for fish, waterfowl, and wildlife	Tolerant of brackish conditions
Fontinalis antipyretica	Antifever fontinalis moss, aquatic moss	Fontinalaceae	Lakes; rivers; attached (rocks or logs in flowing water); floating (loose or attached to substrate in still water); found throughout WA	Habitat for aquatic insects, larvae, and other microorganisms; small fish species will nest in it	
Heteranthera dubia	Water stargrass,	Pontederiaceae	Lakes; rivers; shoreline (up to 3	Waterfowl eat foliage; provides fish cover and	

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
	grassleaf mudplantain		meters (10 feet) deep); found throughout WA	habitat for invertebrates; ducks eat leaves	
Hippuris montana	Mountain mare's-tail	Hippuridaceae	Lakes; rivers; shoreline (shallow water or mud up to 2 meters (6.5 feet) deep); found throughout WA	Seeds and vegetation eaten by waterfowl and shorebirds; provides shelter for small animals and cover for fish and amphibians	
Hippuris vulgaris	Common mare's-tail	Hippuridaceae	Lakes; rivers; shoreline (shallow water or mud up to 2 meters (6.5 feet) deep); found throughout WA	Seeds and vegetation eaten by waterfowl and shorebirds; provides shelter for small animals and cover for fish and amphibians	Easily confused with Equisetum spp.
Hydrocotyle ranunculoides	Water pennywort, floating marshpenny wort	Apiaceae	Lakes; shoreline (forms floating mat or anchors in mud); found in western WA	Provides habitat for aquatic invertebrates; rare	
Isoetes spp. (various)	Quillwort	Isoetaceae	Lakes; rivers shoreline (submersed in shallow to moderate water); found throughout WA	Deer feed on leaves and muskrats and waterfowl eat the fleshy corms; intolerant of nutrient enrichment and can be an indicator of good water quality	
Juncus spp. (various)	Rush	Juncaceae	Lakes; rivers; shoreline; found	Birds use plant material for nests; has been used by the	Identification to species level not necessary

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
			throughout WA	frog Rana pretiosa Juncus effusus as breeding habitat; provides food and shelter for insects, birds and small mammals; contributes plant material to wetlands; removes excess nutrients and heavy metals	
Leersia oryzoides	Rice cutgrass	Poaceae	Lakes; rivers; (slow and still water); shoreline (margin or mud); found throughout WA	Provides food and cover for amphibious organisms and waterfowl	
Lipocarpha spp. (various)	Halfchaff sedge	Cyperaceae	Lakes; rivers; shoreline; uncommon in WA	Lipocarpha aristulata is state listed as threatened	
Lobelia dortmanna	Water lobelia, Dortmann's cardinalflowe r	Campanulaceae	Lakes; shoreline (submersed up to 2 meters (6.5 feet) deep); found in western WA	State listed as threatened; at high risk of extirpation in WA state	Identify during blooming season; can be confused for more common species
Marsilea spp. (various)	Waterclover	Marsileaceae	Lakes; rivers (slow and still water); shoreline; found throughout WA	Spore cases are eaten by waterfowl; the plant provides shelter for fish	Some non-native species in WA
Myriophyllum spp. (various)	Watermilfoil	Haloragaceae	Lakes; submersed; found	Provides habitat for aquatic invertebrates, amphibians,	Three species are on the noxious weed list:

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
			throughout WA	and juvenile fish	Myriophyllum spicatum, M. heterophyllum, and M. aquaticum; M. hippuroides is a native that can be confused with M. heterophyllum
Najas flexilis	Nodding waternymph	Najadaceae	Lakes; rivers; submersed (to 4 meters (13 feet) depth); found throughout WA	Entire plant is eaten by waterfowl and considered one of their most important food sources; provides shelter for small fish and insects	Tolerant of brackish conditions
Najas guadalupensis	Southern waternymph	Najadaceae	Lakes; rivers; brackish conditions; submersed (to 4 meters (13 feet) depth); found throughout WA	Entire plant is eaten by waterfowl and considered one of their most important food sources; provides shelter for small fish and insects	Tolerant of brackish conditions
Nitella spp.	Brittlewort	Characeae	Lakes; shoreline to deep (about 5 centimeters (2 inches) to 20 meters (66 feet)) water; floats above sediment or attaches to sediment; found throughout WA	Important food source for waterfowl; provides cover and food source for fish; stabilizes soil	A plant-like algae that uses root-like structures called holdfasts to attach to sediment; sometimes forms underwater meadows with muskgrass (Chara spp.)
Nuphar polysepalum	Yellow water lily	Nymphaceae	Lakes; rivers; (slow and still water);	Food source for mammals and waterfowl; spawning habitat for fish; adult frogs	

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
			shoreline (up to 4 meters (13 feet) deep); found throughout WA	observed using floating and emergent vegetation; plant eaten by pond turtle postpartum	
Polygonum spp. (various)	Knotweed, floating smartweed	Polygonaceae	Lakes; rivers; (slow and still water); shoreline to deep water; found throughout WA	Food for birds	Some Polygonum species have taxonomic synonyms within the Fallopia or Persicaria genus; for those species that may be on the WA noxious weed list, identify to species level
Potamogeton spp. (various)	Pondweed	Potamogetonaceae	Lakes; floating (rooted 0–6 meters (0–20 feet) deep); found throughout WA	Seeds, tubers, and vegetation provide food and cover for aquatic animals and waterfowl	Potamogeton crispus is on the WA noxious weed list
Ranunculus aquatilis	Water buttercup, spearwort, white water crowfoot	Ranunculaceae	Lakes; rivers; submersed; found throughout WA	Fruit eaten by waterfowl	
Ruppia cirrhosa	Ditchgrass	Ruppiaceae	Lakes; river; submersed; throughout WA	Cover and food for many aquatic species; all plant parts eaten by waterfowl; used in restoration projects;	Identification to species level not necessary; unclear if Ruppia cirrhosa and R. maritima are the same species
Sagittaria spp. (various)	Arrowhead	Alismataceae	Lakes; shoreline (rarely submersed); found throughout WA	Eaten by waterfowl, beaver, muskrat, and porcupine	Sagittaria graminea and S. platyphylla are on the WA noxious weed list
Scheuchzeria	Rannoch-	Scheuchzeriaceae	Lakes;	Similar in growth and	

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
palustris	rush		shoreline; uncommon in WA	structure to other valuable shoreline species	
Schoenoplectus spp. (various)	Bulrush	Cyperaceae	Lakes; rivers; shoreline (up to 1.5 meters (5 feet) deep); throughout WA	Food, cover, and nesting habitat for birds; shoreline stabilizer and used for contaminated water treatment	Schoenoplectus mucronatus is on the WA noxious weed list
Scirpus spp. (various)	Bulrush	Cyperaceae	Lakes; shoreline; found throughout WA	Food, cover, and nesting habitat for birds; shoreline stabilizer and used for contaminated water treatment	Used in habitat restoration projects for stabilization and to increase diversity
Sparganium spp. (various)	Bur-reed	Scrophulariaceae	Lakes; rivers; shoreline (1–2 meters (3–6.5 feet) deep); found throughout WA	Food source and habitat for waterfowl and mammals; known to absorb pollutants	Used in restoration projects
Spartina gracilis	Alkali cordgrass	Poaceae	Lakes; rivers; shoreline; found mostly in eastern WA	Wildlife cover, nesting habitat, and hunting area for various birds	Many invasive Spartina species present in WA saltwater areas
Spartina pectinata	Prairie Cordgrass	Poaceae	Lakes; rivers; shoreline; found mostly in eastern WA	Wildlife cover, nesting habitat, and hunting area for various birds	Spartina pectinata is uncommon in WA
Stuckenia pectinata	Sago pondweed	Potamogetonaceae	Lakes; shoreline (submersed); found throughout WA	Food source for ducks; habitat for invertebrates and young fish	Three species Stuckenia pectinata, S. filiformis, and S. vaginatus are so similar they can be lumped together
Torreyochloa spp.	Weak alkaligrass,	Poaceae	Lakes; rivers; shoreline;	Shoreline stabilizer and palatable	

Freshwater Species

Species	Common Names	Family	General Location	Rationale	Comments
	false mannagrass		found throughout WA		
Typha latifolia	Cattail	Typhaceae	Lakes; rivers; shoreline; found throughout WA	Filters runoff; reduces nutrients and sediment loading; eaten by pond turtles	Typha angustifolia is on the WA noxious weed list
Utricularia spp. (various)	Bladderwort	Lentibulariaceae	Lakes; rivers; (slow and still water); shoreline (no roots but can attach); found throughout WA	Utricularia gibba, U. intermedia, and U. minor are all rare	U. inflata is on the WA noxious weed list
Veronica spp. (various)	Speedwell	Scrophulariaceae	Lakes; rivers; (slow and still water); Shoreline (2.5–10 centimeters (1–4 inches) deep); found throughout WA	Typically occurs with sedges and rushes	
Zannichellia palustris	Horned pondweed	Zannichelliaceae	Lakes; rivers; submersed; Found throughout WA	Fruit and entire plant eaten by waterfowl and other birds. Habitat for small aquatic animals.	Tolerant of brackish conditions

Marine/Estuarine Species

Species	Common Names	Family	General Location	Rationale	Comments
Agarum **spp**.	Sea colander, solid broad kelp	Laminariaceae	Marine; subtidal; attaches to rocks, wood and algae; found along the Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	This prostrate kelp is part of a large functional group in the Laminariales order
Alaria spp. (various)	Ribbon kelp	Alariaceae	Marine; low intertidal; subtidal; found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	These prostrate kelps are part of a large functional group in the Laminariales order; they are associated with *Nereocystis* beds
Carex lyngbyei	Lyngbye's sedge	Cyperaceae	Estuarine; shoreline; Pacific Coast	Seeds eaten by birds; browsed by deer, elk and moose; shoreline stabilizer	Used as an indicator in riverine estuaries of the extent of marine influence
Costaria costata	Five-ribbed kelp	Costariaceae	Marine; low intertidal and shallow subtidal; attaches to rocks; found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	This prostrate kelp is part of a large functional group in the Laminariales order
Cymathaere triplicata	Three-ribbed kelp	Laminariaceae	Marine; lower intertidal and shallow subtidal; attaches to rocks up to 30 meters (98 feet) deep; Found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	These prostrate kelps are part of a large functional group in the Laminariales order; they are commonly associated with other species of kelp
Distichlis spicata	Saltgrass	Gramineae	Estuarine; Shoreline;	Potential salmonid use	Supports primary productivity of salt marshes

Marine/Estuarine Species

Species	Common Names	Family	General Location	Rationale	Comments
			found along Pacific Coast and Puget Sound		
Egregia menziesii	Feather boa kelp	Laminariaceae	Marine; upper subtidal; attaches to rocks up to 30 meters (98 feet) deep; fully sheltered to fully exposed; found along Pacific Coast and Puget Sound	Habitat for salmonids, juvenile rock fish, forage fish, and numerous invertebrates	This floating kelp is part of a large functional group in the Laminariales order; often co-occurs with bull kelp, giant kelp and other floating kelps
Jaumea carnosa	Jaumea	Compositae	Estuarine; shoreline; found along Pacific Coast	Potential salmonid use	Supports primary productivity of salt marshes
Laminaria spp. (various)	Brown kelp	Laminariaceae	Marine; estuarine; low intertidal and upper subtidal; attaches to rocks; found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	These prostrate and stipitate kelps are part of a large functional group in the Laminariales order; *Laminaria farlowii, L. longipes, L. ephemera, L. setchellii and L. sinclairii* are uncommon in WA
Macrocystis pyrifera	Giant kelp	Laminariaceae	Marine; low intertidal and subtidal; attaches to rocks; found in open ocean and along Pacific Coast and Juan de	Benefits to numerous fish and invertebrate species, including salmonids and forage fish.	This floating kelp is part of a large functional group in the Laminariales order

Marine/Estuarine Species

Species	Common Names	Family	General Location	Rationale	Comments
			Fuca		
Nereocystis luetkeana	Bull kelp	Laminariaceae	Marine; upper subtidal; attaches to rocks up to 30 meters (98 feet) deep; fully sheltered to fully exposed; found along Pacific Coast and Puget Sound	Habitat for salmonids, juvenile rock fish, forage fish, and numerous invertebrates	This floating kelp is part of a large functional group in the Laminariales order; restoration methods with this species are being researched
Phyllospadix spp.	Surfgrass	Zosteraceae	Marine; low intertidal and subtidal; attaches to rocky substrates in regions with moderate-to-high wave exposure; found along Pacific Coast and Puget Sound	Small organisms inhabit the canopy and rhizomes; herring lay their eggs on surfgrass; provides juvenile salmon habitat; nourishment for detritivores, fish and waterfowl	Common in exposed areas along the Strait of Juan de Fuca, western Whidbey Island, and the San Juan Archipelago; often occurs with *Zostera marina*; roots are often covered by sand
Pterygophora californica	Woody kelp	Laminariaceae	Marine; Estuarine; low intertidal and subtidal; attaches to rocks; found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish	This stipitate kelp is part of the Laminariales order
Ruppia maritima	Widgeongrass	Ruppiaceae	Estuarine; submersed; found	Cover and food for many aquatic species; all plant	Identification to species level not necessary; unknown if

Marine/Estuarine Species

Species	Common Names	Family	General Location	Rationale	Comments
			along Pacific Coast	parts eaten by waterfowl; used in restoration projects	*Ruppia maritima* and *R. cirrhosa* are the same species
Saccharina spp. (various)	Brown kelp	Laminariaceae	Marine; Estuarine; low intertidal and subtidal; attaches to rocks; found along Pacific Coast and Puget Sound	Used by salmonids, juvenile fish, and forage fish; nursery habitat for rock fish; herring spawn on this kelp	These floating kelps are part of a large functional group in the Laminariales order
Salicornia virginica	Pickleweed, Virginia glasswort	Chenopodiaceae	Marine; estuarine; low elevation salt marsh; mud flat; found in western WA	Supports small copepods on which salmonids feed	
Scirpus maritimus	Seacoast bulrush	Cyperaceae	Estuarine; shoreline; found along Pacific Coast and Puget Sound	Potential salmonid use	Supports primary productivity of salt marshes
Triglochin maritimum	Seaside arrowgrass	Juncaginaceae	Estuarine Shoreline Coastal	Potential salmonid use	Supports primary productivity of salt marshes
Zostera marina	Eelgrass	Zosteraceae	Marine; estuarine; intertidal (up to 12 meters (39 feet) deep; found in western WA	Small organisms inhabit the canopy, including juvenile shellfish; herring lay eggs on eelgrass; provides habitat juvenile salmon; nourishment for detritivores	

Appendix D
Derelict Vessel Program
Hydraulic Project
Approval

Appendix D – Derelict Vessel Program Hydraulic Project Approval

Washington Department of FISH and WILDLIFE

HYDRAULIC PROJECT APPROVAL

RCW 77.55.100 - Appeal Pursuant to Chapter 34.05 RCW

Statewide
600 Capitol Way N
Olympia, WA 98501-1091
(360) 902-2200

Issue Date: January 27, 2011
Project Expiration Date: January 26, 2016

Control Number: 121939-1
FPA/Public Notice #: N/A

PERMITTEE	AUTHORIZED AGENT OR CONTRACTOR
Washington Department of Natural Resources ATTENTION: Melissa Ferris 1111 Washington Street SE MS 47027 Olympia, WA 98501 360-902-1574	

Project Name: Derelict vessel removal

Project Description: Remove derelict vessels under Washington Department of Natural Resources' Derelict Vessel Removal Program.

PROVISIONS

1. This HPA authorizes removal of derelict and abandoned vessels from the beds of state waters under the Washington Department of Natural Resources' Derelict Vessel Removal Program. This HPA does not authorize removal of any vessel on the bed in contaminated sediment, eelgrass, kelp beds or other attached macroalgae, or a documented herring or forage fish spawning area. This does HPA does not authorize removal of any vessel where removal requires that the vessel be cut up on the beach. Separate written approval from WDFW is required to remove a vessel from such habitat or using such a method.

2. Work shall be accomplished per plans and specifications approved by WDFW entitled JARPA and dated January 5, 2011, except as modified by this HPA. A copy of these plans shall be available on site during vessel removal operations.

3. TIMING LIMITATIONS
If the removal method involves only the use of floatation bags with no hydraulic jetting of sediments, the vessel may be removed at any time of the year from January 27, 2011 to January 26, 2016.

If the removal involves the use of hydraulic jetting for sling placement, work must be accomplished during the marine or freshwater work windows specified in Attachment 1, which is part of this HPA.

4. NOTIFICATION REQUIREMENT: The permittee or contractor shall notify (verbal, fax, email, etc.) the WDFW Regional Habitat Program Manager (RHPM), listed in Attachment 2, prior to the removal of a sunken derelict vessel. The notification shall include the contractor name, project location, vessel name, starting date for work, and the control number for this HPA.

5. ANNUAL REPORTING: The permittee shall submit a calendar year annual report of the Derelict Vessel Removal Program projects by March 31 of the following year, or in the final year of the permit prior to the expiration date. Reports may be submitted by email to HPAapplications@dfw.wa.gov, or by mail to WDFW Habitat Program, 600 Capitol Way N. Olympia, WA 98501.

The report shall be provided in Excel; a template is provided in Attachment 3 to this HPA.

An annual report is required even if no work was conducted under the agreement.

The report shall include:

a. The HPA control number.
b. Name, address, email address, and telephone number of the person preparing the report.
c. The date and time period of the report.
d. List of individual projects completed: By WDFW region including water body name, vessel name, location, date of work, method of removal, and disposition of the vessel (e.g., sold or landfilled).
e. The total number of individual projects completed, by WDFW region and statewide.
f. Problem(s) encountered: Provision violation, notification, corrective action, impacts to fish life and water quality from problem.
g. Recommendations for improvement to Best Management Practices (BMP's) and mitigation [Optional]

6. All debris or deleterious material resulting from the vessel removal shall be removed from the aquatic bedlands and state waters, and prevented from re-entering waters of the state. A boom or similar device shall be used to contain floatable materials.

7. Vessels and associated materials shall be disposed of so they will not re-enter state waters.

8. Sunken vessels shall not be dragged along the bed.

9. Barges shall be restricted to water levels or tide elevations adequate to prevent grounding of the barge, however, barges are permitted to 'spud down', anchor, or otherwise stabilize themselves to maintain position when conducting a removal.

10. No petroleum products or other deleterious materials from equipment or vessels used to carry out the removal shall enter surface waters.

11. If at any time, as a result of project activities, fish are observed in distress, a fish kill occurs, or water quality problems develop (including equipment leaks or spills), immediate notification shall be made to the Washington Military Department's Emergency Management Division at 1-800-258-5990, and the appropriate Regional Habitat Program Manager in Attachment 2.

Issue Date: January 27, 2011
Project Expiration Date: January 26, 2016

Control Number: 121939-1
FPA/Public Notice #: N/A

PROJECT LOCATIONS

Location #1

WORK START: January 27, 2011					WORK END: January 26, 2016	
WRIA: 99.0000	Waterbody: Various				Tributary to: Statewide	
1/4 SEC: All	Section: 01	Township: 99	Range: 99	Latitude: N	Longitude:	County: Multiple
Location #1 Driving Directions						

APPLY TO ALL HYDRAULIC PROJECT APPROVALS

This Hydraulic Project Approval pertains only to those requirements of the Washington State Hydraulic Code, specifically Chapter 77.55 RCW (formerly RCW 77.20). Additional authorization from other public agencies may be necessary for this project. The person(s) to whom this Hydraulic Project Approval is issued is responsible for applying for and obtaining any additional authorization from other public agencies (local, state and/or federal) that may be necessary for this project.

This Hydraulic Project Approval shall be available on the job site at all times and all its provisions followed by the person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work.

This Hydraulic Project Approval does not authorize trespass.

The person(s) to whom this Hydraulic Project Approval is issued and operator(s) performing the work may be held liable for any loss or damage to fish life or fish habitat that results from failure to comply with the provisions of this Hydraulic Project Approval.

Failure to comply with the provisions of this Hydraulic Project Approval could result in a civil penalty of up to one hundred dollars per day and/or a gross misdemeanor charge, possibly punishable by fine and/or imprisonment.

All Hydraulic Project Approvals issued under RCW 77.55.021 are subject to additional restrictions, conditions, or revocation if the Department of Fish and Wildlife determines that changed conditions require such action. The person(s) to whom this Hydraulic Project Approval is issued has the right to appeal those decisions. Procedures for filing appeals are listed below.

Requests for any change to an unexpired HPA must be made in writing. Requests for new HPAs must be made by submitting a new complete application. Send your requests to the department by: mail to the Washington Department of Fish and Wildlife, Habitat Program, 600 Capitol Way North, Olympia, Washington 98501-1091; e-mail to HPAapplications@dfw.wa.gov; fax to (360) 902-2946; or hand-delivery to the Natural Resources Building, 1111 Washington St SE, Habitat Program, Fifth floor.

Issue Date: January 27, 2011 | Control Number: 121939-1

Project Expiration Date: January 26, 2016 | FPA/Public Notice #: N/A

APPEALS INFORMATION

If you wish to appeal the issuance, denial, conditioning, or modification of a Hydraulic Project Approval (HPA), Washington Department of Fish and Wildlife (WDFW) recommends that you first contact the department employee who issued or denied the HPA to discuss your concerns. Such a discussion may resolve your concerns without the need for further appeal action. If you proceed with an appeal, you may request an informal or formal appeal. WDFW encourages you to take advantage of the informal appeal process before initiating a formal appeal. The informal appeal process includes a review by department management of the HPA or denial and often resolves issues faster and with less legal complexity than the formal appeal process. If the informal appeal process does not resolve your concerns, you may advance your appeal to the formal process. You may contact the HPA Appeals Coordinator at (360) 902-2260 for more information.

A. INFORMAL APPEALS: WAC 220-110-340 is the rule describing how to request an informal appeal of WDFW actions taken under Chapter 77.55 RCW. Please refer to that rule for complete informal appeal procedures. The following information summarizes that rule.

A person who is aggrieved by the issuance, denial, conditioning, or modification of an HPA may request an informal appeal of that action. You must send your request to WDFW by mail to the Washington Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091; e-mail to HPAapplications@dfw.wa.gov; fax to (360) 902-2946; or hand-delivery to the Natural Resources Building, 1111 Washington St SE, Habitat Program, Fifth floor. WDFW must receive your request within 30 days from the date you receive notice of the decision. If you agree, and you applied for the HPA, resolution of the appeal may be facilitated through an informal conference with the WDFW employee responsible for the decision and a supervisor. If a resolution is not reached through the informal conference, or you are not the person who applied for the HPA, the HPA Appeals Coordinator or designee will conduct an informal hearing and recommend a decision to the Director or designee. If you are not satisfied with the results of the informal appeal, you may file a request for a formal appeal.

B. FORMAL APPEALS: WAC 220-110-350 is the rule describing how to request a formal appeal of WDFW actions taken under Chapter 77.55 RCW. Please refer to that rule for complete formal appeal procedures. The following information summarizes that rule.

A person who is aggrieved by the issuance, denial, conditioning, or modification of an HPA may request a formal appeal of that action. You must send your request for a formal appeal to the clerk of the Pollution Control Hearings Boards and serve a copy on WDFW within 30 days from the date you receive notice of the decision. You may serve WDFW by mail to the Washington Department of Fish and Wildlife HPA Appeals Coordinator, 600 Capitol Way North, Olympia, Washington 98501-1091; e-mail to HPAapplications@dfw.wa.gov; fax to (360) 902-2946; or hand-delivery to the Natural Resources Building, 1111 Washington St SE, Habitat Program, Fifth floor. The time period for requesting a formal appeal is suspended during consideration of a timely informal appeal. If there has been an informal appeal, you may request a formal appeal within 30 days from the date you receive the Director's or designee's written decision in response to the informal appeal.

C. FAILURE TO APPEAL WITHIN THE REQUIRED TIME PERIODS: If there is no timely request for an appeal, the WDFW action shall be final and unappealable.

ENFORCEMENT: Sergeant Anderson (202) P3

Habitat Biologist Carol Piening	Carol.Piening@dfw.wa.gov 360-902-2588		for Director WDFW

CC: Email with attachments:
All RHPMs, WDFW
All Regional Enforcement Sergeants, WDFW

Melissa Ferris, WDNR

Attachments:
Work Times for DVRP
WDFW Regional Habitat Program Managers
DVRP Report Template
JARPA

Appendix E
Aquatic Reserve Program Implementation and Designation Guidance

NATURAL RESOURCES

Aquatic Reserve Program
Implementation and Designation
Guidance

September 2005

Photo by Carol Cloen

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

Acknowledgements

Technical Reviewers of Site Evaluation Criteria and Ecological Framework
Dr. James W. Barry, California Department of Parks and Recreation
Dr. Mike Beck, The Nature Conservancy
Dr. Megan Dethier, University of Washington
Dr. David Fluharty, University of Washington
Dr. Ron Hilborn, University of Washington
Wayne Palsson, Washington Department of Fish and Wildlife
Dr. Julia Parrish, University of Washington
Kit Rawson, Tulalip Tribe
Dr. Mary Ruckelshaus, National Marine Fisheries Service

Other Contributors
Marc Daily
Carol Piening
Jay Udelhoven
Helen Berry
Tom Mumford
Scott Pearson
John Gammon

DNR Regional Review
David Roberts
Scott Robinson
Rex Thompson

Editor / Report Production
Jane Chavey

All contributors are DNR staff unless otherwise indicated.
Copies of this report may be obtained from the Aquatic Reserves Program Manager or copied from the web page.

Contact Information
Aquatic Reserve Program Manager
Phone: 360-902-1100
E-mail: aquaticreserve@wadnr.gov

Webpage: www.dnr.wa.gov/htdocs/aqr/reserves/home

November 4, 2005

Dear Reader,

Washington's aquatic environment is an invaluable public resource that is treasured by the people of the state. The 2.4 million acres of state-owned aquatic lands is managed by the Washington State Department of Natural Resources to foster water-dependent use, public access, renewable resources, and environmental protection.

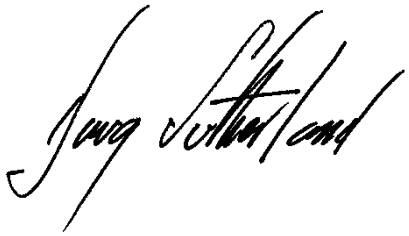
Established in September 2002, the Aquatic Reserves Program is part of the Department's efforts to conserve significant state-owned aquatic lands through preservation, restoration, and enhancement. In order to protect these aquatic systems and functions above other uses, the program provides an ongoing process to evaluate and designate reserves on those state aquatic lands that have unique ecological features and habitats.

State Aquatic Reserves also can help support the connectivity of healthy aquatic systems throughout the state — so important to our salmon and other aquatic life.

We are publishing this *Aquatic Reserves Program Implementation and Designation Guidance* to ensure consistent implementation of the Aquatic Reserves Program and to give people interested in nominating aquatic reserves the necessary information to do so.

I greatly appreciate the time and work of those technical reviewers outside of the Department, as well as DNR staff who devoted their time to develop this guidance. This will be a valuable tool to help identify and protect significant habitats into the future.

Sincerely,



Doug Sutherland
Commissioner of Public Lands

NATURAL RESOURCES

Aquatic Reserve Program
Implementation and Designation
Guidance

September 2005

Philip Bloch
David Palazzi

Aquatic Reserves Program
Aquatic Resources

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Doug Sutherland - Commissioner of Public Lands

Table of Contents

1.0 Preface 1
2.0 Overview 3
2.1 Aquatic Reserves Program 4
2.1.1 Goals and Objectives 5
2.2 Aquatic Reserve Types and Objectives 6
2.3 Program Administration 6
3.0 Aquatic Reserve Application Process 9
3.1 Call for Proposals 10
3.2 Letter of Intent 10
3.3 Proposal and Project Evaluation Information 12
4.0 Aquatic Reserve Proposal Evaluation Process 13
4.1 Proposal Evaluation and Ranking 13
4.1.1 DNR Staff Preliminary Review 13
4.1.2 Open House Public Meeting 14
4.1.3 Aquatic Reserve Technical Advisory Committee 14
4.1.4 DNR Staff Recommendation and Commissioner of Public Lands Review 15
5.0 Aquatic Reserve Designation Process 17
5.1 Site Specific Management Plans 17
5.1.1 Management Plans for Environmental Reserves 17
5.1.2 Management Plans for Scientific Reserves 18
5.1.3 Management Plans for Educational Reserves 18
5.1.4 Monitoring Considerations 19
5.1.5 Other DNR Management Actions 19
5.2 SEPA and Site-Specific Public Review 20
5.3 Commissioner's Order 20
5.4 Program Implementation 21
5.4.1 Cooperate with Managers and Stakeholders 21
5.4.2 Adaptive Management 21
6.0 Aquatic Reserves Ecological Framework and Criteria 22
6.1 Ecological Framework 22
6.1.1 Landscape level structure 22
6.2 General Reserve Criteria 25
6.2.1 Ecological Criteria 25
6.2.2 Socioeconomic Criteria 33
6.2.3 Manageability Criteria 35
6.3 Scientific Reserve Criteria 35
6.4 Educational Reserve Criteria 36
6.5 Application of Criteria 38
7.0 Glossary 39
8.0 References 41
Appendix A - Site Proposal Application 45
Section 1 – New proposal, Boundary change, or De-Listing an Aquatic Reserve 45
Section 2 - Additional information to be provided for SCIENTIFIC RESERVE Proposals 48
Section 3 - Additional information to be provided for EDUCATIONAL RESERVE Proposals 49
Appendix B - Potential Causes of Habitat Modification and Ecological Concerns 50
Appendix C - Priority Marine Habitat 51

Appendix D - Priority Freshwater Habitat 53
Appendix E - Priority Marine Species 55
Appendix F - Priority Freshwater Species 57
Appendix G - Establishing Aquatic Reserves in Harbor Areas and State-Owned Waterways 59
Appendix H - Interim Management Guidance 61
Appendix I – Site Evaluation 63
Site Evaluation Forms 63
General Evaluation Criteria 63
Evaluation Criteria for Scientific Reserves 74
Evaluation Criteria for Educational Reserves 76
Appendix J – Aquatic Reserve Technical Advisory Committee Recruitment 79

Section 1

Preface

The purpose of the Aquatic Reserves Program implementation and designation guidance document is to assist the Washington State Department of Natural Resources (DNR) in the implementation of the Aquatic Reserves Program and to provide guidance and the application material for interested parties to nominate state-owned aquatic lands as aquatic reserves.

DNR's Aquatic Resources Program adopted the Final Environmental Impact Statement for Aquatic Reserves Program Guidance (Final EIS) on September 6, 2002. The Final EIS gives a programmatic description of how DNR will designate aquatic reserves on state-owned aquatic lands that have unique, native ecological features, habitats, and species in order to protect and support those elements.

The preferred alternative of the Final EIS describes how DNR will determine what areas and resources need the special protection provided by the aquatic reserves program, and how those areas are to be managed, once designated. This document provides details and interpretation for the aquatic reserves designation criteria as described in the preferred alternative of the Final EIS.

The criteria set out in the Final EIS, along with the implementation guidance provided by this document, set up the methods and time frames for establishing aquatic reserves on state-owned aquatic lands. The components of this implementation guidance include the Aquatic Reserves Program implementation elements presented in Sections 3, 4, and 5 and the ecological framework criteria presented in Sections 6.0. Appendix A includes the site proposal application. Appendices B – H provide technical information and guidance to assist in the development of aquatic reserve proposals. Appendix I includes the site evaluation forms and recruitment qualifications for the Aquatic Reserve Technical Advisory Committee.

Citizens, stakeholder groups, Tribes, and government agencies that would like to nominate state-owned aquatic lands for aquatic reserve designation for the dedicated purpose of environmental protection, scientific research, or education should use the guidance and application material provided in this document. For additional information about the Aquatic Reserves Program, copies of this implementation guidance, letter of intent form, and the proposal application, contact the DNR Aquatic Reserves Program staff or view the Aquatic Reserves Program web page.

Section 2

Overview

The Washington State Department of Natural Resources (DNR) manages about 2.4 million acres of state-owned aquatic lands. This includes about 1,300 miles of tidelands, 6,700 acres of harbor areas established in the state constitution, and all of the submerged land below extreme low tide. The total area of aquatic lands under management amounts to some 2,000 square miles of marine beds of navigable waters and an undetermined amount of freshwater shorelands and bedlands. Figure 1 (navigable waters in Washington) roughly depicts the distribution of aquatic land ownership in the state. More detailed maps of the navigability assessment of Washington lakes and rivers can be found on the DNR webpage: www.dnr.wa.gov/.

State aquatic lands are managed as a rich land base that offers a variety of recreational, commercial, and natural resource benefits. Management of state-owned aquatic lands is to be consistent with DNR's public trust responsibility, for the benefit of the people of Washington. These lands are "a finite natural resource of great value and an irreplaceable public heritage" and are managed to "provide a balance of public benefits for all citizens of the state" (RCW 79.90.450 and 79.90.455). Within this balance, DNR has recognized the increasing need for site-based conservation management of state-owned aquatic lands. The Aquatic Reserves Program is established to address that need.

Protecting Aquatic Resources

Washington's DNR has the proprietary authority to identify and withdraw lands from leasing when there are potentially conflicting uses (RCW 79.10.210). This could include instances such as choosing to withdraw a site from leasing and manage it for the conservation of important native habitat and species. DNR has direction to protect such sites through designation as state aquatic reserves.

Many other natural resource managers and citizens play important roles in the stewardship of aquatic resources in Washington State. The Aquatic Reserves Program is to work with landowners, citizens, stakeholder groups, Tribes, and regulatory agencies to develop management plans for individual sites that maximize the benefits for individual reserves and the ecosystem.

Although most of the state's aquatic lands are managed by DNR, Washington's Department of Fish and Wildlife (WDFW) and Washington's Treaty Tribes co-manage the fisheries that utilize the state's aquatic lands. Therefore, fisheries management is outside of the scope of the Aquatic Reserves Program. However, the program will, where appropriate, work cooperatively with these fishery managers to conserve aquatic habitats supporting Washington's ecosystems.

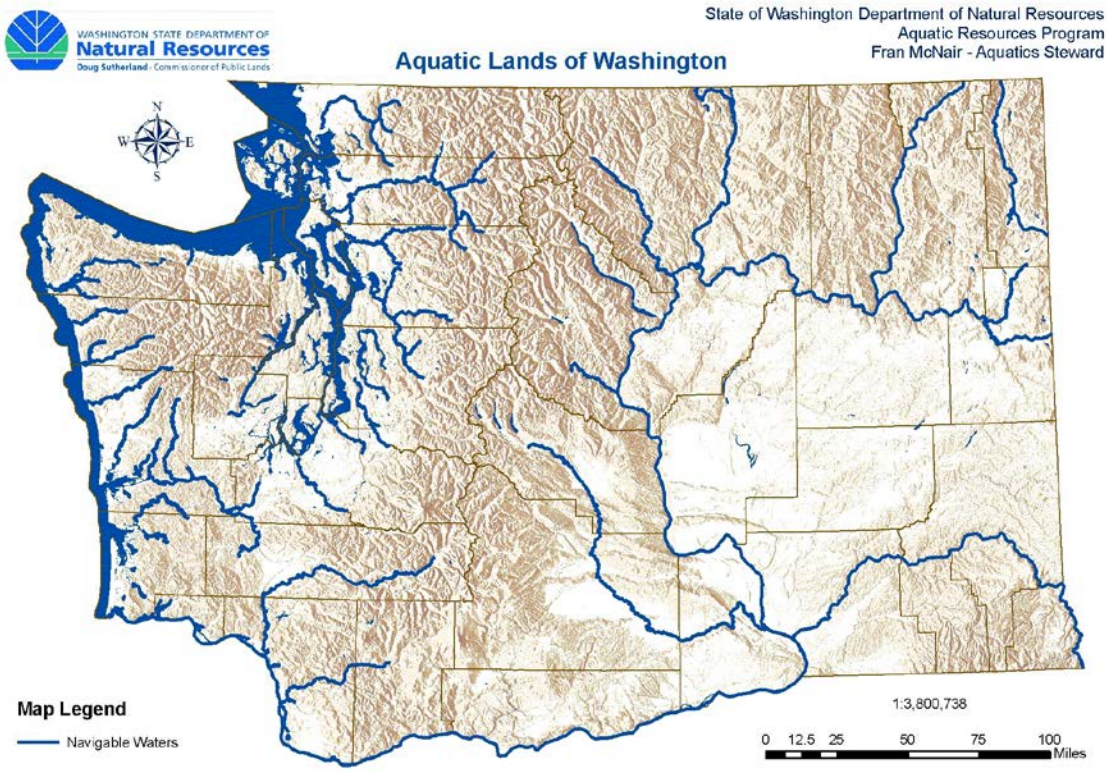


Figure 1: Navigable Waters in Washington (Washington State Department of Natural Resources 2005)

2.1 Aquatic Reserves Program

The Aquatic Reserves Program is set up to help DNR promote conservation (preservation, restoration, and enhancement) of state-owned aquatic lands that will provide direct and indirect benefits to the health of native aquatic habitats and species and other resources of Washington.

The program was created to establish aquatic reserves on selected state-owned aquatic lands to protect important native aquatic ecosystems. Aquatic reserves are lands of special educational or scientific interest, or of special environmental importance (WAC 332-30-151).

The process of evaluating a site for aquatic reserve status includes the development of an initial proposal by the proponent, varying levels of review by DNR, management plan development, review under the State Environmental Policy Act (SEPA), and ultimately final approval for designation of the site by the

Commissioner of Public Lands. Each aquatic reserve proposal is evaluated on a case-by-case basis during a (approximate) two and one/half-year cycle (Figure 2). While sites are evaluated on an individual basis, the intent of this program is to develop an ecologically sound network of reserves that function to achieve the statewide program goals and objectives.

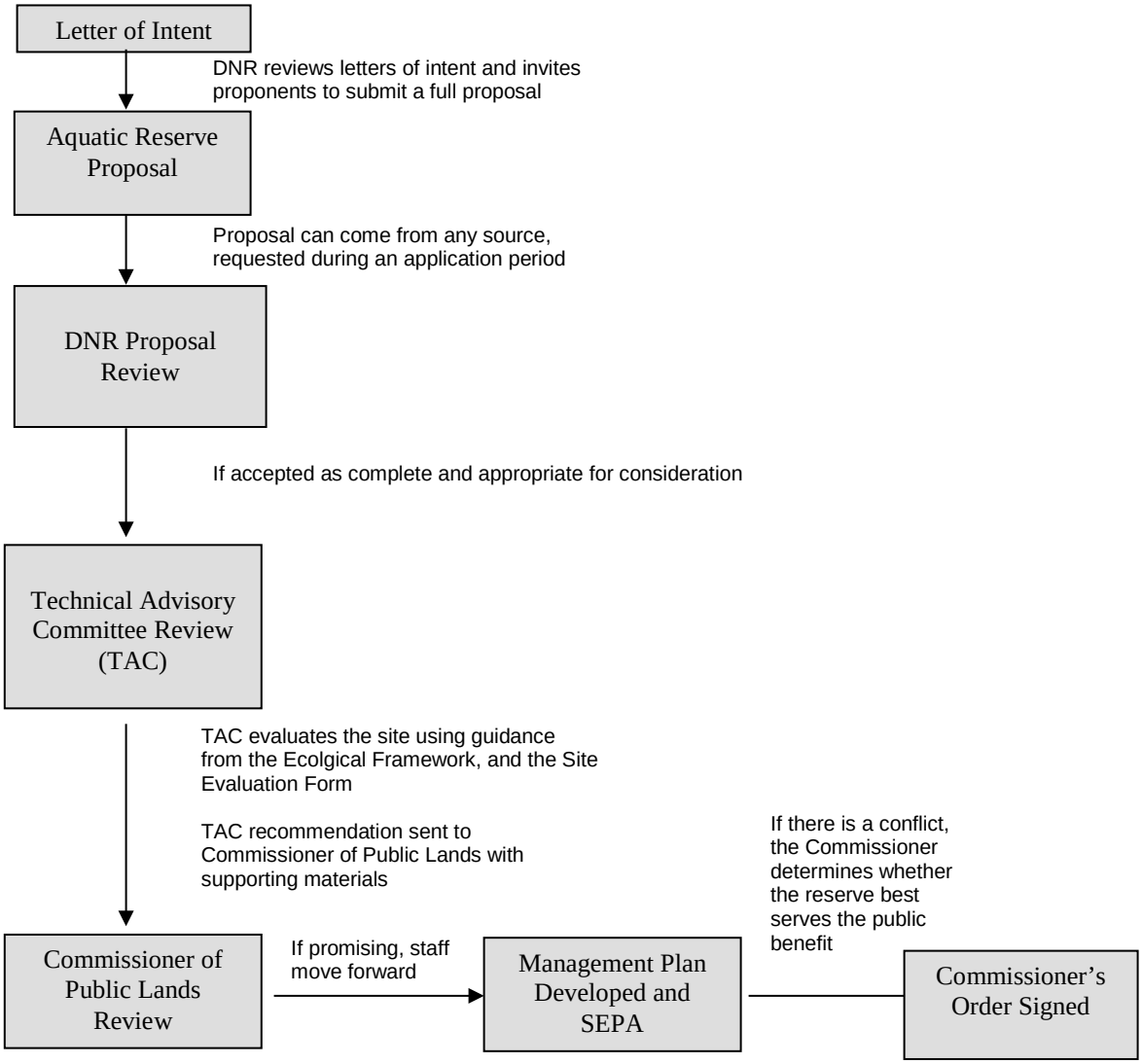


Figure 2: Overview of site evaluation procedure as outlined in the program's Final Environmental Impact Statement (EIS).

2.1.1 Goals and Objectives

The Aquatic Reserves Program partly fulfills DNR's stewardship responsibilities for state-owned aquatic lands. During 2002, DNR developed a Final EIS outlining program goals and objectives. As stated in the Final EIS (3.2.1.1), the overall goal of the Aquatic Reserves Program is to ensure environmental protection and preserve and enhance state-owned aquatic lands in order to provide direct and indirect benefits to aquatic resources in Washington State. Because DNR, Tribes and local, state, and federal regulatory agencies share management authority of the state's aquatic resources (DNR has no regulatory authority over aquatic

resources), achieving this goal will require partnerships among natural resource managers and landowners.

The overall goal is achieved through the designation of three classes of reserves: environmental reserves, scientific reserves, and education reserves (WAC 332-30-151). The objectives for each aquatic reserve category are discussed in Section 2.2.

2.2 Aquatic Reserve Types and Objectives

Environmental Reserves

Environmental aquatic reserves must be areas of regional or statewide environmental importance; sites established for the continuance of environmental baseline monitoring; or areas of historical, geological, or biological interest that require special protective management.

Objectives

- Establish aquatic habitats for conservation of ecological function and services or historical significance.
- Restore important degraded habitats to better functioning conditions.

Scientific Reserves

Scientific aquatic reserves are sites set aside for scientific research projects. These areas may contain unusually rich plant and animal communities suitable for continued scientific observation.

Objectives

- Provide sites that may be manipulated for the benefit of scientific research.
- Provide reference sites to measure the effectiveness of environmental protection.
- Manage sites with unusually rich plant and animal communities.

Educational Reserves

Educational aquatic reserves are accessible areas of aquatic lands typical of specific native habitat types that are protected as sites suitable for education projects.

Objectives

- Keep sites available for environmental education opportunities.
- Educate people on the value of aquatic habitats to help ensure environmental protection.

2.3 Program Administration

Aquatic Reserve Designation

DNR's Aquatic Reserves Program Administrator is responsible for statewide program implementation. This includes:

- Running a biennial application cycle,
- Screening new proposals,

- Reviewing aquatic reserve applications and sites to determine if they fit into the overall goals of the reserves program,
- Working with site proponents in developing proposals,
- Conducting public meetings for proposed sites,
- Establishing and chairing the Aquatic Reserves Program Technical Advisory Committee (Technical Committee),
- Leading the Technical Committee through the evaluation of proposed sites,
- Providing briefings on the Technical Committee's recommendations to executive management,
- Leading the development of management plans for proposed aquatic reserves, and
- Coordinating the transition from plan development to implementation of established aquatic reserves.

The Program Administrator also continues to develop and promote the Aquatic Reserves Program throughout the state.

Existing state aquatic reserves, and areas proposed for consideration as aquatic reserves, are evaluated according to the process in Section 5 and the criteria in Section 6.2. This evaluation process helps determine whether they are suitable aquatic reserve sites.

The Aquatic Reserves Program uses information gathered from scientific literature, new scientific research, and information described by nominating parties to evaluate sites as aquatic reserves. The Technical Advisory Committee consists of people external to DNR with expert knowledge of topics pertinent to establishing and managing aquatic reserves that assist in analyzing the proposed reserves.

The program relies on a two-year designation cycle. DNR receives and evaluates applications according to the time frame in Table 1 in Section 3. Once a reserve site has been identified, a management plan written, and SEPA review of the plan is completed, a Commissioner's Order designates the site as an aquatic reserve. The ability to establish new aquatic reserves is contingent upon funding allocation for the program and Program Administrator, and upon receiving at least one reserve nomination that meets the designation criteria described in Section 6.2.

The development of a successful aquatic reserve proposal relies on coordination and consultation with government entities, Tribal governments, the local community, interest groups, and natural resource users who have an interest in the site.

Creating Changes to a State Aquatic Reserve

Proposals to change boundaries and reserve classifications are to be reviewed by the Technical Advisory Committee. Changes to reserve boundaries and classifications are proposed, evaluated, and determined through the same process for designating reserves. Changes to an existing state aquatic reserve are formalized through a Commissioner's Order.

De-listing Aquatic Reserves

A proposal to de-list an existing state aquatic reserve is to be reviewed by the Technical Advisory Committee. De-listing of a reserve is proposed, evaluated, and determined through the same process as that used for designating reserves. De-listing of an existing aquatic reserve is formalized through a Commissioner's Order.

Section 3

Aquatic Reserve Application Process

DNR uses the following application process to evaluate a proposed aquatic reserve site, to make changes to an existing reserve's boundaries, or to de-list an existing aquatic reserve. Members of the public, non-governmental organizations, Tribes, and local, state, and federal government entities are eligible to submit proposals to DNR to establish an aquatic reserve. DNR staff also may submit proposals for aquatic reserve designation.

Table 1 identifies the steps and timeframes in the application process. The application process will be initiated every two years (subject to change). The important dates are subject to change based on the time it takes to complete each step.

Table 1. Aquatic Reserve Application Steps

STEPS	IMPORTANT DATES*
1. Call for proposals issued by DNR.	*June 1, (year 1)*
2. Letters of intent due.	*July 30*
3. DNR sends request to proponent to submit a complete proposal. DNR decides on the number of reserves to be reviewed for the biennium.	*September 1*
4. Deadline for submitting detailed proposals. Internal review begins.	*November 30*
5. Internal review completed.	*January 15*
6. Open house review of site proposal	*March 1-May 31*
7. Technical Advisory Committee review begins.	*July 1 (year 2)*
8. Technical Advisory Committee review completed.	*September15*
9. DNR staff submits recommendations for further action: Commissioner of Public Lands reviews and selects sites for continued planning and SEPA process.	*October 15*
10. Begin development of draft aquatic reserve management plans. Site- specific SEPA and management planning initiated.	*November 1*
11. SEPA review completed.	*November (year 3)*
12. Commissioner's Order(s) signed.	*January*

* These dates are tentative and may change.

3.1 Call for Proposals

The formal cycle for considering letters of intent for establishing new aquatic reserves, changing an existing aquatic reserve, or de-listing an existing aquatic reserve, is proposed to begin in June of every other year. To issue a call for letters of intent to make any of these proposals, DNR will use a press release or other form of public notice, as well as targeted solicitation from staff. Specific regional and habitat protection priorities also may be established by DNR for an application cycle. These priorities will be identified in the request for proposals.

3.2 Letter of Intent

The first step in proposing a site as an aquatic reserve is for the proponent to submit a letter of intent to DNR. Interested parties, including members of the public, non-government organizations, Tribes, local agencies, state agencies (including DNR), and federal entities wishing to submit applications, must submit a letter of intent to the (DNR) Aquatic Reserves Program Administrator. It is recommended that interested applicants with limited organizational or funding resources work with DNR and other government agencies, private organizations, universities, educational facilities, and others to ensure adequate information is gathered to support their proposal. The letter of intent needs to contain at a minimum the following information about the site:

- Specify whether you are proposing to designate, de-list, or modify a reserve.
- A description of the location and approximate acreage of the proposed area.
- A map of the site and its surrounding area.
- To propose a new aquatic reserve:
    1. Identify the project proponent(s).
    2. Identify what type of reserve is being proposed (environmental, scientific, educational).
    3. Explain why the area should be protected as an aquatic reserve.
    4. Describe the special features of the site and the aquatic resources that are being emphasized for conservation.
    5. Describe who the managers (if other than DNR) would be.
    6. Indicate the level of local, public, governmental, and tribal support for reserve status (include letters of support if possible).
    7. Confirm that the site is in state ownership (DNR can assist).
- To propose to de-list an existing aquatic reserve:
    1. Identify the type of reserve, when it was established, and features identified for protection.
    2. Explain why the site should be removed from the Aquatic Reserves Program.
    3. Indicate the level of local, public, governmental, and tribal support (as appropriate) for removal of the site from the Aquatic Reserves Program (include letters of support if possible).
- To propose to change the features or boundary of an existing aquatic reserve site:

1. Identify the project proponent(s).
2. Identify the type of reserve, when it was established, and the features identified for protection.
3. Describe the features and or boundary changes you are proposing and why.
4. Describe who the managers would be (if other than DNR).
5. Indicate the level of local public, governmental, and tribal support for changes to the existing reserve (include letters of support if possible).
6. Identify ownership (if changing boundaries).

(NOTE: The letter of intent form can be found at www.dnr.wa.gov/htdocs/aqr/reserves/home).

This introductory letter initiates an exchange of information between DNR and the proponent and helps determine the potential of the proposed site as a state aquatic reserve.

DNR works with a proponent to make sure that the letter of intent contains the necessary information. Upon review of all completed letters of intent, DNR staff determine which proponent(s) are invited to submit a full proposal for consideration.

The invitation to submit full proposals includes clarification of the limit of aquatic reserve applications DNR will review during the cycle.

Notification to Interested Parties

When DNR determines which proponent(s) are to be invited to develop and submit a full proposal, DNR staff will notify the following parties:

- Tribal governments with legal treaty rights or cultural interests within the area.
- Local government jurisdictions.
- Appropriate state and federal agencies with management or jurisdictional authority.
- Any other government or non-government agency, interest groups, or the general public.

Re-submitting Proposals

To re-submit a site to DNR for consideration as a new reserve, or to change boundaries of a recently established reserve, or re-establish a site recently de-listed, a proponent must demonstrate to DNR that additional information is available that warrants reconsideration of the site.

The only exception to this requirement would be re-submission of a proposal that had been rated highly by the Technical Advisory Committee in a previous evaluation cycle but was not designated due to limited DNR resources.

3.3 Proposal and Project Evaluation Information

In order to be considered, a full proposal needs to include the site-specific information outlined in the application form in Appendix A. The application questions in Section 1 of Appendix A, direct the applicant to provide the information on the site in the order and context of the evaluation criteria that is used by the Technical Advisory Committee to evaluate the site as discussed in Section 6. In addition, a proposal for scientific or educational reserves also needs to include answers to the questions in Section 2 or Section 3 of Appendix A respectively. A proponent needs to include references to support the information presented in the application.

Section 4

Aquatic Reserve Proposal Evaluation Process

DNR conducts a preliminary review of the proposals for completeness, taking the questions below into consideration. If the proposal is incomplete, staff informs the proponent about what information is still needed and works with the proponent to complete the application information. Staff may conduct site visits and consult with the appropriate governments, Tribes, and others regarding the feasibility of the proposal. If DNR determines that aquatic reserve status may not be the appropriate designation, the applicant is informed that the proposal will not be considered, and, when possible, is provided with recommendations for other alternatives.

4.1 Proposal Evaluation and Ranking

A complete aquatic reserve proposal includes written answers to the questions on the Site Proposal Application (Appendix A). Those questions, which parallel the reserve criteria in Section 6.2 and the site evaluation questions used by the Technical Advisory Committee (Appendix I), are derived from the preferred alternative (Alternative 1) in the Final EIS.

4.1.1 DNR Staff Preliminary Review

DNR staff review the completed applications for the following information:

- Is the application complete based on the requirements of the Site Proposal Application (Appendix A)?
- Has the proponent coordinated and consulted with local jurisdictions, Tribes, government entities, local landowners and other pertinent organizations or people?
- Is the proposed site on state-owned aquatic land? Does the proposal require land transfers, acquisitions, and/or cooperation from adjacent landowners?
- Has the area been adequately characterized, including a description of the condition and presence or absence of special features? What type of information was used to characterize the site (scientific, anecdotal)?
- Are there local issues or conflicts occurring at the site? Does the area or adjacent areas include current or proposed uses that conflict with the goal of the reserve program or the proposed reserve's objectives?
- What are the anticipated impacts of the proposed site being placed in reserve status?
- Has all relevant data for the site been included in the proposal?

After the preliminary review is completed, DNR staff present the list of proposed reserve sites to the Aquatics Program management team, and inform the Commissioner of Public Lands of the nature of the application pool. At that time, DNR will make a final determination as to the number of reserves that can be evaluated during the cycle, based on available funds, resources, and general quality of the proposals.

4.1.2 Open House Public Meeting

After the Commissioner of Public Lands directs the Aquatic Reserve Program Administrator to proceed with review of site proposals, DNR staff in cooperation with the site proponent conduct an open house public meeting to present an overview of the Aquatic Reserves Program and share the site-specific information collected to date to support the proposal. The meeting provides the public an opportunity to offer additional information to be included in the evaluation of the site. The public also has a chance to ask questions and discuss the Aquatic Reserves Program with DNR staff and the reserve proponent.

4.1.3 Aquatic Reserve Technical Advisory Committee

An aquatic reserve Technical Advisory Committee is established for each evaluation cycle. The qualifications for committee members include the following (and are described in Appendix I):

- Advanced degree and professional experience in a related field.
- Limited professional affiliations with DNR.
- Time commitment to complete the duties of the Committee.

Committee members review, evaluate, and rank nominated sites for the Aquatic Reserves Program and make recommendations to the Commissioner of Public Lands for further consideration and action.

The committee evaluates each proposal using the site evaluation forms in Appendix I and the criteria in Section 6 as guidance.

Technical Advisory Committee Site Visits

In coordination with DNR staff, each proponent of a site under consideration is required to organize a site visit for the Technical Advisory Committee. The site visit offers the committee an opportunity to see the site with the proponent and review the features of their proposal in context.

Evaluation Criteria

Each site proposal (Environmental, Scientific, and Educational) is evaluated based on the general reserve criteria discussed in Section 6.2. Each question addressed by the proponent in their proposal is related to specific evaluation criteria that will

guide the committee in evaluating how well each reserve proposal meets the Aquatic Reserves Program's goals and objectives. In addition to reviewing, evaluating, and ranking the proposals, the Technical Advisory Committee discusses the merits of different proposals, including, if appropriate, a statement of why a proposed area should not be considered for reserve status.

In addition, proposals for scientific reserves are evaluated based on the scientific reserve criteria discussed in Section 6.3, while proposals for educational reserves are evaluated using the educational reserve criteria discussed in Section 6.4.

4.1.4 DNR Staff Recommendation and Commissioner of Public Lands Review

Following evaluation by DNR staff and the Technical Advisory Committee, DNR provides a final list of reserve nominations to the Commissioner of Public Lands that includes the following information:

- DNR staff review summary
- Review of Aquatic Reserves Program goals and objectives
- Evaluation of available DNR resources (staff and budget) to plan and implement new reserves
- Summary of the committee rating, evaluation, ranking, and recommendations.
- Identification of potential conflicts with other current or projected uses of the nominated reserve site.

The Commissioner evaluates the nominations based on the above information. If the Commissioner accepts one or more nominations, staff is directed to develop management plans as appropriate, and to perform site-specific SEPA review of the selected proposals.

Photo by Sunny Walter

Section 5

Aquatic Reserve Designation Process

Proposal evaluations are the primary information collected to determine whether a site should be designated as a state aquatic reserve. The site designation triggers some limited protection for the site by withdrawing it from any potentially harmful leasing activity for a period of 90 years. It is important to note that designating a site as an aquatic reserve does not imply that commercial or other human activities are prohibited. Rather, its status is intended to ensure that human use is held at levels that are ecologically sustainable by restricting activities to those that are compatible with the reserve goals (Final EIS 3.2.1.4.2). DNR also works with educational and research institutions to encourage the use of aquatic reserve sites for educational experiences and research projects. Additionally, the agency may develop educational and outreach materials regarding individual aquatic reserves, the ecological functions they support, and the best management practices associated with those reserves.

The effectiveness of the Aquatic Reserves Program depends, in part, on the successful partnership with state, Tribal, and local resource managers and stakeholders in developing management plans for each individual site. Therefore, while the boundaries of state aquatic reserves are limited to areas under state ownership, DNR works with adjacent landowners and regulators on issues and ecological concerns that extend beyond reserve boundaries, but affect reserve resources.

5.1 Site Specific Management Plans

DNR, with the assistance of the proponent, develops a draft management plan for the selected proposal. Specific elements of a reserve management plan depends on the type of reserve, recommendations from DNR staff, the reserve proposal, pertinent jurisdictions and user groups, and the input from the Technical Advisory Committee. A management plan, at a minimum, addresses how management decisions and other activities are to be administered at the site.

5.1.1 Management Plans for Environmental Reserves

Management plans for environmental reserves should:

- Be based on habitat and species considerations, restoration and recovery efforts, and cultural resources.
- Have adequate protection to preserve and improve biodiversity and ecosystem function.

- Include coordination with other entities with jurisdiction, treaty rights, adjacent landowners, and others with legal rights to use the area.
- Include adequate protection of cultural resources, where applicable.
- Limit activities to those that will not negatively impact the habitats and species identified for conservation.
- Ensure that lease activities implement measures to primarily serve the objectives of an environmental reserve.

5.1.2 Management Plans for Scientific Reserves

Management plans for scientific reserves should:

- Be based upon the potential to conduct biological research and the need to protect these areas in a relatively undisturbed state.
- Have adequate protection mechanisms to ensure continuity of the site's features by reducing external ecological concerns and disturbances and allowing for natural disturbance regimes.
- Allow for some manipulation in areas stable enough to withstand alteration, for the benefit of scientific research. Other scientific reserves should be managed as un-altered sites to measure their natural variability or to compare as a control site to altered or impacted sites.
- Include coordination with other entities with jurisdiction, treaty rights, adjacent landowners, and others interested people and organizations.
- Limit access to scientific reserves to those individuals conducting approved research. Mechanisms should be established to ensure limited access.
- Establish guidelines for approved research activities, the length of research, mitigation, and the sharing of data.

5.1.3 Management Plans for Educational Reserves

Management plans for educational reserves should:

- Be based upon the unique physical features of the site that enhance environmental protection through public awareness and provide environmental education opportunities.
- Have adequate protection to ensure the longevity of the site, and its features, to provide ongoing opportunities for education into the future.
- Allow for some manipulation of a site in areas stable enough to withstand alterations, for the benefit of education or public access.
- Include coordination with other entities with jurisdiction, treaty rights, adjacent landowners, and others interested people and organizations.
- Include access and information on site to reach a wide audience. The facilities and staffing necessary to support the reserve must be managed and maintained.

- Ensure that lease activities are consistent with the objectives of the education reserves and that lessees implement measures to primarily serve the objectives of the education reserves.

5.1.4 Monitoring Considerations

Monitoring for state aquatic reserves is to be based on the site-specific reserve objectives and performance measures. A monitoring plan must be developed to observe and record the conditions of the resources and the natural and human-induced changes. Monitoring activities are typically sorted into the following three categories:

- **Implementation Monitoring** – Measures the extent to which activities are carried out as planned.
- **Effectiveness Monitoring** – Measures the effectiveness of the planned management actions in meeting the explicit conservation objectives for the site.
- **Validation Monitoring** – On the ground evaluation of the site's habitat, populations or other features of interest, and examines the appropriateness of the assumptions used to develop the management strategy for a specific site.

It may not be appropriate for all aquatic reserves to implement a monitoring strategy. The decision to implement a monitoring plan and the monitoring actions and strategy is to be made jointly by the management partners. The decision is to be based upon the features and objectives of the reserve, available funding and resources, and feasibility of monitoring actions at the site.

5.1.5 Other DNR Management Actions

General Lease Management Considerations

When considering a lease within or adjacent to an area that is under consideration as an aquatic reserve, DNR land managers are to follow the ***Interim Management Guidance*** in Appendix H.

The exact types and conditions for future leasing activities that are authorized or prohibited within state aquatic reserves will be established in the final site-specific management plans. Leases that are not consistent with the conditions of that aquatic reserve's management plan are not permitted.

In addition to the site-specific management plan, DNR land managers are to use the following general management considerations when reviewing new or renewed authorizations within and adjacent to a reserve:

Use Authorizations

To meet the purpose of the aquatic reserve program and achieve the specific goals and objective for the reserve, the basic principles below will be applied by DNR for existing, pending, and future proposed use authorizations within the reserve. The activities must:

1. Primarily serve the objective of the reserve,

2. Reduce site-specific impacts over time,
3. Monitor impacts, and
4. Apply adaptive management strategies

Use authorizations that were granted prior to the establishment of the reserve are honored throughout the duration of the current leasing period. Modifications or extensions to such leases are evaluated for compliance with reserve objectives and site management plan.

DNR supports maintenance and facility upgrades that serve to implement the objectives of an aquatic reserve.

Guidelines for Establishing Aquatic Reserves in Harbor Areas and State-owned Waterways

Establishing state aquatic reserves in harbor areas could be inconsistent with the specific uses for which harbor areas are established. Article XV, Harbors and Tide Waters of the Constitution of the State of Washington, states that harbor areas "*shall be forever reserved for landings, wharves, streets, and other conveniences of navigation and commerce.*"

In addition, establishing aquatic reserves in state-owned waterways could be inconsistent with the specific uses and priorities for which state waterways are established, as described in RCW 79.93.010.

Appendix G provides alternatives for establishing aquatic reserves in existing harbor areas and state-owned waterways. Any changes to a harbor line boundary or status of a state-owned waterway could be viewed as part of the site-specific SEPA process for a proposed reserve site.

5.2 SEPA and Site-Specific Public Review

Once a draft management plan for proposed reserve has been developed, it goes through public review under the State Environmental Policy Act (SEPA).

DNR staff and the project proponents develop a SEPA checklist for each proposed reserve, or for a change to an existing reserve, consistent with the programmatic EIS developed for aquatic reserves. In accordance with SEPA, if it is determined from review of the environmental checklist that the reserve proposal could result in significant adverse environmental impacts, DNR prepares a site-specific supplement to the Final EIS; the public has an opportunity to review and comment on all proposals. As part of the site-specific SEPA process, a review is conducted for any changes proposed for harbor areas or state-owned waterway boundaries.

5.3 Commissioner's Order

Upon completion of SEPA review, the Commissioner of Public Lands formally establishes a reserve through the issuance of a "Commissioner's Order" withdrawing the lands from general leasing and designating them as an aquatic reserve. The language in the Commissioner's Order includes references to the management plan and other specific lease limitations that have been established for the reserve. The Commissioner's Order establishes aquatic reserve status for

90 years, at which time the site is re-evaluated to determine if its reserve status should be continued for an additional 90 years.

5.4 Program Implementation

Once an aquatic reserve is established, DNR land managers apply management guidance described in the site-specific management plan in order to evaluate what uses are appropriate within and adjacent to the reserve. DNR manages the site and prevents unauthorized uses. DNR staff will coordinate with the partners identified in the aquatic reserve's management plan for the implementation of the management actions identified in the plan.

5.4.1 Cooperate with Managers and Stakeholders

The ability of DNR to fully realize its goals and objectives is influenced by many factors outside of DNR's direct control. Therefore, DNR works with partners, including government agencies, Tribes, academic institutions, non-governmental organizations, individuals and stakeholders, to select and manage aquatic reserves.

5.4.2 Adaptive Management

Protecting the best available sites during each application cycle may fail to adequately achieve the Aquatic Reserves Program goals and objectives. Therefore, calls for aquatic reserve proposals are guided, in part, by the success of the Aquatic Reserves Program in achieving the program goals and objectives (Section 2.1.1) and specific objectives (Section 2.2). The progress of the program in meeting its goals and objectives will be determined as reserves are established, and 10-year reviews and updates of specific aquatic reserve management plans are conducted.

Photo by Tom Stilz

Section 6

Aquatic Reserves Ecological Framework and Criteria

The ecological framework is the scientific foundation of the Technical Advisory Committee criteria form (Appendix I) used to review candidate aquatic reserve sites. The framework provides the criteria for educational, environmental, and scientific reserves, and detailed scientific discussion about those criteria that are discussed in Section 3.2.1.3.5 of the Final Programmatic EIS.

Prospective applicants should reference the ecologic framework when developing an aquatic reserve site proposal application (Appendix A) in order to meet the Aquatic Reserves Program goals and objectives.

6.1 Ecological Framework

The ecological framework supports the criteria used for evaluating aquatic reserve proposals and, in the long-term, building a system of aquatic reserves. The ecologic framework helps ensure that reserve selection and management are based on sound science.

In designing reserves, the scale and size of sites need to be appropriate to the goals and objectives for the sites. Since different regional conservation targets are at distinctly different scales, DNR incorporates a hierarchical approach into the site selection process and in building a reserve system. DNR considers hierarchical at the following five scales:

1. **Individual** – A specific animal or plant residing at a site, such as Dungeness crab or bull trout.
2. **Population** – A group of individual organisms belonging to a single species that is endemic to an area, such as Pacific herring.
3. **Community** – Trophic interactions of species assemblages with regular joint occurrence and subject to common environmental influences. For example, an eelgrass community including plants, epiphytes, zooplankton, and fish known to be frequently associated with eelgrass beds.
4. **Ecosystem** – A community of organisms and their physical environment interacting as an ecological unit.
5. **Landscape** – Large-scale biogeographic regions that define watersheds or hydrologic units (Figures 3 and 4).

6.1.1 Landscape level structure

The Aquatic Reserves Program seeks to conserve aquatic resources across both marine and freshwater regions. The larger landscape scale provides an underlying structure for conservation planning. This scale can be effectively defined through

the development and application of aquatic biogeographic regions across the statewide aquatic landscape. A regional breakout is based upon the extent of fresh and marine water mixing and/or the locations of sediment source material and sediment deposition. Figures 3 and 4 depict biogeographic regions of Washington State. Due to differences in the function and characteristics of freshwater and marine aquatic systems, different methods are used to identify biogeographic regions in freshwater compared to marine waters.

The main ecological unit of large-scale freshwater systems is the major watershed or drainage basin.

The main ecological units of large-scale marine systems are defined by oceanographic conditions, such as energy, salinity, temperature, upwelling, currents and the mixing of fresh and marine waters and the regional biological diversity supported by these conditions.

Freshwater regions

For freshwater systems, classification is by watershed (hydraulic) sub-region or unit (USGS 1979). These sub-regions are created by river systems but may include a river reach and its tributaries, a closed basin or basins, or a group of streams forming a coastal drainage area (Seaber et al. 1987). A sub-region may include one or several individual watersheds, depending upon local or regional topography.

A total of eight sub-regions are found in Washington State (Figure 3). Because hydraulic sub-regions are based on watershed characteristics, they are appropriate units for the conservation planning of aquatic systems. Currently, many local and regional conservation and restoration efforts are organized around watershed planning units, based upon the (watershed) hydraulic sub-regions described in this guidance document.

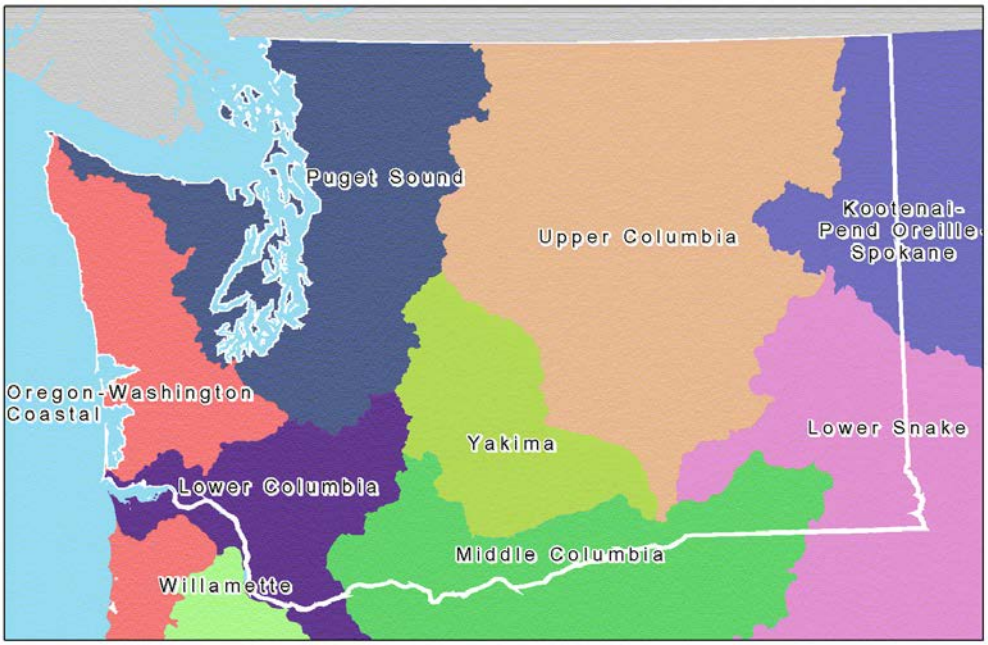


Figure 3: Freshwater Biogeographic Regions of Washington State **(USGS 1979)**

Marine regions

At the landscape scale, Washington's marine ecosystems are defined primarily by the influences and mixing of specific freshwater systems with marine waters. Three primary marine regions in Washington are identified by oceanographic and species observations.

- **Columbia River Littoral Cell—**defined by the movement of sediments in the Columbia River from their source to their point of deposition, this is a region extends from the Columbia River estuary northward to North Beach. This region encompassing approximately half of the outer Washington State coastline (Peterson et al. 1991), and includes the Columbia River Estuary, Willapa Bay and Grays Harbor. Each receives important sandy sediments from the Columbia River.
- **Olympic Coast**—North Beach northward to the entrance of Neah Bay. This region is distinct, as it is influenced by the Pacific Ocean with no large freshwater discharges to the region.
- **Puget Sound** "inland sea" of Washington— extending from Neah Bay eastward and into Puget Sound. In order to have a common reporting template for monitoring results at a sub-basin scale (PSWQAT 2002), this inland sea is divided into nine sub-basins which are defined primarily by oceanographic zones and sills (Ebbesmeyer et al.1984). These nine sub-regions are: West Strait of Juan de Fuca, East Strait of Juan de Fuca, San Juan Archipelago, Strait of Georgia, Whidbey Basin, Admiralty Inlet, Hood Canal, Central Puget Sound, and South Puget Sound (Figure 4).

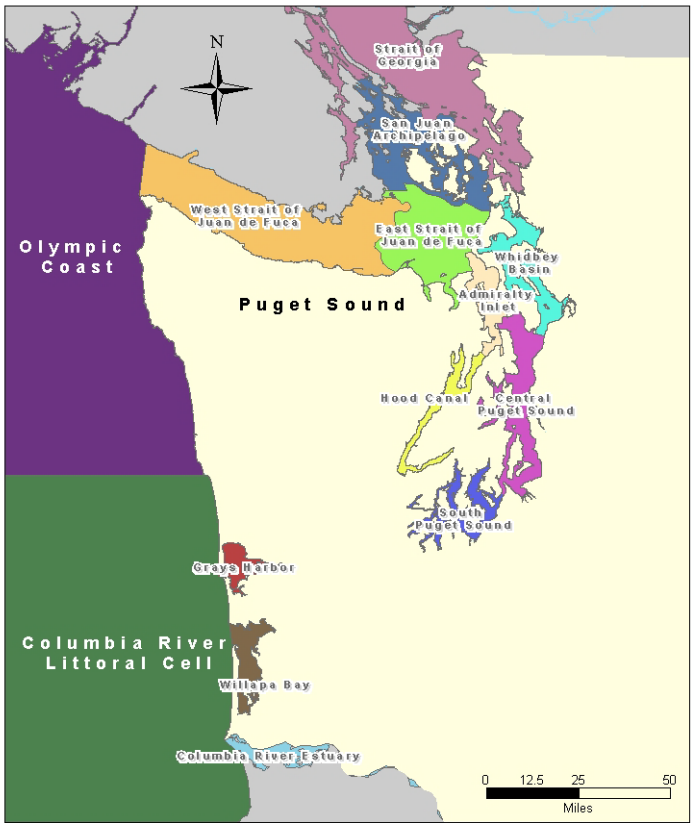


Figure 4: Marine biogeographic regions of Washington State (Ebbesmeyer 1984)

6.2 General Reserve Criteria

6.2.1 Ecological Criteria

The overall intent of the following series of criteria is to capture sites that exhibit high ecological quality and can enhance the management of aquatic resources in a manner consistent with Aquatic Reserves Program goals. Whether a site is proposed as an environmental, scientific, or educational reserve, it must meet this basic set of criteria to qualify as a state aquatic reserve. The evaluation of an environmental reserve relies entirely on the application of the general reserve criteria described in this section, while 'educational' or 'scientific reserve' proposals are evaluated using additional criteria described in sections 6.3 and 6.4 respectively.

Site Condition

- **Among equivalent proposed sites, DNR is to select the more pristine site.**
- **Less pristine sites may be selected if they aid in the restoration of strategically important aquatic habitats within the overall ecosystem.**

Discussion: Since very few ecosystems have avoided direct human influence and degradation (Vitousek et al. 1997), we lack a fundamental understanding of the historic natural condition. Therefore, it is important to act upon conservation opportunities using the precautionary approach until our understanding of these areas develops further (Sloan 2002). Applying this principle to aquatic reserve design suggests that sites that are fully functional and in relatively good condition have a higher conservation value. They are more predictable in their behavior and more resilient to minor insults than heavily degraded sites.

Among equivalent sites, DNR selects the more pristine site. However, this program has been developed in part to aid in the restoration of important aquatic habitats. It is recognized that the program likely will be applicable to sites that are undergoing intensive restoration. Where proposed reserves include a substantial restoration plan, the restoration plan should be included as an addendum to the proposal.

Biogeographic Representation

- **Sites are selected to distribute conservation efforts and ensure protection of aquatic habitats across aquatic biogeographic regions.**

Discussion: Representation of all biogeographic regions is a prerequisite for protection of biodiversity because assemblages of species will vary by region (Ballantine 1997). The Aquatic Reserves Program uses aquatic biogeographic regions to help make decisions that distribute conservation efforts and help ensure the protection of aquatic habitats across the diversity of habitats found in Washington State. However, it is important that reserve sites within a bioregion are sited in close proximity to each other (Rebelo and Sigfried 1992;Turpie and Crowe 1994).

Habitat Representation

- **Sites are to protect the majority of habitats at a level proportional to their abundance in a given biogeographic region.**
- **Sensitive, important or diminished habitats are targets for protection and may be over-represented in the reserve network when compared to the current distribution and abundance of habitats.**
- **Man-made, artificial, or altered habitats are not direct targets of conservation efforts, but may be included in reserves as restoration areas or as areas that conserve relict portions of the ecosystem.**

Discussion: Marine and estuarine habitats are classified according to Dethier (1990) or a similar habitat classification system. Many marine shoreline resources have been inventoried using the ShoreZone classification method (Berry et al. 2001), which is compatible with Dethier (1990).

Until such efforts are undertaken for freshwater habitats, DNR relies on the Cowardin et al. (1979) classification system. This classification system distinguishes major systems by a variety of hydrologic, geomorphologic, chemical, and biological characteristics. An overview of the habitat classes for riverine and lake (lacustrine) systems is provided in Figures 5 and 6.

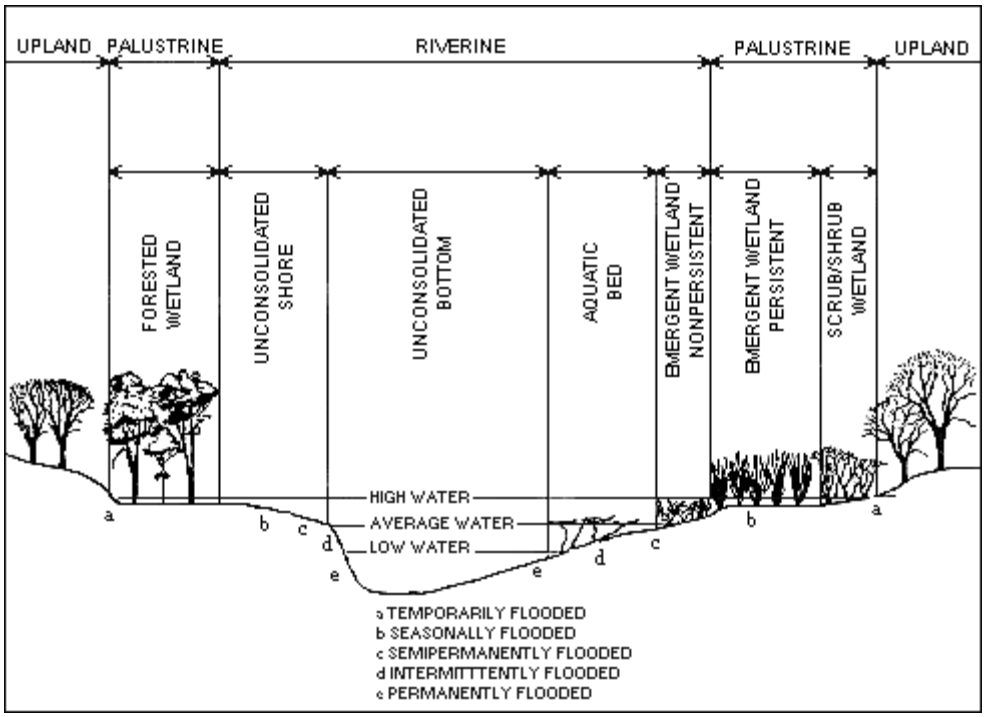


Figure 5: Distinguishing features and examples of habitats in Riverine Systems (Cowardin et al. 1979)

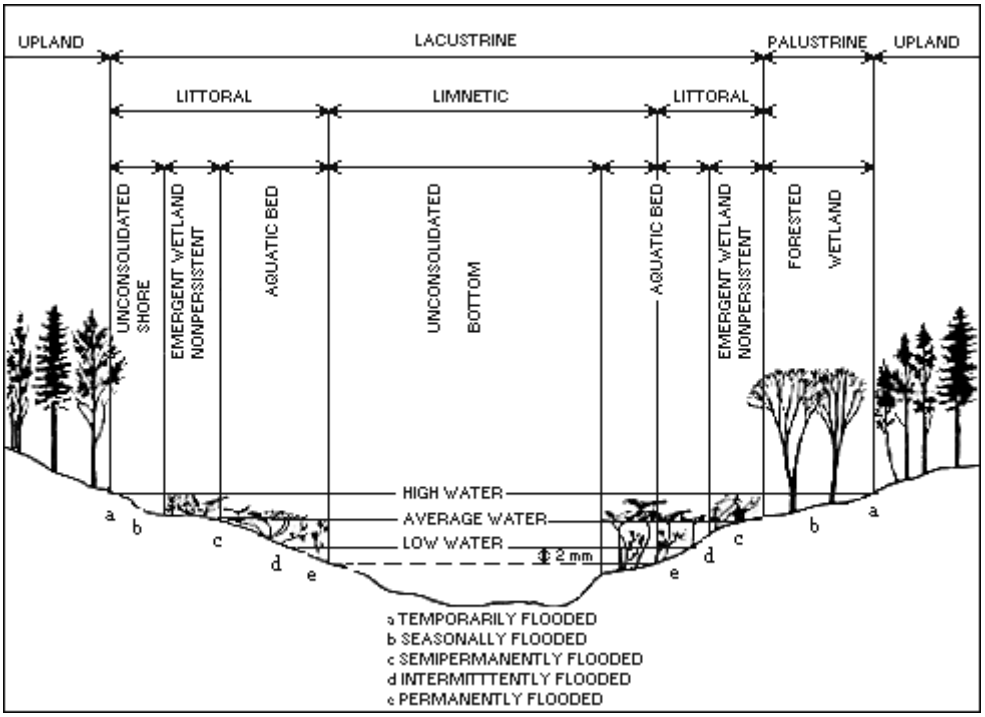


Figure 6: Distinguishing features and examples of habitats in lake (lacustrine) systems (Cowardin et al. 1979)

In the long term, the Aquatic Reserves Program would benefit from the collection of data following the hierarchical classification framework for freshwater ecosystems developed by The Nature Conservancy (Figure 7). This framework describes and predicts biological community diversity and distribution (Lammert et al. 1997). It characterizes aquatic ecosystems in abiotic (i.e., geologic, climatic, spatial) and biotic (i.e., biological) terms. Biological communities are nested within the following four spatially hierarchical levels. These levels, described in Table 2, range from the coarsest to the finest in scale:

- Ecoregional province
- Ecoregional section
- Macrohabitat type
- Habitat unit type

This classification system provides a standard way to describe the range of physical characteristics associated with each biological community type and to distinguish between ecological units that contain potentially distinct community types (Angermeier and Schlosser 1995).

The quantities of each type of habitat are to be assessed for their historic relative abundance within each biogeographic region, and a running tally of habitats in protected status are to be established. As the number of sustainable habitats found within a single reserve site increases, so does the value of the site as a reserve. Increased habitat diversity improves the ability of reserves to meet the overall reserves program objectives of protecting representative amounts of natural habitat. Furthermore, reserves that protect many types of habitat are more likely to support multiple life stages of target species (Appeldoorn et al. 1997).

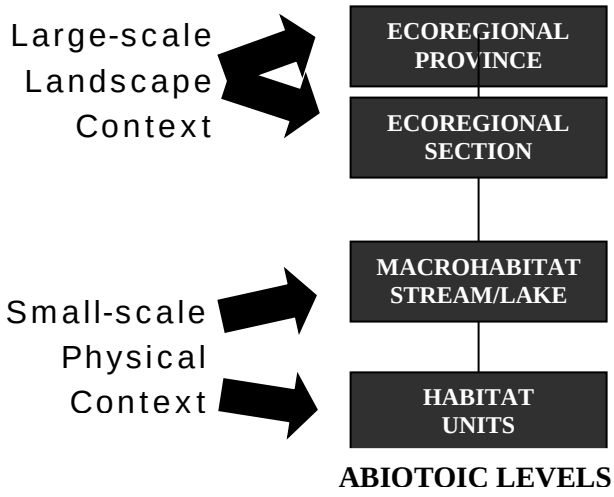


Figure 7: The Nature Conservancy's aquatic community classification framework.

Level	Description	Key Variables
Ecoregional Province	Large areas of similar climate corresponding to a broad vegetation region.	Climate General physical characteristics of the vegetation
Ecoregional Section	Areas of similar physiography within Ecoregional Provinces.	Landform Geology
Macrohabital Type	Types of small to medium-sized lakes or lake basins, and valley segment types of streams. Note: lake, riverine, and nearshore ecosystems are treated separately.	Surficial geology Local physiography Size, shape, and network position
Habitat Unit Type	Distinct subunits of macrohabitats that capture the physical variability.	Depth and light penetration Velocity (riverine) Substrate

Table 2. Definitions and key variables for each classification framework level

Biodiversity within a site

- **Habitat biodiversity should be factored when promoting a site as part of a reserve network.**

Discussion: Sites with the highest biodiversity per unit area provide a mechanism for conserving a maximal amount of our aquatic natural heritage. A danger in focusing protection efforts on areas with high "observed" biodiversity is that areas with intermediate habitat quality are known to frequently harbor high species richness, even though they may be dominated by cosmopolitan or invasive species (Rapoport et al. 1986). In identifying areas of high biodiversity we must also account for:

- Natural increases in biodiversity associated with larger areas due to species-area effects, and
- Natural differences in biodiversity between biogeographic regions.

In marine ecosystems, representative examples of most species can be captured in a relatively small number of larger reserves. Freshwater habitats exhibit considerably high diversity due to large differences in species composition between the various river and lake systems. Therefore, in freshwater systems, DNR may expect to develop a reserve system consisting of a relatively larger number of smaller reserves in order to capture viable examples of most species and habitat types.

Site Size

- **Sites are to be of sufficient size to provide for internal recolonization of species in response to natural disturbances.**
- **Proposed reserve sites should be large enough to capture entire habitats of interest, including eelgrass beds, kelp beds, stream reach, riparian area, or other aquatic habitats.**
- **When possible, reserve sites should include buffers surrounding species populations and habitats of interest.**

Discussion: Providing clear guidance on aquatic reserve size is difficult, due to the trade-offs associated with increasing size. There is no single size, scheme of management, or means of protection that is universally applicable to all aquatic reserves. The appropriate size, management scheme, and means of protection depend upon the purpose for which a reserve is to be established.

Since reserves often act like habitat islands in a sea of habitat degradation, larger and more numerous connected reserves tend to be particularly beneficial for preserving species diversity (Diamond 1975, Simberloff and Abele 1976). Research in marine habitats suggests that the preservation of discrete fragments of habitat within larger areas of degraded habitat could provide significant conservation benefits (McNeill and Fairweather 1993). However, social, political, and economic forces tend to create smaller, less numerous and highly dispersed reserves. An important goal for all reserves is to be of sufficient size to provide for internal recolonization of species in response to natural disturbances (Pickett and Thompson 1978).

Models suggest that highly mobile species decrease the effective size of reserves (Boersma and Parrish 1999). Reserves targeting species that are more mobile should be larger than those focused on protection of sedentary or sessile organisms. Thus, setting the minimum reserve size will vary depending upon the specific species or habitats the reserve is designed to conserve. Sites should be large enough for plant and animal populations to be self-supporting. Larval studies suggest that sites less than one square kilometer in size are likely to export most larval production (Figure 8), and therefore are unlikely to receive recruitment benefits from habitat protection (Kinlan and Gaines 2003). Whenever possible, sites should capture the full range of habitats used by animals throughout various life-history stages.

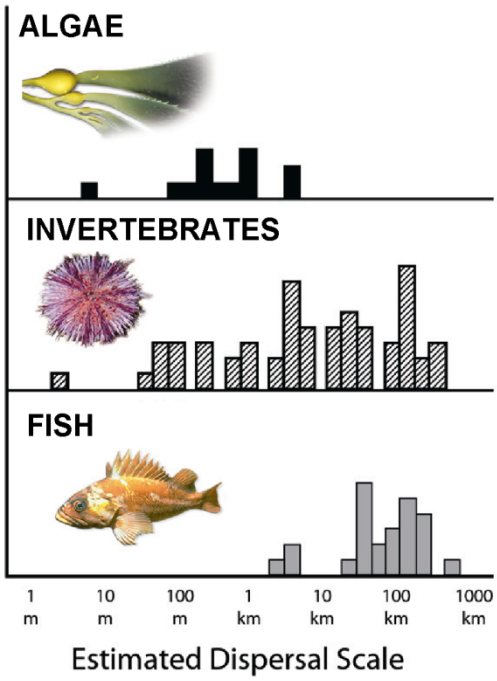


Figure 8: Estimated dispersal of algae, invertebrate and fish (adapted from Kinlan and Gaines 2003)

It is likely that the state Aquatic Reserves Program is best suited for sites that are hundreds to thousands of acres in size. Sites smaller than this range will likely require intensive management to maintain features of interest. This intensive management would raise costs while generating uncertain outcomes. Increasing reserve size increases the likelihood that the reserve network can capture and sustain entire ecosystem components.

Viability

- **Focal species and habitats are to be protected in multiple, spatially disjunct, but ecologically connected reserves.**

Discussion: Populations of large animals found within aquatic reserves are unlikely to be viable in isolation. However, wherever possible the reserves are to contain viable populations that are large enough to maintain populations despite random effects. When protecting sufficient habitat for larger animals in a single reserve is not possible, protecting many habitat patches may enhance the viability of populations (Roberts 2000). Therefore, the Aquatic Reserves Program is to seek proportionately more representations of habitats used by larger, more mobile target species.

A basic tenet of reserve design is that targets should be protected in different reserves (Ballantine 1997). In developing the Aquatic Reserves Program, DNR recognizes the important role of regulation and protection for aquatic resources. Multiple representation is particularly important in aquatic systems because such systems are naturally dynamic and prone to pulses of rapid change. Severe storms, floods, species invasions, and disease are among the natural catastrophes that can be expected to impact many aquatic reserves. Natural catastrophes tend to be unpredictable, and occur at temporal and spatial scales that are beyond the scope of this program's management. Reserves may be adversely affected by natural disturbances that are prolonged, extreme, rapid, or infrequent (Roberts et al.

2003). To mitigate for these potential impacts, sites should be large enough for internal replenishment. However, to avoid unintended consequences of natural catastrophes, it is also important to protect focal species and habitats in multiple, spatially separated, but ecologically connected reserves.

Ecological Connectivity

- **Ecological connectivity among reserves is important to support biodiversity within and beyond aquatic reserves.**

Discussion: An important consideration of reserve selection is the need to link between terrestrial and aquatic realms, as well as the links between aquatic realms. Conserving aquatic resources requires consideration of shorelines and upland areas (Salm and Clark 2000). In addition, since many aquatic species are highly mobile, and have different habitat requirements at different life stages, habitat connectivity is instrumental to successful reserve network design. Types of connectivity may include:

- Exchange of offspring, such as mating of individual members of a species, which improves gene pools for countering impacts of various kinds.
- Movement of juveniles and adults in breeding ground activities to sustain population viability.
- Transfer of materials, such as organic carbon (Roberts et al. 2003), and transfer of species to areas outside the reserve supports expansion of species' ranges and provides an advantage for resource gathering that could improve the health of sensitive species populations.

Individual sites managed through the state Aquatic Reserves Program are unlikely to protect sufficient territory to fully capture the range of habitats used by most species throughout their lifetimes. Cetaceans, salmonids, and pinnipeds are likely to spend a small portion of their lifetimes in any one reserve. However, the reserve network should support the ecological processes, habitats, and species that ultimately provide for the long-term survival of these species. Additionally, aquatic reserves can directly support the long-term survival of species by protecting areas used during sensitive life stages, such as haul-out areas and spawning beaches.

Variability in ocean currents, spawning seasons, larval life histories, and dispersal distances (from meters to hundreds of kilometers) makes it virtually impossible to obtain a single value to measure connectivity between sites for all taxonomic groups (Sala et al. 2002). Studies examining marine larval dispersal have identified at least two scales— distances of less than one and greater than 20 kilometers—in which reserves should be positioned relative to each other to support dispersal of aquatic larvae among reserves (Grantham et al. 2003). While recent studies have suggested that larvae may be traveling shorter distances than initially thought (Kinlan and Gaines 2003), reserves less than one square km in size are likely to support internal colonization for a limited portion of the ecosystem—primarily algae and some invertebrates. Most fishes and many invertebrates are believed to disperse more than 10 kilometers with a mean dispersal distance for fish species of approximately 100 kilometers (Figure 8; Kinlan and Gaines 2003). These taxonomic differences in dispersal emphasize the need to examine connectivity at multiple scales to adequately support metapopulation dynamics of aquatic species.

Species of Special Concern

- **DNR considers a species or subspecies "of special concern" if it is identified through population viability analysis to have a moderate to high probability of extirpation from Washington State over a 100-year planning horizon. A species found to have declined in abundance by 90 percent or more from historic levels within their (Washington) range are considered a species of special concern.**
- **Specific types of habitat receive special attention, including those that are rare, support high primary productivity, are known to support large numbers of animals, or support species of special concern.**

Discussion: Species of special concern include threatened, endangered, and sensitive species, as recognized by the state or federal governments. Species receiving similar designations by the provincial government in British Columbia or the federal government in Canada will also be considered. However, these lists are known to have taxonomic bias (Tear et al. 1995), as the listing or lack of listing of any one species may be limited by the understanding of a given species' needs. Therefore, this document provides additional guidance for the inclusion of species that may not yet be officially listed as conservation targets. DNR will consider any species or subspecies identified through population viability analysis, such as those found in Lande (1988), to have a 90 percent or greater probability of extirpation from Washington State over a 100-year planning horizon to be a species of special concern, regardless of its formal listing status. Additionally, any species found to have declined in abundance by 90 percent or more from historic levels within their Washington range are to be considered a species of special concern.

Unfortunately, population and distribution information is rarely kept for species that are not the targets of harvest fisheries. The Aquatic Reserves Program will work with other partners to further develop the capacity to collect and store species observations of abundance and distribution for both commercially important species and those that are not the target of harvest.

The Aquatic Reserves Program seeks to protect representations of all major aquatic habitats found in Washington. However, a few types of habitat will receive special attention in this program, including habitats that are rare, support high primary productivity, are known to support large numbers of animals, or support species of special concern – particularly during predictable aggregations. In addition, the Aquatic Reserves Program recognizes that habitats often occur in a range of successional stages and it will attempt to support that range of successional stages.

Vulnerable Habitats, Life Stages, or Populations

- **Sites protect those habitats that are used by species during vulnerable life stages.**

Discussion: A central role of the Aquatic Reserves Program is to protect habitats used by species during vulnerable life stages. Vulnerable life stages include periods of natural aggregation, such as during spawning, breeding, or migration as well as haul-out areas. River and stream mouths are especially sensitive areas for a number of reasons. First, species often 'hold' in the vicinity of stream and river mouths both before they enter the freshwater from the marine environment and before they leave the freshwater for marine waters. This

‘holding’ is often essential to the physiological adjustment necessary to transition from fresh to saltwater or vice versa. River and stream mouths also deliver nutrients to the marine environment leading to the development of relatively rare habitats that thrive in this high nutrient environment.

Ecosystem Processes

- **A reserve network supports important biological processes including spawning areas, migratory pathways, feeding areas, settlement, and concentrated feeding areas.**
- **The Aquatic Reserves Program maintains physiochemical processes and other ecosystem functions to sustain aquatic ecosystems.**

Discussion: Important biological processes to be captured within the aquatic reserves network include spawning areas, migratory pathways, feeding areas, holding areas, and concentrated feeding areas. Natural disturbance regimes, such as seasonal flooding and tidal action, sustain the structure and functions of regional aquatic ecosystems. Dynamic and sometimes destructive forces play an important role in structuring biological communities and habitats (Paine 1969). The natural organization of aquatic ecosystems, and particularly wetlands, is strongly influenced by dynamic disturbance regimes (White and Pickett 1985).

Unlike terrestrial ecosystems where ecological structure is strongly dominated by trophic interactions, the organization of aquatic ecosystems is strongly mediated by physiochemical and other environmental factors. Factors, such as river flow, sediment re-suspension, and circulation features, alter the scope and intensity of responses to either bottom-up (Boynton and Kemp 2000) or top-down (Alpine and Cloern 1992) controls on community and food web structure and production. Therefore, the Aquatic Reserves Program is to target the maintenance of physiochemical processes because of their essential role in sustaining aquatic ecosystems.

6.2.2 Socioeconomic Criteria

When balancing the environmental, educational, or scientific benefits of an aquatic reserve designation against the actual or perceived economic costs, “we are often left trying to balance the ‘good’ of ethics with the ‘goods’ of economics” (Morowitz 1991). Beyond the difficulties in assigning economic values to environmental features and services, it is often necessary to contrast what is financially beneficial to private individuals against what is broadly beneficial to society as a whole. Protected areas have a valuable economic characteristic—most of the benefits of a protected area can be “consumed” by one person without affecting the ability of another person to also benefit from the protected area (Munasinghe and McNeely 1992).

Cultural Resources

- **Aquatic reserves will support valuable cultural and archeological resources where appropriate.**

Discussion: Washington has a rich cultural history, a history that has been degraded and damaged by time, changes in climate and human disturbance. Cultural resources include a range of different resource types. These resources include archaeological remains and locations of continued traditional use of primary significance to Native Americans. While reserves are examined primarily

for their environmental attributes, reserve designation may be influenced by the presence of sensitive cultural artifacts or current uses.

As part of the protection and management of reserves, DNR promotes a greater knowledge base and understanding of cultural resources, tribal cultural practices, and significance of archaeological sites and place names.

By preserving and managing cultural resources in a sustainable manner, future generations may share in the understanding of regional archaeological and cultural sites. Furthermore, protection may provide opportunities for individuals and groups to continue to engage in culturally important practices.

Historic artifacts such as historic fishing villages or clam middens are potential indicators of the long-term importance of a site for environmental and cultural purposes. By identifying and protecting cultural artifacts, we also may provide opportunities for study and exploration of historical interactions between society and the environment.

Public Benefits

- **DNR is to provide a balance of public benefits.**

Discussion: Living marine resources provide essential economic, environmental, aesthetic, and other benefits. Management of aquatic lands is intended to "provide a balance of public benefits for all citizens of the state" (RCW 79.90.450). This balance requires DNR to consider all relevant values associated with a site. In some cases, the Aquatic Reserves Program will arbitrate or synchronize alternative uses for a site.

The values associated with a site include: direct use values, indirect use values, future option values, and non-use values.

- Direct use values would include consumptive (e.g., marina development or shellfish aquaculture) as well as non-consumptive (e.g., tourism or SCUBA diving) uses.
- Indirect use values are derived from the economic benefits associated with ecosystem services, such as wetlands purifying surface water, sediment transport (that has costs and benefits associated with it), oceanographic mixing (for instance, diluting and disbursing sewage), tidal action, etc.
- Future option values relate to potential future use of resources, such as components of the ecosystem that might be useful sources of food or medical products in the future but are not currently utilized. Option values could also apply to situations such as reserving an area for a future port for ships.
- Non-use values relate primarily to spiritual, cultural, and aesthetic values that individuals and cultures hold for the natural environment.

If aquatic reserve designation conflicts with current or projected uses of an area, analysis of the site's values are to be provided to the Commissioner of Public Lands to assist in a decision as to what use best serves the long-term public benefit.

6.2.3 Manageability Criteria

The effectiveness of reserves as a mechanism for conservation is highly dependent upon the quality of protection and management of the reserves (McNeely et al. 1994). To maximize the effectiveness of the state Aquatic Reserves Program, sites must be manageable and have clear boundaries that are transparent to potential users. Ecologically sound biological boundaries are difficult to identify in many cases due to the dynamic and transient nature of many aquatic habitats and species. Therefore, boundaries should tend to be ecologically conservative, capturing the target resources in addition to a buffer zone to account for unintentional encroachment on reserve boundaries as well as uncertainty regarding biological behaviors.

Ecological concerns

- **Management strategies are developed to address environmental impacts.**

Discussion: The Aquatic Reserves Program is designed to protect specific ecological features from degradation. Each aquatic reserve management plan must implement actions to preserve the viability of aquatic reserve and attain site specific and programmatic goals and objectives.

Management plans should identify sources, intensity, and manageability of environmental impacts to the site-specific ecological features that originate from within the reserve. However, reserve planning also must identify potential sources, intensity, and manageability of potential impacts that originate from outside of the reserve boundary.

Social/Political Acceptability

- **There is to be stakeholder participation in the proposal process, development of the management plan, and implementation of an aquatic reserve.**

Discussion: A lesson from other protected areas is that the active participation of stakeholders in planning and management can improve success of the protected area. Forcing local user groups to accept a protected area may create resentment and diminish the likelihood of compliance with voluntary, proprietary, or regulatory practices. The degree of local recognition for natural resource value at a site is an important barometer for reserve implementation success. The Aquatic Reserves Program must promote public participation to aid in determining the public perception of natural resource values at the site, identify their interests, and to ultimately foster acceptance and support for reserve designation.

6.3 Scientific Reserve Criteria

In addition to the general reserve criteria in Section 6.2, the following criteria are desirable for proposed scientific aquatic reserves. Scientific aquatic reserves are primarily developed as controls for scientific inquiry, with occasional opportunities for manipulation. However, it is important to have flexibility in the application of scientific reserves. Research on scientific reserves may assist in the development of baseline population densities and assemblages. Such research can be undertaken to improve understanding of the natural system. By enhancing our

understanding of the functioning of the natural system, we may improve aquatic resource management.

Interest to the scientific community

- **The site has expressed support from the scientific community.**

Discussion: Proponents of scientific aquatic reserves should have adequate financial support, technical capabilities, staffing, and resources to establish and maintain a long-term research program. Project proponents should have established ties to public or private research facilities, recognized statewide or regional research programs such as the Puget Sound Ambient Monitoring Program (PSAMP), public and private education facilities, or association with government entities.

Presence of current research projects

- **DNR favors sites with a history of ongoing monitoring.**

Discussion: For many locations, reserve designation provides a change in management from unprotected status to protected status. A failure of many monitoring efforts is to adequately capture and describe the pre-protection baseline conditions that allow for the evaluation of the impacts of management on biological communities and habitats. Therefore, sites with a long or detailed history of scientific research projects that might benefit from reserve status are favored during reserve selection.

Low degree of alteration

- **Scientific aquatic reserves are selected for and are maintained to have a low degree of alteration from their natural state.**

Discussion: Since there are very few ecosystems that have avoided human influence (Vitousek et al. 1997), there is a lack a fundamental understanding of natural conditions at a site. Fully functional scientific aquatic reserves in good condition have a higher research value than those sites that have been altered from their natural state.

Research without irreparable harm

- **The site has the capacity to support research without causing irreparable harm**

Discussion: Scientific manipulation at a site can significantly disrupt ecosystem process or the physical structure of a site. Therefore, research proposed for a reserve, in most cases, should not permanently or dramatically alter the natural conditions of the aquatic reserve or neighboring systems or habitats in order to advance knowledge.

6.4 Educational Reserve Criteria

In addition to the general reserve criteria in Section 6.2, the following criteria are desirable for proposed educational aquatic reserve proposals. The education of an ‘environmentally literate citizenry’ and the acquisition of responsible environmental behavior has long been recognized to be the primary and ultimate goals of environmental education (Stapp 1969, Roth 1970, UNESCO 1980, Roth 1992). The active participation of the general public is a key factor in preventing

and solving the environmental problems of contemporary society (UNESCO 1978, 1980).

Through the designation of educational reserves, the Aquatic Reserves Program will support the requirement for "instruction about conservation, natural resources, and the environment" to be provided at all grade levels, as required by state law (RCW 28A.230.020). A recent survey of 709 K-12 schools in Washington identified access to field-based learning as one of the most important resources needed to improve student learning (Angell 2003). Many studies have indicated that experiences in the outdoors (and in particular experiences in natural areas) is the number one factor influencing people towards development of environmental sensitivity (James 1993, Palmer 1993, Tanner 1980) and commitment to environmental protection (Chawla 1999). Outdoor experiences at an early age have positive long-term effects.

Educational Value

- **Sites that have a history of use for education are given priority.**

Aquatic reserves provide a natural laboratory for exploration by students of all ages. There are several lessons that can be taught using such areas as natural laboratories for observational inquiry. Lessons may include exploration of the relationships between species and their habitats as well as the impacts of other disturbances and development of resources. Sites that have a history of use for educational purposes are to be given priority over sites of similar ecological value. To maximize the value of these reserve sites, proponents should establish repositories for observational and natural history information for the site.

Distribution of Sites

- **Areas with habitat that is underrepresented in the region have higher priority.**

One function of aquatic reserves is to provide educational opportunities for adults and children. This requires that sites be accessible to people where they live. An emphasis is placed on distributing sites throughout Washington. Therefore, the Aquatic Reserves Program prioritizes proposals for sites that are under-represented in the existing educational network.

In addition to the location of other reserves, it is important to consider the types of habitat that are available for students of all ages to experience. Habitats that are under-represented in the educational reserve network are given higher priority.

Ease of Access

- **Proposed sites must have safe and ready public access.**

A vital consideration for all reserves is the amount and quality of access to the site. Access can be from the water or the adjacent uplands. Appropriate management measures such as the development of entry paths or boardwalks, establishing a right-of-way or arrangements for established access to the site, mooring buoys, or other measures that concentrate and direct use during site visits should be established.

6.5 Application of Criteria

The selection of areas for conservation often involves the prioritization of potential reserve sites based on selection criteria (Wright 1977). However, few researchers agree on the relative importance of different criteria, complicating efforts to develop universally accepted methods (Margules and Usher 1981). Evaluating sites using criteria scores is an artificial construct that can be misleading when evaluated in isolation. Therefore, drawing conclusions from site-specific scores is most valuable when placed in context and compared to a range of well-documented sites. Therefore, over time, DNR will develop site evaluations for several reference sites using the described criteria to provide appropriate context for site evaluations (Alder et al. 2002). The Aquatic Reserves Program will take advantage of such iterative approaches by developing the reserve network over time.

All goals and criteria are unlikely to be satisfied for any individual site. It is important that the program be flexible in the application of reserve criteria. Over time, the program will adapt to prioritize criteria and goals that are being underachieved by the reserve network.

Site proposals are evaluated using ecological criteria first. The program places the most emphasis on selecting those sites that have the highest ecological value. However, where two sites are of comparable value ecologically, then socio-economic criteria dominate the choice of which ones should be protected (Roberts et al. 2003).

The Technical Advisory Committee, an independent panel of scientists and professionals, evaluates individual site proposals for aquatic reserve status. The criteria and specific indicators used to address each criterion are delineated on the Site Evaluation Form (Appendix I). Several of the criteria identified in the program's Final EIS require use of multiple indicators and questions pertaining to them. To avoid overvaluing one criterion over another, the committee members apply the criteria as they relate to each site and ecoregional priorities.

Environmental reserve evaluations rely entirely on the application of the general reserve criteria (Section 6.2), while scientific (Section 6.3) or educational reserve (Section 6.4) proposals are evaluated using additional criteria.

Best Practices for Aquatic Reserve Evaluation

Use All Available Data

DNR staff make a concerted effort to work with site proponents to find all available relevant data for aquatic reserve proposals prior to convening the Technical Advisory Committee to evaluate those proposals. Additionally, the Department must attempt to collect adequate information to determine the potential for success in achieving the Aquatic Reserves Program's goals and objectives.

Criteria Update and Review

Criteria used to evaluate reserve proposals is reviewed and updated as scientific information becomes available. All available scientific information will be made available to the committee for their site evaluation.

Section 7

Glossary

Benthic – living at, in, or associated with structures on the bottom of a body of water.

Biodiversity – variety of organisms considered at all levels, from genetic variants belonging to the same species through arrays of species to the arrays of genera, families and still higher taxonomic levels; includes the variety of ecosystems, which comprise both communities of organisms within particular habitats and the physical conditions where they live. Structural, functional, and compositional diversity of organisms and their environments.

Biogeography – spatial distribution of plants and animals, both past and present.

Degradation - loss of native species and processes resulting from human activities such that only certain components of the original biodiversity still persist, often including significantly altered natural communities.

Distribution – occurrence, frequency of occurrence, position, or arrangement of animals and plants within an area.

Indicator physical, chemical, biological or socioeconomic measures of particular attributes used to indicate state or condition.

Ecosystem – community of organisms and their physical environment interacting as an ecological unit.

Ecosystem functions – biophysical processes that take place within an ecosystem. Examples include nutrient cycling and water purification.

Ecological process – processes that govern material, energy, or information transfer (e.g. nearshore drift).

Ecosystem integrity – capability of supporting and maintaining a balanced, integrated, adaptive community of organisms having species composition, diversity, and functional organization comparable to that of the natural habitat of a region (Karr 1987).

Habitat – an environment of a particular kind, often used to describe the environmental requirements of a certain species or community.

Marine – saltwater or living in saltwater.

Manageable – a human-induced or natural event, action, structure, or characteristic that can be affected by regulation or proprietary actions.

Nearshore – estuarine delta and marine shoreline and areas of shallow water from the top of the coastal bank or bluffs water-ward to a depth of about 10 meters relative to Mean Lower Low Water (average depth limit of photic zone).

Plankton – small plants and animals, generally smaller than 2 mm and without strong locomotive ability, that are suspended in the water column and carried by currents or waves and that may make daily or seasonal movements in the water column.

Resilience – the speed at which a habitat, population, or community is able to return to equilibrium following a perturbation.

Shoreline – the zone where the ocean is in contact with dry land.

Species richness – a simple measure of species diversity calculated as the total number of species in a habitat or community.

Terrestrial – living or occurring on land.

Threat – A human-induced or natural event, action, structure, or characteristic that is likely or documented to cause harm to a species, population, or ecosystem.

Trophic – related to the processes of energy and nutrient transfer (i.e., productivity) from one level of organisms to another in an ecosystem.

Viable – when referring to a species, capable of living through reproductive age; when referring to a population or ecosystem, able to survive into the foreseeable future at current abundances without external support or immigration.

Section 8

References

Alder, J., D. Zeller, T. Pitcher, and R. Sumaila. 2002. A method for evaluating marine protected area management. Coastal Management 30:121-131.

Alpine, A.E., and J.E. Cloern. 1992. Trophic interactions and direct physical effects control phytoplankton biomass and production in an estuary. Limnology. Oceanogr. 37: 946-955.

Angell, T. 2003. Personal Communication. Former supervisor of environmental education for the Washington Office of the Superintendent of Public Instruction.

Angermeier, P.L. and I.J. Schlosser. 1995. Conserving aquatic biodiversity: Beyond species and populations. American Fisheries Society Symposium 17: 402-414.

Appeldoorn, R.S., C.W. Recksiek, R.L. Hill, F.E. Pagan, and G.D. Dennis. 1997. Marine protected areas and reef fish movements: the role of habitat in controlling ontogenic migration. Pages 1917 –1922. *In:* H. Lessios and I.G. Macintyre, editors. Proceedings of the Eighth International Coral Reef Symposium. Volume 2. Smithsonian Tropical Research Institute, Balboa, Republic of Panama.

Ballantine, W.J. 1997. Design principles for systems of 'no-take' marine reserves. *In:* Pitcher, T.J. (Ed.), the Design and Monitoring of Marine Reserves', Vol. 5 (1). University of British Columbia Fisheries Centre Research Reports, pp. 4-5.

Berry, H.D., J.R. Harper, T.F. Mumford Jr., B.E. Bookheim, A.T. Sewell, L.J. Tamayo. 2001 The Washington State ShoreZone Inventory Data Dictionary. Report for Washington Department of Natural Resources, Aquatic Resources Division, Olympia, WA.

Boersma, P.D. and J.K. Parrish. 1999. Limiting abuse: marine protected areas, a limited solution. Ecological Economics 31:287-304.

Boynton, W.R., and W.M. Kemp. 2000. Influence of river flow and nutrient loads on selected ecosystem processes. Pp. 269-298 in J.E. Hobbie (ed.), Estuarine Science: A synthetic approach to research and practice. Island Press, Washington, D.C. 539 pp.

Chawla, L. 1999. Life paths into effective environmental action. The Journal of Environmental Education.

Cowardin, L.M., V. Carter, F.C. Golet, and E.T. LaRoe. 1979. Classification of wetlands and deepwater habitats of the United States. U.S. Fish and Wildlife Service FWS/OBS 79/31. 103pp.

Cullinan, T. 2001. Important bird areas of Washington. Audubon Washington. Olympia Washington, 170 pp.

Dethier, M.N. 1990. A marine and estuarine habitat classification system for Washington State. Natural Heritage Program, Washington Department of Natural Resources. 60 pp.

Dethier, M.N. 1989. "Considerations for the selection of marine preserves" and "Sites in Washington State suggested for consideration for marine preserves."

Diamond, J.M. 1975. The island dilemma: lessons of modern biogeographic studies for the design of natural reserves. Biological Conservation 7:129-146.

Dyrness, C.T., J.F. Franklin, C. Maser, S.A. Cook, J.D. Hall, and G. Faxon. 1975. Research natural area needs in the Pacific Northwest: A contribution to land-use planning. USDA Forest Service General Technical Report, PNW-38.

Ebbesmeyer, C.C., C. A. Coomes, G.A. Cannon and C.A. Barnes. 1984. Synthesis of current measurements in Puget Sound, Washington— Volume 3: Circulation in Puget Sound: An interpretation based on historical records of currents. NOAA Technical Memorandum NOS OMS 5. NOAA, Rockville, Maryland.

Grantham, B.A., G.L. Eckert, and A.L. Shanks. 2003. Dispersal potential of marine invertebrates in diverse habitats. Ecological Applications 13:5108–5116.

James, K. 1993. A qualitative study of factors influencing racial diversity in environmental education. Unpublished doctoral dissertation, University of Minnesota, Minneapolis.

Karr, J.R. 1987. Biological monitoring and environmental assessment: a conceptual framework. Environmental Management. 11: 249-256.

Kinlan, B. and S.D. Gaines. 2003. Propagule dispersal in marine and terrestrial environments: A community perspective. Ecology, 84(8), 2003, pp. 2007-2020.

Kunze, L.M. 1984. Puget trough coastal wetlands : a summary report of biologically significant sites. Washington Natural Heritage Program, Department of Natural Resources. Prepared for Washington Department of Ecology. Olympia, WA.

Lammert, M., J. Higgins, D. Grossman, and M. Bryer. 1997. A classification framework for freshwater communities: Proceedings of The Nature Conservancy's aquatic community classification workshop. Arlington, VA: The Nature Conservancy.

Lande, R. 1988. Demographic models of the Northern Spotted Owl (*Strix occidentalis caurina*). Oecologia 75: 601-607.

Margules, C.R. and M.B. User. 1981. Criteria used in assessing wildlife conservation potential: A review. Biological Conservation 21: 79-109.

McNeill, S. E. and P. G. Fairweather. 1993. Single large or several small marine reserves? An experimental approach with seagrass fauna. Journal of Biogeography, Vol. 20, pp. 429-440.

McNeely, J.A., J. Harrison, and P. Dingwall. 1994. Protecting nature: regional views of protected areas. World Conservation Union, Gland Switzerland.

Morowitz, H. J. 1991. Balancing species preservation and economic considerations. Science 253:752–54.

Munasinghe, M. (ed), and J.A. McNeely (ed), A. Schwab (compiler). 1994. Protected area economics and policy: linking conservation and sustainable development. Schwab, Adelaida, Comp. – IUCN; World Bank – Washington D.C. Distributed for the World Conservation Union (IUCN) by the World Bank. 242 pp.

Paine, R.T. 1969. A note on trophic complexity and species diversity. American Naturalist 100:91–93.

Palmer, J.A.1993. Development of concern for the environment and formative experiences of educators. The Journal of Environmental Education, 24 (3), 26-30.

Peterson, C.D., M.E. Darienzo, D.J. Pettit, P.L. Jackson, and C.L. Rosenfeld, 1991. Littoral-cell development in the convergent Cascadia Margin of the Pacific Northwest, USA: SEPM Special Publication No. 46, Society for Sedimentary Geology, pp. 17-34.

Pickett, S.T.A., and J.N. Thompson. 1978. Patch dynamics and the design of nature reserves. Biological Conservation 13: 27-37.

Possingham, H., I. Ball, and S. Andelman. 2000. Chapter 17: Mathematical methods for identifying representative reserve networks. Pages 291-306. *In:* S. Ferson and M.A. Burgman (editors) Quantitative methods in conservation biology. Springer-Verlag. Berlin, Germany.

Pressey, R.L., C.J. Humphries, C.R. Margules, R.I. Wright, and P.H. Williams. 1993. Beyond opportunism: Key principles for systematic reserve selection . TREE 8: 124-128.

Rapoport, E.H., G. Borioli, J.A. Monjeau, J.E. Puntieri, and R.D. Oviedo. 1986. The design of natural reserves: a simulation trial for assessing specific conservation value. Biological Conservation 37: 269-90.

Rebelo, A.G. and W.R. Siegfried. 1992. Where should natural reserves be located in the Cape Floristic Region, South Africa? Models for the spatial configuration of a reserve network aimed at maximizing the protection of floral diversity. Conservation Biology 6: 243-252.

Roberts, C.M. 2000. Selecting marine reserve locations: optimality versus opportunism. Bulletin of Marine Science 66: 581-592.

Roberts, C.M., S. Andelman, G. Branch, R.H. Bustamante, J.C. Castilla, J. Dugan, B.S. Halpern, K.D. Lafferty, H. Leslie, J. Lubchenco, D. McArdle, H.P. Possingham, M. Ruckelshaus, and R.R. Warner. 2003. Ecological criteria for evaluating candidate sites for marine reserves. Ecological Applications 13: S199-S214.

Roth, C.E. 1992. Environmental Literacy: Its roots, evolution, and directions in the 1990s. (Columbus, OH, ERIC/SMEAC Information Reference Center).

Roth, R.E. 1970. Fundamental concepts for environmental management education (k-16), Journal of Environmental Education, 1(3), pp. 65-74.

Sala, E., O. Aburto-Oropeza, G. Paredes, I. Parra, J.C. Barrera, and P.K. Dayton. 2002. A general model for designing networks of marine reserves. Science 298: 1991-1993.

Salm, R.V. and J.R. Clark, 2000. Marine and coastal protected areas: A guide for planners and managers. World Conservation Union.

P.R. Seaber, F.P. Kapinos, and G.L. Knapp, 1987. Hydrologic unit maps: U.S. Geological Survey water-supply paper 2294, 63 pp.

Simberloff, D.S., and L.G. Abele. 1976. Island biogeographic theory and conservation practice. Science 191:285-286.

Sloan, N.A. 2002. History and application of the wilderness concept in marine conservation. Conservation Biology 16:294-305.

Sohappy v. Smith/U. S. v. Oregon, "Belloni Decision" [302 F. Supp. 899 (1969); affirmed 529 F. 2d 570 (1976)].

Stapp, W.B. 1969. The concept of environmental education. Journal of Environmental Education, 1(3), pp. 31-36.

Tanner, T. 1980. Significant life experiences: A new research area in environmental education, Journal of Environmental Education, 11(4), pp. 20-24.

Tear, T.H., J.M. Scott, P.H. Hayward and B. Griffith. 1995. Recovery plans and the Endangered Species Act – Are criticisms supported by data. Conservation Biology 9:182-195.

Turpie, J.K. and T.M. Crowe. 1994. Patterns of distribution and diversity of larger mammals in Africa. South African Journal of Zoology 29:19-31.

United Nations Educational, Scientific, and Cultural Organization1978a. The World's first intergovernmental conference on environmental education in Tbilisi. (Columbus, OH, ERIC/SMEAC Information Reference Center, ED 179408).

United Nations Educational, Scientific, and Cultural Organization 1980. Environmental education in the light of the Tbilisi Conference (Paris, UNESCO).

United States. v. Washington, "Boldt Decision" [384 F. Supp. 312 (1974); affirmed, 520

U.S. Geologic Services. 1979. Accounting units of the national water data network. Reston, VA

Washington State Department of Natural Resources. 2004. Provisional navigability assessment of Washington lakes and rivers.

Vitousek, P.M., H.A. Mooney, J. Lubchenco, and J.M. Melillo. 1997. Human domination of earth's ecosystems. Science 277:494-499.

White, P.S., and S.T. Pickett. 1985. Natural disturbance and patch dynamics: an introduction. Pp. 3-13 in The Ecology of Natural Disturbance and Patch Dynamics. Acad. Press, San Diego, CA.

Wright, D.F. 1977. A site evaluation scheme for use in the assessment of potential nature reserves. Biological Conservation 11: 293-305.

Appendix A - Site Proposal Application

Section 1 – New proposal, Boundary change, or De-Listing an Aquatic Reserve

Please fill out the form as completely as possible. Answer those items that you know apply to the proposed site. Leave blank any questions to which you do not know the answer.

(The site proposal application can be found at www.dnr.wa.gov/htdocs/aqr/reserves/home.html).

Site Proponent

Name:
Address:
Phone:
E-mail:
Primary contact:
Who have you cooperated with to develop the proposal?

General site information

A. Site location:

B. Site Overview:

1. General site description (including acreage)
2. Boundaries description (include section, range and township, county)
3. Current ownership of privately and publicly owned (other than DNR) aquatic lands adjacent to the proposed site (include detailed ownership map).
4. Current county shoreline designation and description

C. Justification for proposal: (Briefly summarize the reasons for proposing the site as an aquatic reserve based on the criteria discussed in Section 6 and Appendices C, D, E, and F).

Environmental Reserve Information

To be provided for each reserve proposal (environmental, scientific, or educational).

Ecological and cultural quality of the site

1. **Current condition of the site**

a. Is the site degraded?
b. Are there signs of habitat loss within the site?
c. Are there signs of habitat loss within the biogeographic region?
d. Are ecosystem processes (e.g., freshwater flow, littoral drift, nutrient cycling, etc.) intact?

2. **Risks to the ecosystem or feature of interest (if applicable) –** Can ecological concerns contributing directly to the area's decline be prevented through reserve establishment?

3. **Restoration potential**
   a. Is there pending restoration or identified restoration needs at the site?
   b. Would restoration benefits extend beyond site boundaries?

4. **Special value for biodiversity or species diversity**
   a. Does the proposed site capture habitat used regularly by species of special conservation interest?
   b. Does the proposed site capture vulnerable habitats, life stages or populations? (Vulnerable habitats, life stages or populations include: seal haul-outs, breeding bird aggregations or rookeries, seasonal bird aggregations, seasonal fish aggregations (e.g. feeding, spawning) or fish and wildlife migration routes.

5. **Ecological processes that sustain the aquatic landscape –** Would protection of the site protect/maintain ecological processes that sustain the aquatic landscape (e.g., freshwater flow, littoral drift, nutrient cycling)?

6. **The cultural quality of the site–** Does the site contain or protect significant cultural resources? (Does the site contain heritage, historical, or cultural resources that are eligible for the Washington Register of Historic Places, (RCW27.34.220) or the National Register of Historic Places?

Habitats and features represented within the site

7. Is the site a good example (relatively undisturbed) of representative native habitat?
8. Does the site contain representative habitats not otherwise protected in the network of protected areas or aquatic reserves?
9. Does the proposed site capture species or habitats that are currently much less common than they were historically within the site's "biogeographic region" (See Section 6, Figures 3 and 4)?

Viability of the occurrences of interest

10. **Site features meet the intent of the reserve**
    Are species, habitat, or ecosystem processes consistently associated with the reserve site?
11. **Number of conservation targets** *(As it relates to information in "Special value for biodiversity or species diversity," question #9 above)*. Identify the habitat(s) and associated species you are proposing for conservation.

Summarize the conservation goals.

12. **Number of ecological processes**
    Does the site contain unique or distinctive physical habitat features (e.g., oceanographic gyre, oceanographic sill, natural beach spit, side channels, ox bow, estuary, etc.)?

Defensibility of the site

13. **Complementary protection within a reserve or protected area network**
    Does the site include habitat types that are under-represented on a bioregional basis, in the Aquatic Reserves Program, or other marine protected area or network?
14. **Connectivity to a reserve or protected area network and/or for species and/or habitats**
    a. Is site adjacent to existing marine or freshwater protected areas administered for preservation or restoration purposes?
    b. Does the site provide regional habitat connectivity through any of the following functions? Refuge (predator, physiological, high energy), food production, migratory, corridors, spawning, nursery or rearing, riparian vegetation, adult habitat, other functions. Please provide references to support this information.
15. **Appropriate size to be sustainable**
    Is the area large enough to be self-sustaining? Is the entire feature identified for conservation included in the proposed site? Does the site include the adjacent areas necessary to support and buffer the conservation features of the site?
16. **Ability to persist over time**
    a. Can site be successfully managed to maintain the features of interest?
    b. Are there known human-caused, or natural ecological concerns, to continued viability of the site?
17. **Known or anticipated activities that endanger the site or habitat**
    Are proposed land uses or modifications compatible with reserve designation (Modifications of interest are described in Appendix B)?
18. **Potential for factors contributing directly to the area's decline to be prevented**
    Would reserve status provide protection for habitats, species, or processes of interest from encroachment?

Manageability of the site

19. **Coordination with other entities, including local jurisdictions and current leaseholders**

a. Does the proposal include coordination of reserve actions with other entities, including local jurisdictions and current leaseholders?[1]
b. Has another entity previously identified this site or areas within the site as a priority for protection? *[Examples include Important Bird Areas (Cullinan 2001), priority areas for Research Natural Area Designation (Dyrness et al. 1975), or priority areas for conservation (e.g., through ecoregional planning, Natural Heritage Program research (Kunze 1984), or similar process (Dethier 1989)]*
c. Have potential cooperative management partners been identified for management, monitoring, and enforcement? [2]
d. Is the site adjacent to terrestrial protected areas managed for conservation or restoration purposes?

20. **Provide a description of how to measure success (i.e., monitoring). Describe what, if any, monitoring needs**

    Does the reserve proposal include a monitoring plan that measures reserve progress toward goals and provide for adaptive management?

21. **Kinds of enforcement needed to make sure incompatible uses and impacts do not encroach on the reserve**

    What kind of enforcement is needed to prevent incompatible uses and impacts from encroaching on the reserve?

22. **Does the site serve or conflict with the greatest public benefit?**
    a. Does reserve status represent the greatest public benefit?
    b. Is reserve status compatible with existing or proposed adjacent uses?

Section 2 - Additional information to be provided for SCIENTIFIC RESERVE Proposals

Coordinate your responses to the following questions with answers provided under site-specific Environmental Reserve site information, above.

1. **Rare site including a wide variety of habitat types and ecological processes** *(See: "Special value for biodiversity")*
2. **Relatively undisturbed example of habitat that was common historically** *(See: "What is the current condition of the site?")*

3. **Is the site of interest to the scientific community?**
    a. Does site represent a unique research opportunity?
    b. Do proponents have a history of successful scientific research?
4. **Species richness**

    Does site exceed expected species richness for areas of similar size? *(i.e., does site contain plant and animal communities suitable for continuing*

[1] This criterion is intended to gauge the amount of planning and effort that has already been invested in the development of a protection plan for the area of interest. These criteria represent best management principles that the Aquatic Reserve Program will seek to employ, and will be used to give preference to proposals that are in more advanced stages of development.
[2] This criterion is intended to gauge the amount of planning and effort that has already been invested in the development of a protection plan for the area of interest. These criteria represent the best management principles that the Aquatic Reserve program will seek to employ, and will be used to give preference to proposals that are in more advanced stages of development.

scientific observations (WAC 332.30.106).

5. **Viability and manageability of the site, able to support rare, special, and unique features?**
6. **Site contains a high degree of biodiversity for habitat type**

   Does site exceed expected biodiversity as measured using Shannon's diversity index (an index that measures diversity and evenness of species) for similar habitats?
7. **Site should be manipulated without doing irreparable harm to neighboring systems or habitats in order to advance knowledge (where applicable)**

   a. Do proposed manipulations affect the physical (e.g., habitat structure or ecosystem processes) or biological composition of the site?

   b.Are impacts of manipulation restricted to the site?
8. **History of monitoring or an opportunity for long term monitoring at the site**

   Does site have a historical monitoring record?

Section 3 - Additional information to be provided for EDUCATIONAL RESERVE Proposals

1. **Network of sites that provides an accessible distribution of sites throughout the state**

   Are education reserves available within a biogeographic region? (Education reserves may include areas operated by U.S. Fish and Wildlife Service, National Park Service, Washington State Parks and Recreation, or The Nature Conservancy that offer educational curricula.)
2. **Network of sites that provides an adequate distribution among habitat types –** Is the proposed site a unique example of habitat available for educational opportunities regionally or statewide?
3. **Sites that attract a range of target audiences –** Is the curriculum integrated into an applied educational program (e.g., school, public education program, etc.) and tailored to the unique features of the site.
4. **Sites that are compatible with educational use activities** – Are activities and conditions in the areas adjacent to the proposed reserve compatible with the uses proposed for the reserve?
5. **Current site conditions or activities adjacent to the site are compatible with the educational reserve** – Are activities and conditions in the areas adjacent to the proposed reserve compatible to the uses proposed for the reserve?
6. **Site whose ecological integrity can be preserved while providing public access –** How will the proponent maintain the unique ecological features of the site while providing public access for an education program?
7. **Site has a history of monitoring and an opportunity for long-term monitoring.** (Criterion applicable in cases described by Final EIS 3.2.1.4.3) – Does site have a historical monitoring record?

Appendix B - Potential Causes of Habitat Modification and Ecological Concerns

1. Adjacent residential upland development *
2. Adjacent industrial upland development *
3. Adjacent agricultural upland development *
4. Over water structures *
5. Shoreline armoring
6. Slope/bank stabilization
7. Development (marinas, port facilities, boat ramps, marine repair facilities, etc.) *
8. Sewer outfalls *
9. Stormwater outfalls
10. Mooring buoys
11. Derelict vessels
12. Submerged vessels
13. Fill
14. Underwater disposal sites
15. Contaminated sediment
16. Dredged areas
17. Revetments *
18. Piles
19. Nuisance species
20. Water Quality
21. Hydraulic modifications
22. Other

* Source: Final Report - Northwest Straits Nearshore Habitat Evaluation, prepared for the Northwest Straits Commission, prepared by Anchor Environmental, L.L.C. and People for Puget Sound. January 2002.

Appendix C – Priority Marine Habitat

The Washington State Deparment of Natural Resources' (DNR) responsibility is to manage aquatic habitat on state-owned aquatic lands. Priorities are driven by the use of this habitat by aquatic species that are not managed by DNR.

DNR-designated sensitive marine habitat

Source: Washington State Department of Natural Resources, Aquatic Resources Management Reference Manual, Section 20.1 (rev. date 9/94)

Vegetated marine estuarine

Includes eelgrass meadows, kelp beds, and turf algae in intertidal and subtidal areas to a depth of approximately 30.5 meters below mean lower, low water. Priority is also given to maintaining the following physical parameters necessary for kelp and eelgrass survival and growth: substrate, wave exposure/energy, salinity, light level, and nutrients.

- Kelp *(Macrocystis* and/or *Nereocystis*): Patches of sedentary floating aquatic vegetation.
- Eelgrass *(Zostera):* Habitat consisting of intertidal and shallow subtidal shores that are colonized by rooted vascular angiosperms of the genus *Zostera*.
- Commonly used forage fish spawning structural habitat for fish stocks identified by Washington State Department of Fish and Wildlife (WDFW) in the 1996 Forage Fish Stock Status Report (or updated edition).
- Habitat documented for use during critical life stages of priority aquatic species (e.g., refuge, forage areas, concentrated migratory corridor use versus lower value for passage, spawning, rearing, riparian habitat, adult habitat).
- Turf algae: Habitats consisting of non-emergent green, red, and/or brown algae plants growing on solid substrates rocks, shell, hardpan).
- Native (unaltered) estuarine mudflats.
- Gravel beaches - low energy, high energy.
- Sand beaches - low energy, high energy.

Marine priority habitat

Source: Washington Department of Fish and Wildlife, Priority Habitat and Species (www.wa.gov/wdfw/hab/phshabs/htm)

Estuary, estuary-like

- Deepwater tidal habitats and adjacent tidal wetlands usually semi-enclosed by land but with open, partly obstructed, or sporadic access to the open marine waters, where marine water is at least occasionally diluted by terrestrial freshwater runoff (not including non-point sources, such as stormwater runoff or sewer outfalls).

Marine/estuary shorelines

- Shorelines include the intertidal and subtidal zones of beaches. Backshore and adjacent components of the terrestrial landscape (such as cliffs, snags, mature trees, dunes, meadows) are important associated habitat for fish and contribute to marine/estuary shoreline function (such as sand/rock/log recruitment, nutrient contribution, erosion control). Though these areas may not be state-owned aquatic lands, and therefore, not included in the aquatic reserves, they may be significant adjacent habitat that are critical to the function of the reserve.
- Consolidated substrate: Rocky outcroppings in the intertidal and subtidal marine/estuarine environment consisting of rocks greater than 25 cm (10 inches) diameter, hardpan, and/or bedrock. Unconsolidated Substrate: Substrata in the

intertidal and subtidal marine environment consisting of rocks less than 25 cm diameter, gravel, shell, sand, and/or mud.

Riparian

- Area adjacent to marine shorelines that contain elements of both the aquatic and terrestrial ecosystems that mutually influence each other. Riparian habitat encompasses the area beginning at the ordinary high water mark and extends to the portion of the terrestrial landscape that is influenced by the aquatic system.

Appendix D - Priority Freshwater Habitat

Source: Washington Department of Fish and Wildlife, Priority Habitat and Species (www.wa.gov/wdfw/hab/phshabs/htm)

Note: These areas may not be on state-owned aquatic lands, and therefore, not included in the aquatic reserves. If not, they should be considered significant adjacent habitat that are critical to the function of the reserve.

Freshwater wetlands and fresh deepwater

- Lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface or the land is covered by shallow water. Wetlands must have one or more of the following attributes: the land supports, at least periodically, predominantly hydrophytic plants; substrate is predominantly undrained hydric soils; and/or the substrate is saturated with water or covered by shallow water at some time during the growing season of each year.
- Deepwater habitats are permanently flooded lands lying below the deepwater boundary of wetlands. Deepwater habitats include environments where surface water is permanent and often deep, so that water, rather than air, is the principal medium within which the dominant organisms live. The dominant plants are hydrophytes; however, the substrates are not considered soil because the water is too deep to support emergent vegetation. These habitats include all underwater structures and features (e.g., woody debris, rock piles, caverns).

Instream

- The combination of physical, biological, and chemical processes and conditions that provide important functional life history requirements for fish and invertebrates.

Riparian

- The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other. In riparian systems, the vegetation, water tables, soils, microclimate, and wildlife inhabitants of terrestrial ecosystems are influenced by perennial or intermittent water. Simultaneously, the biological and physical properties of the aquatic ecosystems are influenced by adjacent vegetation, nutrient and sediment loading, terrestrial wildlife and organic and inorganic debris. Riparian habitat encompasses the area beginning at the ordinary high water mark and extends to that portion of the terrestrial landscape that is influenced by, or that directly influences, the aquatic ecosystem. Riparian habitat includes the entire extent of the floodplain and riparian areas of wetlands that are directly connected to stream courses.

Appendix E – Priority Marine Species

Priority habitat and species lists are dynamic and because the Department of Natural Resources does not administer any lists of priority species, reference is made to three sources that DNR will use as the sources for its Priority Marine Species lists. Priority marine species are identified from the following three sources: Washington Department of Fish and Wildlife - Species of Concern in Washington State; Washington Department of Fish and Wildlife Fish Stock Status Reports, Species with critical stock status.

Source: Washington Department of Fish and Wildlife, Species of Concern in Washington State (June 2002) (http://www.wa.gov/wdfw/wlm/diversity/soc/soc/htm)

More habitat value if documented use for critical life stages of these species (e.g., spawning, rearing, concentrated use versus lower value for passage)

Fish (any documented occurrence)

COMMON NAME	SCIENTIFIC NAME	STATE STATUS	FEDERAL STATUS
BLACK ROCKFISH	*SEBASTES MELANOPS*	SC	none
BOCACCIO ROCKFISH	*SEBASTES PAUCISPINIS*	SC	none
BROWN ROCKFISH	*SEBASTES AURICULATUS*	SC	none
BULL TROUT (COASTAL/PUGET SOUND)	*SALVELINUS CONFLUENTUS*	SC	FT
CANARY ROCKFISH	*SEBASTES PINNIGER*	SC	none
CHINA ROCKFISH	*SEBASTES NEBULOSUS*	SC	none
CHINOOK SALMON (PUGET SOUND ESU)	*ONCORHYNCHUS TSHAWYTSCHA*	SC	FT
CHUM SALMON (HOOD CANAL ESU)	*ONCORHYNCHUS KETA*	SC	FT
COPPER ROCKFISH	*SEBASTES CAURINUS*	SC	none
EULACHON	*THALEICHTHYS PACIFICUS*	SC	none
GREENSTRIPED ROCKFISH	*SEBASTES ELONGATUS*	SC	none
PACIFIC COD (S&C PUGET SOUND)	*GADUS MACROCEPHALUS*	SC	none
PACIFIC HAKE (C. PUGET SOUND)	*MERLUCCIUS PRODUCTUS*	SC	none
PACIFIC HERRING (CHERRY POINT)	*CLUPEA PALLASI*	SC	none
PACIFIC HERRING (DISCOVERY BAY)	*CLUPEA PALLASI*	SC	none
QUILLBACK ROCKFISH	*SEBASTES MALIGER*	SC	none
REDSTRIPE ROCKFISH	*SEBASTES PRORIGER*	SC	none
TIGER ROCKFISH	*SEBASTES NIGROCINCTUS*	SC	none
UMATILLA DACE	*RHINICHTHYS UMATILLA*	SC	none
WALLEYE POLLOCK (SO. PUGET SOUND)	*THERAGRA CHALCOGRAMMA*	SC	none
WIDOW ROCKFISH	*SEBASTES ENTOMELAS*	SC	none
YELLOWEYE ROCKFISH	*SEBASTES RUBERRIMUS*	SC	none
YELLOWTAIL ROCKFISH	*SEBASTES FLAVIDUS*	SC	none

Fish (breeding areas, documented regular large concentrations)

COMMON NAME	SCIENTIFIC NAME	STATE STATUS	FEDERAL STATUS
PACIFIC HERRING	*CLUPEA PALLASI*	none	none
LONGFIN SMELT	*SPIRINCHUS THALEICHTHYS*	None	none
SURFSMELT	*HYPOMESUS PRETIOSUS*	None	none
PACIFIC SAND LANCE	*AMMODYTES HEXAPTERUS*	None	none

Mammals (documented regular occurrence)

COMMON NAME	SCIENTIFIC NAME	STATE STATUS	FEDERAL STATUS
BLACK RIGHT WHALE	*BALAENA GLACIALIS*	SE	FE
FIN WHALE	*BALAENOPTERA PHYSALUS*	SE	FE
HUMPBACK WHALE	*MEGAPTERA NOVAEANGLIAE*	SE	FE
KEEN'S MYOTIS	*MYOTIS KEENII*	SC	none
KILLER WHALE	*ORCINUS ORCA*	SC	threatened
PACIFIC HARBOR PORPOISE	*PHOCOENA PHOCOENA*	SC	none
SEA OTTER	*ENHYDRA LUTRIS*	SE	none
SEA OTTER	*ENHYDRA LUTRIS LUTRIS*	SE	none
SEI WHALE	*BALAENOPTERA BOREALIS*	SE	FE

Mollusk (documented natural occurrence)

COMMON NAME	SCIENTIFIC NAME	STATE STATUS	FEDERAL STATUS
NORTHERN ABALONE	*HALIOTIS KAMTSCHATKANA*	SC	none
OLYMPIA OYSTER	*OSTREA LURIDA*	SC	none

Marine Birds (Breeding areas, areas of documented regular large concentrations)

COMMON NAME	SCIENTIFIC NAME	STATE STATUS	FEDERAL STATUS
AMERICAN WHITE PELICAN	*PELECANUS ERYTHRORHYNCHOS*	SE	none
BRANDT'S CORMORANT	*PHALACROCORAX PENICILLATUS*	SC	none
BROWN PELICAN	*PELECANUS OCCIDENTALIS*	SE	FE
CASSIN'S AUKLET	*PTYCHORAMPHUS ALEUTICUS*	SC	FC
COMMON LOON	*GAVIA IMMER*	SS	none
COMMON MURRE	*URIA AALGE*	SC	none
ALEUTIAN CANADA GOOSE	*BRANTA CANADENSIS LEUCOPAREIA*	ST	none
MARBLED MURRELET	*BRACHYRAMPHUS MARMORATUS*	ST	FT
SNOWY PLOVER	*CHARADRIUS ALEXANDRINUS*	SE	FT
TUFTED PUFFIN	*FRATERCULA CIRRHATA*	SC	FC
UPLAND SANDPIPER	*BARTRAMIA LONGICAUDA*	SE	none
WESTERN GREBE	*AECHMOPHORUS OCCIDENTALIS*	SC	none

FE: Federal Endangered FC: Federal Candidate
FT: Federal Threatened SC: State Candidate
SE: State Endangered ST: State Threatened None: No listing status

Appendix F–Priority Freshwater Species

Lists of priority habitat and species are dynamic and because DNR does not administer such lists, reference is made to three sources it uses as the sources for its Priority Marine Species lists; priority species are identified from the following three sources: Washington Department of Fish and Wildlife - Species of Concern in Washington State; Washington Department of Fish and Wildlife Fish Stock Status Reports, Species with critical stock status.

Source: Washington Department of Fish and Wildlife, Species of Concern in Washington State (June 2002) (www.wa.gov/wdfw/wlm/diversity/soc/soc/htm)

More habitat value if documented use for critical life stages of these species (e.g. spawning, rearing, concentrated use versus lower value for passage).

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	STATE STATUS	FEDERAL STATUS
CASCADE TORRENT SALAMANDER	*RHYACOTRITON CASCADAE*	Amphibian	SC	none
COLUMBIA SPOTTED FROG	*RANA LUTEIVENTRIS*	Amphibian	SC	FC
DUNN'S SALAMANDER	*PLETHODON DUNNI*	Amphibian	SC	none
LARCH MOUNTAIN SALAMANDER	*PLETHODON LARSELLI*	Amphibian	SS	FC
NORTHERN LEOPARD FROG	*RANA PIPIENS*	Amphibian	SE	none
OREGON SPOTTED FROG	*RANA PRETIOSA*	Amphibian	SE	FC
BULL TROUT	*SALVELINUS CONFLUENTUS*	Fish	SC	FT
BULL TROUT (COLUMBIA BASIN)	*SALVELINUS CONFLUENTUS*	Fish	SC	FT
CHINOOK SALMON (LOWER COLUMBIA)	*ONCORHYNCHUS TSHAWYTSCHA*	Fish	SC	FT
CHINOOK SALMON (SNAKE R. FALL)	*ONCORHYNCHUS TSHAWYTSCHA*	Fish	SC	FT
CHINOOK SALMON (SNAKE R. SP/SU)	*ONCORHYNCHUS TSHAWYTSCHA*	Fish	SC	FT
CHINOOK SALMON (UPPER COLUMBIA SP)	*ONCORHYNCHUS TSHAWYTSCHA*	Fish	SC	FE
CHUM SALMON (LOWER COLUMBIA)	*ONCORHYNCHUS KETA*	Fish	SC	FT
KOKANEE (LANDLOCKED SOCKEYE)	*ONCORHYNCHUS NERKA*	Fish	SC	FT
LAKE CHUB	*COUESIUS PLUMBEUS*	Fish	SC	none
LEOPARD DACE	*RHINICHTHYS FALCATUS*	Fish	SC	none
MARGINED SCULPIN	*COTTUS MARGINATUS*	Fish	SS	FC
MOUNTAIN SUCKER	*CATOSTOMUS PLATYRHYNCHUS*	Fish	SC	none
RIVER LAMPREY	*LAMPETRA AYRESI*	Fish	SC	FC
SOCKEYE SALMON (SNAKE R.)	*ONCORHYNCHUS NERKA*	Fish	SC	FE
STEELHEAD (LOWER COLUMBIA)	*ONCORHYNCHUS MYKISS*	Fish	SC	FT
STEELHEAD (MIDDLE COLUMBIA)	*ONCORHYNCHUS MYKISS*	Fish	SC	FT
STEELHEAD (SNAKE RIVER)	*ONCORHYNCHUS MYKISS*	Fish	SC	FT
STEELHEAD (UPPER COLUMBIA)	*ONCORHYNCHUS MYKISS*	Fish	SC	FE
CALIFORNIA FLOATER	*ANODONTA CALIFORNIENSIS*	Mollusk	SC	FC
GIANT COLUMBIA RIVER LIMPET	*FISHEROLA NUTTALLI*	Mollusk	SC	none
GIANT COLUMBIA SPIRE SNAIL	*FLUMINICOLA COLUMBIANA*	Mollusk	SC	FC
NEWCOMB'S LITTORINE SNAIL	*ALGAMORDA SUBROTUNDATA*	Mollusk	SC	FC
WESTERN POND TURTLE	*CLEMMYS MARMORATA*	Reptile	SE	FC

1. FE: Federal Endangered
2. FT: Federal Threatened
3. SE: State Endangered
4. ST: State Threatened
5. FC: Federal Candidate
6. SC: State Candidate
7. None: No listing status

Appendix G - Establishing Aquatic Reserves in Harbor Areas and State-Owned Waterways

Harbor Areas

Establishing aquatic reserves in harbor areas could be inconsistent with the specific uses for which harbor areas are established. Article XV, Harbors and Tide Waters of the Constitution of the State of Washington, Article XV states that harbor areas "*shall be forever reserved for landings, wharves, streets, and other conveniences of navigation and commerce.*"

To establish aquatic reserves in an existing harbor area the department can take one of the following steps:

1. Build into the specific aquatic reserve management plan allowances for uses that will not conflict with uses for which the harbor area was established.
2. Adjust the harbor area line to exclude the reserve area as described in RCW 79.92.020.

Under alternative number 2, the commitment by the Washington State Department of Natural Resources (DNR) and the cooperation required by other management entities necessary to adjust the harbor line should be established, documented, and included in the nomination of the site to the Commissioner of Public Lands for review. In addition, SEPA review for the harbor area adjustment will occur simultaneously with SEPA review for establishing the reserve and management plan. The harbor line adjustment should be made before the Commissioner's order is signed for the reserve.

Under alternative 3, DNR is given the authority under RCW 79.90.460(3) to consider "*…the natural values of state-owned aquatic lands as wildlife habitat, natural area preserve, representative ecosystem or spawning area prior to issuing any initial lease…The department may withhold from leasing lands which it finds to have significant natural values …*"
RCW 79.90.010 defines aquatic lands as "…all state-owned tidelands, shorelands, harbor areas, and the beds of navigable waters."
RCW 79.990.465(12) defines state-owned aquatic lands as "*…those aquatic lands and waterways administered by the department of natural resources or managed under RCW 79.90.475 by a port district*."

State-owned Waterways

Establishing aquatic reserves in state-owned waterways could be inconsistent with the specific uses and priorities for which state waterways are established, as described in RCW 79.93.010. In order to establish aquatic reserves in an existing state-owned waterway the department could vacate the waterway according to

RCW 79.93.060 in order to eliminate risks that an aquatic reserve could be utilized for other uses in the future. Refer to DNR Procedure PR09-000-01 (May 6, 2003 or current update) for the details of the procedure for vacating state waterways. The commitment by DNR and the cooperation required by other management entities necessary to vacate a state-owned waterway should be established, documented, and included in the nomination of the site for review.

Appendix H–Interim Management Guidance

This interim guidance is modeled on the Approved Interim Management Guidance for Aquatic Reserves and Withdrawn Areas from Fran McNair, Aquatics Steward to Aquatic Resources Program Staff, June 27, 2001.

The exact types of future leasing activities that are authorized and prohibited within aquatic reserves will be established after the area is formally designated as an aquatic reserve and the site-specific management plan has been adopted.

1. The aquatic reserve interim management guidelines apply to aquatic lands that have been identified by the Commissioner of Public Lands for formal SEPA review and planning for reserve candidacy.
2. The guidelines will continue to be in effect until the area is designated by a Commissioner's Order as an aquatic reserve (at which time a management plan is adopted by DNR) or the area is no longer being considered for reserve status.
3. There will be no attempt to curtail legal activities conducted under existing DNR use authorizations within candidate reserve sites.
   3.1. DNR staff will work with lessees to address environmental concerns and operational improvements related to authorized activities.
4. All legal activities conducted under existing use authorizations in areas adjacent to candidate reserve sites will be managed using the best available knowledge to approve re-authorizations, assignments, maintenance, and construction activities.
   4.1. DNR staff will use the best available knowledge to approve such activities under conditions that afford the greatest amount of environmental protection and improvement of the general area and that minimize the disturbance to the adjacent candidate reserve site relative to its intent.
5. All use authorizations existing within a candidate reserve site at the time of reserve designations, whether in normal or holdover status:
   5.1. Will be honored throughout their current terms.
   5.2. May conduct maintenance and construction activities as per the existing terms and conditions of the original agreement.
      5.2.1 DNR staff will use the best available knowledge to approve maintenance and construction activities that afford the greatest amount of environmental protection and improvement to meet the intent of the candidate reserve.
   5.3. May be re-assigned to another entity under the existing terms and conditions of the original agreement.

5.4. That expire during the candidate reserve site's SEPA review and planning process, will be held in holdover status until completion of the process.

5.4.1. DNR staff will work with lessees to address environmental concerns and operational improvements related to authorized activities.

5.5. That are in holdover status or expire after the area has been formally designated as an aquatic reserve, will be evaluated based on the adopted site management plan to assess their compatibility with the reserve and reserve goals.

5.5.1. Activities determined to be compatible may be authorized.

5.5.2. Activities determined not to be compatible will not be authorized.

6. Applications for use authorizations within candidate reserve sites which occurred before, during, or after the SEPA review and planning process, but were not finalized and signed by DNR (except as described below in 6.1 and 6.2), will be placed on hold pending completion of the SEPA review and planning process. No new uses will be authorized within candidate reserve sites until the SEPA review and planning process for the site is completed (except as described below in 6.1 and 6.2).

6.1 Applications for use authorizations that will restore, enhance, and/or preserve the environmental features of the site and will serve to improve the ecological conditions of the site relative to its intent as described in the applicable reserve application, will be processed under the terms and conditions as set forth by DNR under its Conservation Leasing and Licensing Program.

6.2 Applications for short-term (less than one year) use authorizations that will have no functional, physical, or aesthetic impacts to the environmental features or ecological functions of the site may be authorized after a thorough review by region staff in consultation with Aquatic Resources Division staff.

7. Unauthorized and trespass activities (whether historical or new) located within candidate reserve sites shall be managed as follows:

7.1 Those activities determined to pose no or minimal environmental concerns relative to the intent of the reserve, as described in the applicable reserve application, <u>and that would be</u> authorized under normal (non-reserve) conditions, will be identified, documented as existing by region staff, and allowed to continue until the SEPA review and planning process is completed.

7.2 Those activities determined to pose significant environmental concerns relative to the intent of the reserve, as described in the applicable reserve application, <u>and/or that would not be</u> authorized under normal (non-reserve) conditions, will be prohibited and pursued as a trespass against the state in the same manner as would any trespass in a non-reserve area.

7.3 Those activities that are subject to public, political, and/or regulatory pressures will be evaluated based on the best available knowledge to determine their compatibility with the intent of the reserve, as described in the applicable reserve application.

Appendix I – Site Evaluation

Site Evaluation Forms

General Evaluation Criteria

The following form is used to evaluate all proposed reserve sites. Educational reserves and scientific reserves require additional evaluation. (See additional forms, following).

In the evaluation, most site conditions and characteristics are assigned a score of Poor, Fair, Good, or Excellent. Criteria for assigning the scores are shown for each condition or characteristic evaluated. The scores assist the Technical Advisory Committee in making recommendations for aquatic reserve status.

The evaluation is drawn directly from the Washington State Department of Natural Resources Aquatic Resources Program's "Non-Project Final Environmental Impact Statement Aquatic Reserves Program Guidance" (Final EIS), (September 6, 2002). The italicized items below can be found in Section 3.2.1.3.4, Designation Criteria, on pages 21 and 22 of that document.

The ecological and cultural quality of the site

What is the current condition of the site?

1. Is the site degraded?

Site is heavily degraded with more than 50% of the shoreline hardened or otherwise altered. **Poor**	Site is moderately degraded with 25%- 50% of the shoreline hardened or otherwise altered. **Fair**	Site is minimally degraded with 10 - 25% of the shoreline hardened or otherwise altered, and 75% - 90% of habitat intact. **Good**	No noticeable signs of human-caused impacts on or near site. Site is considered 'pristine.' Site is not degraded or otherwise altered (0-10% shoreline hardened, 90-100% of habitat intact). **Excellent**

2. Are non-native species found at the site?

Site is heavily degraded by multiple non-native species. Habitats are being altered as a result of invasion. **Poor**	Non-native species are abundant at the site and at least one species is considered invasive. **Fair**	Non-native species are identified at the site; however, they are uncommon and none are considered to be invasive. **Good**	No non-native species are identified at the site. **Excellent**

3. Are there water quality concerns associated with the site? (Water quality concerns may include low dissolved oxygen concentrations in the water column, toxic pollutants in the water column, or elevated risks of algal blooms as a result of human-caused inputs).

There are current water quality concerns. The source has not been identified or remediation/ correction or water quality is not improving. **Poor**	There are current water quality concerns. The source has been identified and remediation/correction have begun and water quality is improving. **Fair**	Water quality is not a current concern at the site; however, water pollution or dissolved oxygen concerns have been noted in the area in the past. **Good**	No signs of water pollution exist at the site, nor have any been documented in the past. **Excellent**

4. Are there signs of habitat loss within the site?

Evidence of dramatic habitat loss (less than 25% of historic habitat is intact). **Poor**	Evidence of habitat loss is noticeable (25%-75% of historic habitat is intact). **Fair**	Little evidence of habitat loss as a result of human caused development (75-90% of historic habitat is intact). **Good**	No evidence of habitat loss as a result of human-induced development (more than 90% of historic habitat is intact). **Excellent**

5. Are ecosystem processes intact (e.g., freshwater flow, littoral drift, nutrient cycling, etc.)?

Many ecosystem processes are not functional. Habitat and ecosystem relies on frequent management inter-ventions to be sustained. **Poor**	Some ecosystem processes are degraded or disrupted. Habitat and ecosystem benefits from occasional management interventions. **Fair**	Some ecosystem processes are degraded or disrupted. Ecosystem appears to be recovering without management interventions. **Good**	No ecosystem processes are noticeably degraded or disrupted. Management interventions would not benefit habitat or ecosystem. **Excellent**

Risks to the ecosystem or feature of interest (If applicable)

6. Can ecological concerns contributing directly to the area's decline be prevented through reserve establishment?

All ecological concerns cannot be mitigated through establishment of reserve. Ecological concerns are external to authorization of reserve and must be managed using other tools. **Poor**	Reserve establishment would prevent some, but not all, ecosystem ecological concerns occurring within the site. Ecological concerns contributing to decline beyond site boundaries would not be directly affected. **Fair**	Reserve establishment would prevent most ecosystem ecological concerns occurring within the reserve, and minimize some ecological concerns extending beyond site boundaries. **Good**	Reserve establishment would prevent all ecological concerns occurring within the site and provide benefits beyond site boundaries. **Excellent**

Restoration potential (If applicable)

7. Is there pending restoration at the site?

No restoration plans exist. Transportation or other government infrastructure is highly dependent upon the continued use of the site. **Poor**	Draft restoration plan exists, but no final plans, nor implementation plan exists. Site includes many landowners and stakeholders with divergent interests in restoration. **Fair**	Restoration planning is at advanced stages. Restoration process has identified partial funding for restoration. **Good**	Restoration process is prepared to proceed. Implementation plan exists, partners are in place and permitting is taking place. **Excellent**

8. Would restoration benefits extend beyond site boundaries?

Restoration benefits are not described with a conceptual model. Restoration benefits uncertain. **Poor**	Restoration benefits are described with a conceptual model. Restoration benefits primarily occur within the site. **Good**	Restoration benefits are described with a conceptual model. Restoration benefits both within and beyond site. **Excellent**

Special value for biodiversity or species diversity

9. Does the site contain or support a large number of species?

Species richness at the site is less than similar sites within the region. **Poor**	Species richness at the site is similar to other sites within the region. **Fair**	Species richness at the site exceeds similar sites within the region, however most species are transient or seasonally present. **Good**	Resident species richness at the site exceeds similar sites within the region and the site is highly utilized throughout the year. **Excellent**

10. Does the proposed site capture habitat used regularly by species of special conservation interest?

Habitat is not documented for use during critical life stages of a listed species. **Poor**	Habitat is used during critical life stages by several species whose populations are not depressed or at risk. **Fair**	Habitat is used during critical life stages by any one species listed in appendices E or F or another reference. **Good**	Habitat is used during critical life stages by more than one state or federally threatened or endangered species. **Excellent**

11. Does the proposed site capture vulnerable habitats, life stages or populations? (Vulnerable habitats, life stages or populations include: seal haul-outs, breeding bird aggregations or rookeries, seasonal bird aggregations, seasonal fish aggregations (feeding or breeding), or fish spawning aggregations).

Site is not documented to include any of the described vulnerable habitats, life stages or populations. **Poor**	Site is documented to support at least one of the described vulnerable life stages. **Fair**	Site is documented to support at least one of the described vulnerable life stages; likely to include more than one. **Good**	Site is documented to support more than one vulnerable habitat, life stage or population. **Excellent**

Ecological processes that sustain the aquatic landscape

12. Would protection of the site protect/maintain ecological processes?

Establishment of aquatic reserve will not protect any geological, physical, chemical, or biological processes within or outside of site. **Poor**	Establishment of aquatic reserve will protect some geological, physical, chemical, or biological processes within the site, but will have limited if any impact on processes beyond the site. **Fair**	Establishment of aquatic reserve will protect some geological, physical, chemical, or biological processes within the site and some processes beyond the site. **Good**	Establishment of aquatic reserve will protect most geological, physical, chemical, or biological processes within the site and some processes beyond the site. **Excellent**

The cultural quality of the site

13. Does the site contain or protect significant cultural resources? Does the site contain heritage, historical, or cultural resources that are eligible for the Washington Register of Historic Places, RCW 27.34.220 or the National Register of Historic Places? Evaluate the value of those described in the proposal from a regional or statewide basis (e.g., sites listed on the state or national historical register or significant historical indigenous use areas would have high values).

No sites have been reported at the site. **Poor**	Sites of state importance have been documented at the site. **Good**	Sites of national importance have been documented at the site. **Excellent**

14. Has the site yielded or is the site likely to yield information important in prehistory or history?

No heritage, historical, or cultural features exist at the site. **Poor**	Heritage, historical, and/or cultural features are documented to exist at the site. Features are common regionally. **Good**	Heritage, historical, and/or cultural features are documented to exist at the site. Features are regionally or nationally important. **Excellent**

Habitats and features represented within the site

Good example (relatively undisturbed) of representative habitats compared with the overall reserve program goal

15. Does the proposed site capture species or habitats that are much less common within the biogeographic region than they were historically?

Habitats found at site are common and there is no evidence of habitat loss. (More than 90% of historic habitat abundance is intact).	Habitats found at the site are not common or there is evidence that habitats have declined by 10-25% from historic abundance within biogeographic region.	Habitats found at the site are becoming rare, or have declined more than 25-75% from historic abundance within biogeographic region.	Habitats found at the site are rare or there is evidence of dramatic habitat loss (less than 25% of historic habitat is intact).
Poor	**Fair**	**Good**	**Excellent**

Habitat types that are under-represented in the aquatic reserves program or marine protected area network

16. Does the site contain representative habitats not otherwise protected in the network of protected areas or aquatic reserves?

All natural habitats found on site are protected within biogeographic region at a level that exceeds their historic representation within biogeographic region or sub-region.	All natural habitats found on site are protected within biogeographic region at a level that is comparable to their historic representation within biogeographic region or sub-region.	All natural habitats found on site are protected within biogeographic region at a level that is below their historic representation, but comparable to the current representation of habitats within biogeographic region or sub-region.	All natural habitats found on site are protected within biogeographic region at a level that is below their historic representation and below current representation of habitats within biogeographic region or sub-region.
Poor	**Fair**	**Good**	**Excellent**

Biogeographical location that is under-represented in the aquatic reserves program or marine protected area network

17. Is the site located in a biogeographic region or sub-region that is underrepresented in the existing reserve network?

25% or more of the biogeographic region or sub-region is protected in aquatic reserves or other regulatory or proprietary protected areas. **Poor**	10 – 25% of the biogeo-graphic region or sub-region is protected in aquatic reserves or other regulatory or proprietary protected areas. **Fair**	5-10% of the biogeographic region or sub-region is protected in aquatic reserves or other regulatory or proprietary protected areas. **Good**	Less than 5% of the biogeographic region or sub-region is protected in aquatic reserves or other regulatory or proprietary protected areas. **Excellent**

Viability of the occurrences of interest

Site features meet the intent of the reserve

18. Are species, habitats, or ecosystem processes consistently associated with reserve site?

Habitats, species, or processes are ephemeral and are inconsistently found at site. **Poor**	Habitats, species, or processes are ephemeral, but are consistently found at site. **Fair**	Habitats, species, or pro-cesses are seasonal and have been consistently associated with the site. **Good**	Habitats, species, or processes are found at the site throughout the year. **Excellent**

Number of ecological processes

19. Does the site contain unique or distinctive physical habitat features (e.g., oceanographic gyre, oceanographic sill, natural beach spit, etc)?

No unique or distinctive features are identified. **Poor**	Site includes parts of unique or distinctive features. **Fair**	Site completely surrounds unique or distinctive ecological features. **Good**	Site completely surrounds unique or distinctive ecological features and includes buffers. **Excellent**

Defensibility of the site

Connectivity to a reserve or protected area network and/or species and/or habitats

20. Does the site provide regional habitat connectivity through any of the following functions: refuge (predator, physiological, high energy), food production, migratory, corridors, spawning, nursery or rearing, riparian vegetation, adult habitat, other functions.

Site appears to be isolated and species neither disperse to or from the site on a consistent basis and the site is not used consistently by species during migration or movements. No connectivity.	Site is used by a variety of species that remain within the region. Site is not consistently used. Limited regional connectivity not clearly established for any site-associated species.	Site is heavily used by one or more species on a consistent seasonal basis, however, species appear to be able to use other sites and are not found at the site in abundance every year. Connectivity is established for habitat utilized by site-associated species for more than one function.	Site is heavily used by one or more species, either throughout the year or on a seasonal basis. If only used seasonally, the site is used consistently and species movements include the site every year. Connectivity is established for habitat utilized by site-associated species. Connectivity established for multiple functions.
Poor	**Fair**	**Good**	**Excellent**

Appropriate size to be sustainable

21. Is area large enough to be self-sustaining?

Site is insufficient for internal recolonization.	Site is large enough to allow limited internal recolonization. However, disturbance events are likely to disrupt entire site.	Site is large enough to allow internal recolonization. Disturbance events are unlikely to disrupt entire site.	Site is large enough to allow internal recolonization. Disturbance events are unlikely to disrupt entire site. Site supports range of successional communities
Poor	**Fair**	**Good**	**Excellent**

Ability to persist over time

22. Can site be successfully managed to maintain the features of interest?

Declines in features of interest are caused by factors external to the site. Reserve designation would have no tangible benefits. **Poor**	Declines in features of interest are strongly influenced by factors external to the site. Reserve designation would provide tangible benefits. **Fair**	Declines in features of interest are strongly influenced by factors internal to the site. Reserve designation would have tangible benefits within site boundaries. **Good**	Declines in features of interest are strongly influenced by factors internal to the site. Reserve designation would have tangible benefits within and beyond site boundaries. **Excellent**

Known or anticipated activities that endanger the site or habitat

23. Are there known human-caused or natural ecological concerns to the continued viability of the site?

Existing modifications at the site, and/or adjacent area(s) to the site, will impact the habitat and functions of over 50% of the proposed reserve. **Poor**	Existing modifications at the site and/or in adjacent area(s) will impact the habitat and functions of less than 50% of the proposed reserve. **Fair**	There are no existing modifications in or adjacent to the proposed reserve that will impair the habitat and function of the proposed reserve. Present land use regulations do allow for modifications. **Good**	There are no existing modifications in or adjacent to the proposed reserve that will impair the habitat and function of the proposed reserve. Existing land use regulations do not permit modifications in or adjacent to the site that will impact the habitat & function of the proposed reserve. **Excellent**

Potential for factors contributing directly to the area's decline to be prevented

24. Would reserve status provide protection for habitats, species, or processes of interest from encroachment?

Existing uses at the site, and/or adjacent areas to the site, will impact the habitat and functions of more than 50% of the proposed site. **Poor**	Existing uses at the site and/or in adjacent areas will impact the habitat and functions of 25-50% of the proposed site. **Fair**	Existing uses at the site and/or in adjacent areas will impact the habitat and functions of 0-25% of the proposed site. **Good**	Existing uses, zoning, and land use regulations will complement the proposed site and pose no ecological concerns. **Excellent**

Manageability of the site

Coordination with other entities, including local jurisdictions and current leaseholders

25. Does the proposal include coordination of reserve actions with other entities, including local jurisdictions and current leaseholders?

Proposal fails to identify any steps for coordination among landowners, stakeholders, and regulators. **Poor**	Proposal identifies steps for coordination with regulators; however, fails to recognize role of landowners or stakeholders. **Fair**	Proposal identifies steps for coordination with Tribes, state agencies, landowners/ stakeholders, education organizations and the public. **Good**

Area previously identified for protection

26. Has another entity previously identified this site or areas within the site as a priority for protection? (Examples include Important Bird Areas (Cullinan 2001), priority areas for Research Natural Area Designation (Dyrness et al. 1975), or priority areas for conservation (e.g., through ecoregional planning, Natural Heritage Program research (Kunze 1984), or similar process (Dethier 1989)).

Site has not been documented as a priority for conservation and does not appear to meet documented conservation planning goals. **Poor**	Site has not been documented as a priority for conservation, however site appears to meet documented conservation goals. **Fair**	Site is included in one planning or priority areas document. Site condition and resources appear to be relatively unchanged since planning effort. **Good**	Site is included in two or more planning or priority areas documents. Site condition and resources appear to be relatively unchanged since planning effort. **Excellent**

Potential cooperative partners for management, monitoring, or enforcement

27. Have potential cooperative management partners been identified?

No management, monitoring, nor enforcement partners are identified in proposal. **Poor**	One or more management, monitoring, or enforcement partners are identified. Potential partners make no official letters of support or commitments. **Fair**	One or more management, monitoring, or enforcement partners are identified. Official letters of support or commitment are made by at least one potential partner. **Good**	Two or more management, monitoring, or enforcement partners are identified. Official letters of support or commitment are made by at least two potential partners. **Excellent**

Adjacent natural areas or public lands

28. Is site adjacent to terrestrial protected areas managed for conservation or restoration purposes?

Not adjacent to a terrestrial protected area. **Poor**	25% of proposed site is adjacent to a terrestrial protected area. **Fair**	50% of proposed site is adjacent to a terrestrial protected area. **Good**	Over 75% of proposed site is adjacent to a terrestrial protected area. **Excellent**

Description of how to measure success (i.e., monitoring) and kinds of monitoring needed

29. Does reserve proposal include a monitoring plan that measures reserve progress towards goals and provides for adaptive management?

Proposal does not include any form of monitoring or adaptive management. **Poor**	Proposal includes adaptive management, but does not include any description of the role of monitoring nor implementation of adaptive management. **Fair**	Proposal describes monitoring plan and adaptive management, but does not describe how monitoring results should be used to influence management. **Good**	Proposal includes monitoring and adaptive management. Plan describes how monitoring results will affect management actions. **Excellent**

Kinds of enforcement needed to make sure incompatible uses and impacts do not encroach on the reserve

30. What kind of enforcement is needed to prevent incompatible uses and impacts from encroaching on the reserve?

Active enforcement is a pre-condition for reserve success. **Poor**	Active enforcement would provide benefits not otherwise available. **Fair**	Reserve designation must be accompanied by stakeholder and resource user education to develop best practices. **Good**	Reserve designation alone is sufficient to protect most resources from their primary ecological concerns. **Excellent**

Evaluation Criteria for Scientific Reserves

In addition to being evaluated using the general criteria that apply to all types of reserves, sites proposed as scientific reserves are evaluated to determine their suitability for designation as a Scientific Reserve. The basis for these criteria for scientific reserve evaluation can be found on pages 24 - 25 of the Final EIS. In order to minimize redundancy, criteria that have already been a part of the general discussion will not be repeated here.

Objective

Scientific reserves should be established to ensure environmental protection by:

1. Providing sites that can be scientifically manipulated for the benefit of knowledge.
2. Providing reference sites against which to measure effectiveness of environmental protection; and
3. Managing sites with unusually rich plant and animal communities.

Site is of interest to scientific community

1. Does site represent a unique research opportunity?

Similar research has taken place within the local ecosystem, but not at the proposed site. **Poor**	Similar research has taken place outside of the local ecosystem; however research has not taken place within local system. **Fair**	Research proposal is novel and has not been undertaken. Site provides opportunity to explore ecosystem. **Good**	Research proposal is a continuation or expansion of existing research at or near research site. **Excellent**

Site is unusually species-rich

2. Does site exceed expected species richness for areas of similar size? (e.g., does site contain plant and animal communities suitable for continuing scientific observations (WAC 332-30-106).

Site has lower species richness than similar sized areas within biogeographic region. **Poor**	Site has species richness comparable to similar sized areas within biogeographic region. **Fair**	Site has species richness in excess of similar sized areas within biogeographic region. **Good**

Site contains a high degree of biodiversity for habitat type

3. Does site exceed expected biodiversity as measured using Shannon's diversity index (an index that measures diversity and evenness of species) for similar habitats?

Habitats have a lower diversity index value than similar habitats within the biogeographic region. **Poor**	Habitats have a comparable diversity index value than similar habitats within the biogeographic region. **Fair**	Habitats have a higher diversity index value than similar habitats within the biogeographic region. **Good**

Site could be manipulated without doing irreparable harm to its neighboring systems or habitats in order to advance knowledge (where applicable)

4. Do proposed manipulations affect the physical (e.g., habitat structure or ecosystem processes) or biological composition of the site?

Manipulation significantly disrupts ecosystem processes or physical structure of site. Restoration is uncertain or would take an extended amount of time. **Poor**	Manipulation significantly disrupts ecosystem processes or physical structure of site. Natural recovery is likely and would be rapid. **Fair**	Manipulation primarily affects biological composition of site. Natural recovery is unlikely or would take extended period of time. **Good**	Manipulation primarily affects biological composition of site. Natural recovery is likely and would be rapid. **Excellent**

5. Are impacts of manipulation restricted to the site?

Proposed research will cause permanent damage to site and impacts will extend beyond the site. **Poor**	Proposed research will cause some permanent damage to site; however, impacts are likely to be contained within the site. **Fair**	Proposed research will not cause any permanent harm to the site or adjacent area or habitat. **Good**

Site has a history of monitoring or an opportunity for long - term monitoring

6. Does site have a historical monitoring record?

Site has no historical monitoring record, regional monitoring data do not exist. **Poor**	Site has no historical monitoring record, however regional monitoring data does exist. **Fair**	Site has a history of biological and physical process monitoring. Site is not included in regional monitoring programs (e.g., PSAMP). **Good**	Site has a history of biological and physical process monitoring. Site is presently included in regional monitoring programs (e.g., PSAMP). **Excellent**

Evaluation Criteria for Educational Reserves

In addition to the general evaluation criteria that apply to all types of reserves, above, sites proposed as educational reserves are evaluated for the following specific criteria as well. The basis for these criteria for educational reserves can be found on page 24 of the Final EIS. In order to minimize redundancy, criteria that have already been evaluated in the general discussion above will not be repeated here.

Objective

Educational reserves should be established to ensure environmental protection by:

- Keeping unique aquatic sites available for environmental education opportunities; and
- Educating people about the value of aquatic habitat to ensure environmental protection.

Network of sites that provide an accessible distribution of sites throughout the state

1. Are environmental education reserves available within biogeographic region? (Examples of other education reserves may include areas operated by U.S. Fish and Wildlife Service, National Park Service, Washington State Parks and Recreation, or The Nature Conservancy that offer educational curricula).

Site is within 50 miles of another educational reserve within the biogeographic region that provides educational services for substantially comparable habitats. **Poor**	Publicly accessible education reserves exist within biogeographic region that contain substantially comparable habitats; however, they are more than 50 miles away. **Fair**	Publicly accessible education reserves exist within biogeographic region; however, other reserves represent a substantially different habitat type. **Good**	No publicly accessible education reserves exist within biogeographic region **Excellent**

Network of sites that provides an adequate distribution among habitat types

2. Is the proposed site a unique example of habitat available for educational opportunities regionally or statewide?

The habitat is common in the region. There would be several similar sites available for educational purposes. **Poor**	The habitat is common in the region. However, few of the sites that contain the habitat are available for educational purposes. **Fair**	There are only a few of the habitat types proposed for a reserve dispersed across the region or state. **Good**

Sites that attract a range of target audiences

3. Is the curriculum integrated into an applied educational program (e.g., school, public education program, etc.) and tailored to the unique features of the site.

Curriculum is not being developed for application to any existing educational programs and/or specific habitat features. **Poor**	Curriculum is being developed for generic educational application, but for no specific habitat features. **Fair**	Curriculum is being developed for a specific educational program for an established educational facility or school system, but for no specific habitat features. **Good**	Curriculum is being developed for specific educational program for an established educational facility or school system and tailored for the specific habitat features of the proposed site. **Excellent**

Sites that are compatible with educational-use activities

4. Are activities and conditions in the areas adjacent to the proposed reserve compatible to the uses proposed for the reserve?

Public access and use of the site may have long-term impacts on the site. Most impacts cannot be prevented through passive site management. **Poor**	Public access and use of the site may have long-term impacts on the site. Most impacts can be prevented through passive site management. **Fair**	Public access and use of the site is unlikely to have any long-term impacts on the site. Site may require partial or complete seasonal closures to avoid disturbing the local environment. **Good**	Public access and use of the site is unlikely to have any long-term impacts on the site. Site can be used for education throughout the year without disturbing the environment. **Excellent**

Current site conditions or activities adjacent to the site are compatible with an educational reserve

5. Are activities and conditions in the areas adjacent to the proposed reserve compatible to the uses proposed for the reserve?

Adjacent uses and activities are not compatible with educational activities or environmental preservation. **Poor**	Adjacent uses and activities are mostly compatible with educational activities, but may not be compatible with environmental preservation. **Fair**	Adjacent uses and activities are compatible with educational activities and presently compatible with environmental preservation (e.g., existing zoning not compatible) **Good**	Adjacent uses and activities complement educational activities and support continuing environmental preservation of the site and adjacent areas. **Excellent**

Site whose ecological integrity can be preserved while providing public access

6. How will the proponent maintain the unique ecological features of the site while providing public access for an education program?

Actions are not adequately addressed or established to ensure compatibility of ecological integrity and public access. **Poor**	Actions are addressed or established, but with no assurance that ecological integrity is maintained. **Fair**	Actions are addressed and established that support the environmental goals of the reserve and promote public access with attention to impacts to the site's ecological integrity **Good**

Site has a history of monitoring and an opportunity for long-term monitoring. (Criterion applicable in cases described by Final EIS 3.2.1.4.3).

7. Does site have a historical monitoring record?

Site has no historical monitoring record, and regional monitoring data do not exist. **Poor**	Site has no historical monitoring record, however regional monitoring data do exist. **Fair**	Site has a history of biological and physical process monitoring. Site is not included in regional monitoring programs (e.g., PSAMP). **Good**	Site has a history of biological and physical process monitoring. Site is presently included in regional monitoring programs (e.g., PSAMP). **Excellent**

Appendix J – Aquatic Reserve Technical Advisory Committee Recruitment

Aquatic Reserve Technical Advisory Committee

Opens: March 1, 2003
Closes: Nominations will remain open indefinitely in order to continue to establish a pool of qualified candidates for future Aquatic Reserve Committees.

The Department of Natural Resources (DNR) is recruiting to develop a pool of qualified individuals to serve on the Aquatic Reserves Technical Advisory Committee (TAC).

Aquatic Reserve Program

The Aquatic Reserves Program is used by DNR to establish aquatic reserves on state owned aquatic lands with unique ecological features and habitats, in order to protect and support those elements.

Duties of the Aquatic Reserves Advisory Committee

Committee members will review, score, and rank nominated sites for the Aquatic Reserves Program (Program) and make recommendations to the Commissioner of Public Lands for further consideration and action. The reviewing, scoring, and ranking criteria are established by DNR and are consistent with the Final Environmental Impact Statement Aquatic Reserves Program Guidance September 6, 2002. Seven people are selected to serve as Committee members for each review cycle and two people are chosen as substitutes. Individuals may be asked to serve during other cycles as well. Committee members must:

1. Be available to meet for one day to be briefed on aquatic reserves and the process for reviewing and scoring proposals for aquatic reserves.
2. Be available for up to 3 days to conduct site visit(s) at proposed aquatic reserves locations.
3. Rate and rank all proposals for aquatic reserves.
4. Meet for up to two consecutive days in Olympia to evaluate aquatic reserve proposals.

DNR will provide staff support for the Committee members. Committee members will not be compensated for their services but are reimbursed for travel, lodging, and meals based on Washington State per diem rates.

Nominations for the Aquatic Reserves Advisory Committee

a. Individuals are invited to submit their qualifications for consideration.
b. Candidates for the advisory committee must meet the minimum qualifications described below.
c. All qualified candidates are placed in a pool from which DNR will select committee members for aquatic reserve nomination cycles.

Preferred Qualifications

1. Advanced degree in one of the following disciplines: Coastal, marine, or freshwater aquatic ecosystems; marine resource management; ecology; oceanography; fisheries science; geology; cultural archeology; sociology or related fields.
2. Established professional experience in one or more of the following areas related to aquatic ecosystems: Teaching; conducting research; or designing, establishing, or managing aquatic conservation areas, aquatic reserves, and/or protected areas.
3. Candidates must disclose all professional affiliations with any of the following organizations:
   a. Washington Department of Natural Resources
   b. Aquatic land user groups, environmental advocacy groups, or private industries that utilize aquatic lands and resources.
   c. Sites under consideration for aquatic reserve status (including research, contract, or advocacy efforts). List sites.
4. Candidates must be willing to commit to the following:
   a. Evaluate aquatic reserve proposals using criteria developed by Washington Department of Natural Resources.
   b. Spend the necessary time to review site proposals and aquatic reserve program information, and to complete scoring and ranking of proposals prior to Committee meetings in Olympia.
      Note: Time requirements are dependent on the number and geographic location of proposals. The time requirements described below are the minimum established for evaluating six reserves during the 2003-year cycle.
   c. Be available to meet for one day to be briefed on aquatic reserves and the process for reviewing and scoring proposals for aquatic reserves.
   d. Be available for up to 3 days to conduct site visit(s) at proposed aquatic reserves locations.
   e. Rate and rank all proposals for aquatic reserves.
   f. Meet for up to two consecutive days in Olympia to evaluate aquatic reserve proposals.
   g. Work collaboratively with fellow committee members to evaluate aquatic reserves.
   h. Submit completed site evaluations at the conclusion of the Committee meeting.

To Apply: Submit information on the desired qualifications to:
E-mail: david.palazzi@wadnr.gov
or mail: Aquatic Reserves Program Manager
Washington Department of Natural Resources
Aquatic Resources Division
P.O. Box 47027
Olympia, WA 98504-7027
360-902-1069

This recruitment notice and other updates and information about the DNR Aquatic Reserve Program can be found on the DNR Aquatic Resources Program web site. www.dnr.wa.gov/htdocs/aqr/reserves/home.html

Appendix F
Adaptive Management and Monitoring Program

Table of Contents

Appendix F. Adaptive Management and Monitoring Program F-1

1. Introduction F-1

1.1 Principles F-2

1.1.1 Encourage collaboration and participation F-2

1.1.2 Design scale-appropriate, science-based monitoring F-2

1.1.3 Embrace flexibility and an iterative process F-3

1.1.4 Promote conflict resolution F-3

1.1.5 Acknowledge realistic design costs F-3

2. Program Design F-4

2.1 Goals and Objectives F-4

2.1.1 Goal 1: Increase the quantity and improve the quality of covered species habitat on state-owned aquatic lands F-5

2.1.2 Goal 2: Decrease the quantity of known pressures to state-owned aquatic lands F-5

2.1.3 Goal 3: Increase the effectiveness of management actions applied to state-owned aquatic lands F-5

2.2 Organizational Structure F-5

2.2.1 Implementation Team F-7

2.2.2 Advisory Team F-8

2.2.3 Scientific Review Committee F-8

2.2.4 Habitat Conservation Plan Management Team F-8

2.2.5 Resolution Team F-9

2.3 Decision Framework F-9

3. Adaptive Management and Monitoring Set-up Phase 11

3.1 Conceptual Model Development F-11

3.2 Uncertainty F-13

3.3 Development of Management Alternative Matrices F-20

3.4 Development of Monitoring Plans F-22

3.4.1 Monitoring Scale F-23

3.5 Data Management Plan F-24

3.6 Assessment Methods and Decision Criteria F-24

4. Adaptive Management And Monitoring Program Iterative Phase F-26

5. References F-28

6. Attachments F-30

List of Figures and Tables

Figures

Figure 1.1 Relationship between adaptive management and monitoring..... F-1
Figure 2.1 - Adaptive Management and Monitoring Program organizational structure..... F-6
Figure 2.2 Aquatic Resources Program organization structure..... F-7
Figure 2.3. Decision framework indicating program and project scales of monitoring and targeted studies..... F-10
Figure 3.1 Illustration of the two phases of adaptive management and monitoring ... F-11
Figure 3.2 Conceptual model: overwater structures F-12
Figure 3.3 Log raft conceptual model F-13

Tables

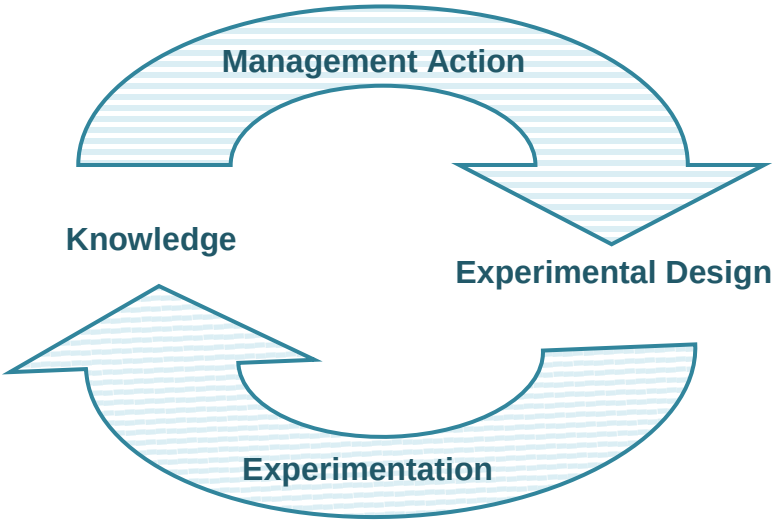
Table 3.1 Program level uncertainty F-14
Table 3.2 Preliminary research proposal F-16
Table 3.3 Example management alternatives matrix for overwater structures..... F-21
Figure 4.1 Reporting-feedback framework F-27

1. Introduction

Adaptive management emerged from the recognition that management of renewable resources requires that policy decisions be made in spite of biological uncertainty and data gaps. The term was originally defined by Holling in 1978 and expanded on by Walters (1986) as an approach "…to treat management as an adaptive learning process, where management activities themselves are viewed as the primary tools for experimentation." In the intervening years, adaptive management has become an approach to designing and implementing management actions as experiments, monitoring how the system responds to the management/experiment, evaluating the results of the action, and using the acquired knowledge to adjust future actions.

Because decisions made within the context of environmental management are often based on incomplete data and imperfect scientific understanding, adaptive management has become an essential component of natural resource management. Adaptive management is used to provide a decision-making process that can adjust resource management actions based on newly acquired science and the results of monitoring. The process is iterative by design, with management actions and experimentation linked as a way to increase the likelihood that natural resource management goals and objectives are achieved (Figure 1.1). For the process to be successful, it must begin with clearly defined goals and objectives, and ensure implementation of standardized procedures to track progress and guide change.

Figure 1.1 Relationship between adaptive management and monitoring.



For the Aquatic Lands Habitat Conservation Program, the Washington State Department of Natural Resources (Washington DNR) has chosen to combine adaptive management and effectiveness monitoring into a single program with two distinct phases:

- **Planning phase** –Define and refine objectives, uncertainty prioritization, conservation measures, decision criteria, monitoring plans and recruitment of interested parties.
- **Operational phase** – Implement , experiment , assess and, as necessary, adjust management actions.

1.1 Principles

The habitat conservation plan Adaptive Management and Effectiveness Monitoring Program is built on the following principles:

1.1.1 Encourage collaboration and participation

Although Washington DNR is the proprietary manager of state-owned aquatic lands, there are a number of governmental entities, tribes, businesses and individuals who regulate or use the land or associated biological communities. Therefore, DNR's Adaptive Management Program organizational structure will include an Advisory Team of invited individuals selected from Tribal governments, industry and state and federal agencies that have expertise to serve in an advisory role in the designing, implementing, and integrating adaptive management. These experts will assist in defining the objectives, methods and triggers for adaptive management. The support of external agency staff and other interested parties will decrease the potential for conflicts during the term of the habitat conservation plan (Stankey *et al.*, 2005, Williams *et al*. 2007), as well as provide opportunities for entities to share in the costs and benefits of reducing uncertainty.

1.1.2 Design scale-appropriate, science-based monitoring

Designing an effective monitoring and adaptive management program requires a clear strategy to establish priorities for the most important elements and critical uncertainties, as well as recognize that no program has the resources to monitor everything. Because of the complex interactions between biology, chemistry, and physical structure, this is particularly true in aquatic ecosystems. To address these interactions, Washington DNR has proposed use of flexible conceptual models (Section 3.3) that capture the complexities of the activity/ecosystem/species interactions, provide the opportunity to hypothesize potential responses, illustrate at what point management alternatives may be applied, and highlight where uncertainty is introduced. Field collection of data will focus on the types of habitat to be conserved (e.g., submerged vegetation) and limited to defined questions and uncertainties, with the scale of the question guiding the scale of the monitoring.

1.1.3 Embrace flexibility and an iterative process

Decision criteria will be developed with the recognition that the criteria may need to be updated and amended as our understanding of the system function increases. This iterative process allows for the incorporation of new, independently researched and published scientific information that is relevant to management of the habitat to be protected.

1.1.4 Promote conflict resolution

While adaptive management has helped make decision-making easier in the face of uncertainty, this approach has been criticized as weak from a conflict resolution perspective (Johnson 1999). Washington DNR will address this weakness through the use of a conflict resolution process led by a qualified and independent facilitator.

1.1.5 Acknowledge realistic design costs

DNR will maintain a sustainable level of funding for Adaptive Management that reflects the elasticity of Washington state's biennial budget. Washington DNR will carefully evaluate design costs over the course of the experiment, as well as potential costs of implementation before any research commitments are made.

2. Program Design

Washington DNR's habitat conservation plan Adaptive Management and Monitoring Program encompasses all aquatic lands directly owned by the state of Washington and managed by Washington DNR, underlying navigable[1] fresh, salt, and estuarine waters within the state of Washington. It does not include those lands that have been sold into private ownership, are managed by agencies other than Washington DNR, or are under waters that are not navigable for the purpose of establishing state title[2].

While the timeframe for this program—50 years—is the same as that for the habitat conservation plan and the incidental take permit, monitoring and decision criteria will be designed on interim timelines to allow the opportunity to adapt the management alternatives as necessary.

2.1 Goals and objectives

While this program is compatible with the goals and objectives of the habitat conservation plan [3], the goals and objectives for adaptive management and monitoring focus on monitoring changes in habitat. The goals of the program also frame the core parameters for effectiveness monitoring and direct the focus areas for the targeted studies.

2.1.1 Goal 1: Increase the quantity and improve the quality of covered species habitat on state-owned aquatic lands

Objectives

- Increase the area of aquatic vegetation coverage on state-owned aquatic lands
- Increased biodiversity of biological communities attached to and in state-owned aquatic lands (e.g., benthic invertebrates, aquatic vegetation).
- Increased area of restored or protected habitat on state-owned aquatic lands.

[1] Navigable waters are those lands that are capable of serving as a highway for commerce in their natural and ordinary condition, using customary modes of travel and trade on water. (WAC 332-30-106(41)).

[2] Washington DNR presumes "…all bodies of water meandered by government surveyors…" to be navigable for the purpose of establishing state title unless declared otherwise by a court. If there is a dispute about whether a water body is navigable for the purpose of vesting title in the state, the judiciary makes the final determination.

[3] Avoid and minimize effects to covered species and their habitats; Identify and protect important habitats for covered species; Improve and restore habitat quality to compensate for unavoidable effects of covered activities (Washington DNR 2010).

2.1.2 Goal 2: Decrease the quantity of known pressures to state-owned aquatic lands

Objectives

- Decrease the area of aquatic vegetation shaded by structures (e.g., overwater structures, log rafts).
- Decrease disturbance of sediment transport/deposition processes on state-owned aquatic lands.
- Decrease alteration of native sediment type or sediment chemistry.

2.1.3 Goal 3: Increase the effectiveness of management actions applied to state-owned aquatic lands

Objectives

- Design experimental treatments to evaluate the impacts of covered activities on habitat managed by Washington DNR.
- Design targeted studies to resolve uncertainties and improve understanding of the ecological function of aquatic vegetation, benthic communities, and sediment transport.

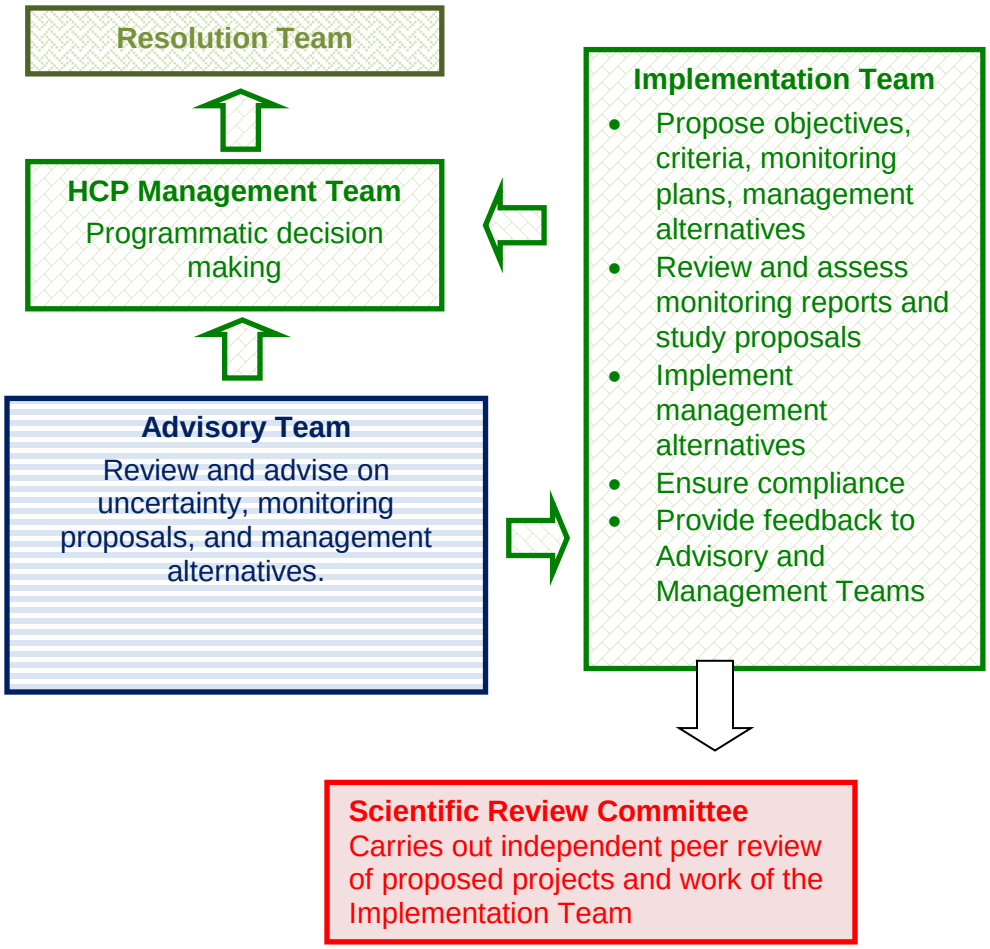
2.2 Organizational structure

The Washington DNR habitat conservation plan adaptive management and monitoring organizational structure consists of several groups that are responsible for initializing the set-up of the program, implementing the iterative phase, serving in an advisory role, providing peer review, and resolving disputes (Figure 2.1), These groups include the Implementation Team, the Advisory Team, a Management team and a Resolution team.

The Adaptive Management and Monitoring Program for habitat conservation plan is designed to incorporate strong interagency expertise and involvement by other interested parties. However, the program will be most successful if others who regulate or use state-owned aquatic lands reach agreement on the program's objectives; advise on approaches for reducing uncertainties; and research results justify adjusting management actions in the plan. Because the geographic scope of the habitat conservation plan is so large, involving diverse ecosystems and habitats as well as legal and political jurisdictions, adaptive management and monitoring require the resources of more than a single entity. Therefore, the scope of the adaptive management program is contingent on the level of resources provided to monitoring and assessment from interested parties other than DNR.

It is anticipated that much of the baseline information and broader scale status and trends monitoring data can be gathered and evaluated through existing external monitoring and modeling programs. Where data is unavailable or incomplete, Washington DNR will dedicate staff and funding for the necessary field sampling, analysis, and reporting. Other interested parties will be encouraged to identify and explore targeted studies relevant to their area of expertise or interest. To ensure participation by others, expectations regarding resource commitment and areas of uncertainty to be addressed will be explicitly defined and agreed upon early in the process. Involvement by others will be encouraged throughout the set up (planning) and iterative (process) phases of the habitat conservation plan.

Figure 2.1 Adaptive Management and Monitoring Program organizational structure**.**

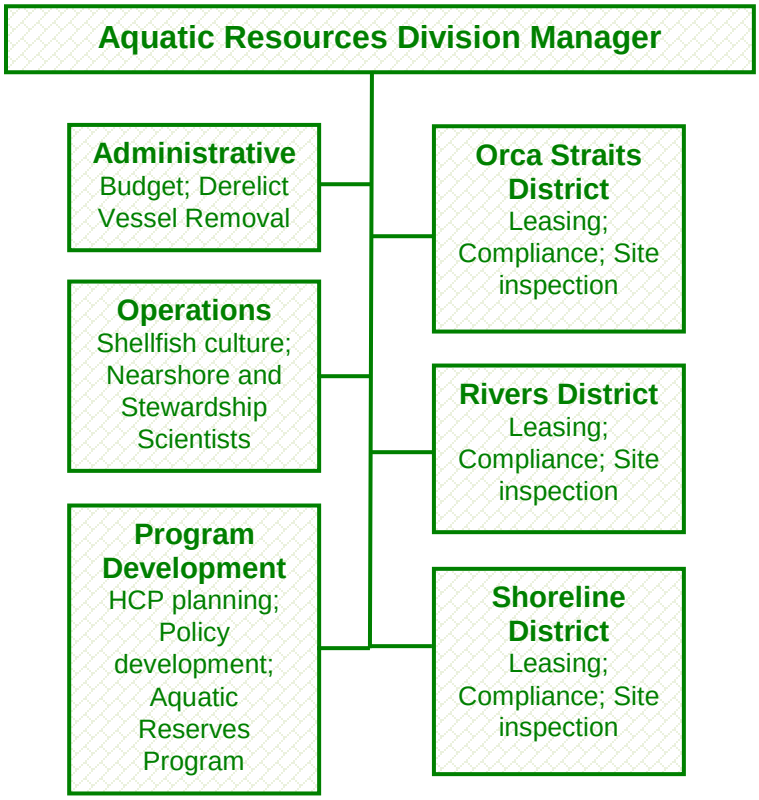


2.2.1 Implementation Team

The Implementation Team comprises agency staff responsible for the day-to-day operations, development. and implementation of both the habitat conservation plan and the Adaptive Management and Effectiveness Monitoring Program. There will be a core team comprising the research and monitoring staff from the Washington DNR's Aquatic Resources Division; land managers with contributions as needed from stewardship and nearshore science programs; planning and policy staff; assistant division managers; and program specialists (e.g., shellfish aquaculture, derelict vessel removal), and is organized under the current Aquatic Resources Division structure. Figure 2.2 illustrates the structure that currently exists. Only elements relevant to the habitat conservation plan are shown.

The team proposes objectives and management alternatives; implements the management actions; reviews and assesses monitoring results and targeted study proposals; collects data; ensures compliance with the terms and conditions of the habitat conservation plan; and provides summaries and recommendations to both the Technical Team and the Management Team.

Figure 2.2 Aquatic Resources Program organization structure (2012).



2.2.2 Advisory Team

The Advisory Team comprises interagency, tribal, and private sector scientists and technical staff. This Team's involvement is critical to successful initiation of the adaptive management and monitoring planning phase. They are responsible for providing input on management objectives and monitoring plans. While their work is collaborative, it is also intended to integrate technical and practical expertise on a specific subject matter into the overall discussion.

The Advisory Group will be led by the Aquatic Lands Habitat Conservation Plan Research and Monitoring staff, with members invited to participate by the Management Team. Members will be recruited based on expertise related to covered species and activities. Meetings frequency will be contingent on the pace of the decision-making process.

2.2.3 Scientific Review Committee

The Science Review Committee performs independent peer review of proposed projects and work of the Implementation Team to determine if it is scientifically sound and technically reliable. The SRC may also review relevant external work submitted to the Implementation or Advisory Teams. The Scientific Review Committee is contracted by the Management Team to carry out an independent scientific peer review process. The Science Review Committee comprises individuals who have experience in scientific research and who have no affiliation with the DNR habitat conservation plan. Members of the Advisory Team may nominate committee members, members are selected by a coordinator appointed by the habitat conservation plan Management Team. The habitat conservation plan Advisory teams recommends what products should be subject to review by the SRC; however, the SRC generally reviews final reports of Implementation Team studies, study proposals, final study plans, and pertinent studies not published in Advisory Team-approved, peer-reviewed journal. Other products that may require review include external information or data, work plans, requests for proposal and progress reports.

2.2.4 Habitat Conservation Plan Management Team

The Management Team is led by the Washington DNR Planning Program manager and includes the Aquatic Resources Division manager, Assistant Division managers, and the Aquatic Assessment and Monitoring Team lead. The team meeting frequency will be determined as the program becomes operational. This team is responsible for successful implementation of the habitat conservation plan operating conservation program, as well as programmatic decision-making related to adaptive management and effectiveness monitoring. Programmatic decisions will be made based on input from the Advisory Team and recommendations and identified issues from the Implementation Team. In the event that agreement cannot be reached among these two groups, the Management Team will attempt to resolve the issues. Where the parties do not achieve resolution, the matter given to the Resolution Team for consideration.

2.2.5 Resolution Team

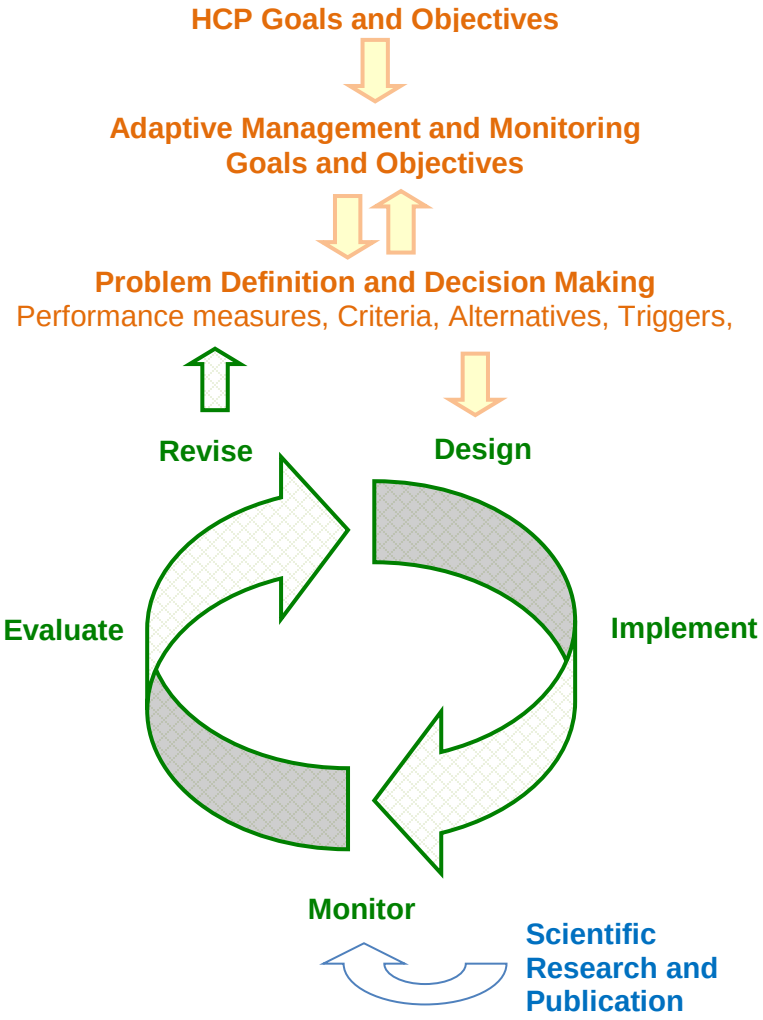
The group consists of an independent facilitator selected by Washington DNR; a representative from the Management Team; a senior-level manager from Washington DNR, NOAA Fisheries, and U.S. Fish and Wildlife; and an issue representative from the Technical Team. The function of the team is to negotiate a successful resolution of issues arising under the Adaptive Management and Effectiveness Monitoring Program and to ensure compliance with the habitat conservation plan, as well as applicable state and federal mandates.

When the Technical Team or Implementation Team are unable to agree on a matter of the Adaptive Management and Monitoring Program, issues will be elevated to the Management Team. If the Management Team is unable to reach agreement, issues will then be elevated to the Resolution Team. Decisions reached by either the Management Team or the Resolution Team are considered final.

2.3 Decision framework

The decision framework for this program follows the adaptive management cycle and incorporates pathways for the inclusion of external research in the evaluation of actions and monitoring (Figure 2.3). The decision- and problem-definition processes are guided by the goals and objectives of both the habitat conservation plan and the Adaptive Management and Monitoring Program, with risk and uncertainty assessed through targeted studies. Monitoring will occur on both a project (effectiveness) and programmatic basis Performance measures will be used to define desirable ecosystem responses to management actions (e.g. increased density in submerged aquatic vegetation with reduced shading), undesirable responses (e.g. increase in invasive vegetation), and other endpoints or parameters of concern.

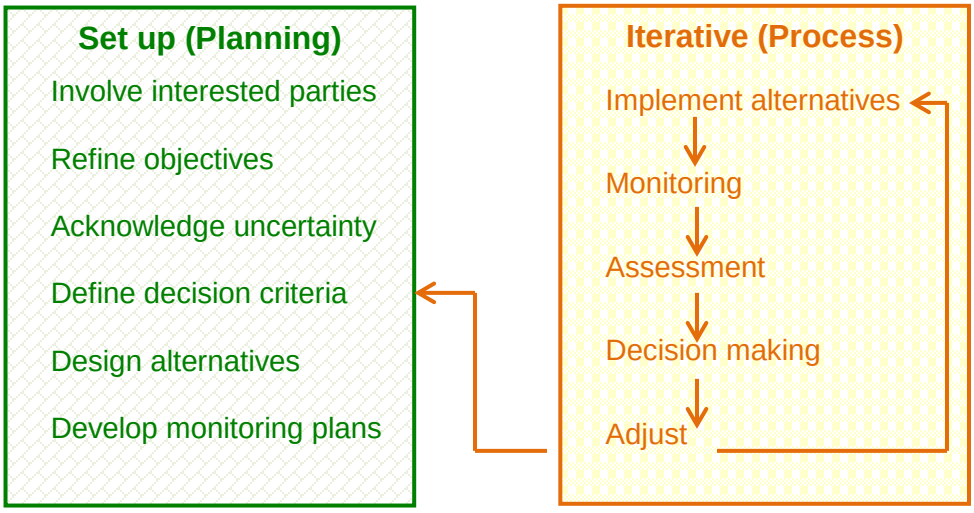
Figure 2.3 Decision framework indicating program and project scales of monitoring and targeted studies (modified from Murray and Marmorek, 2004).



3. Adaptive Management and Monitoring Set-up Phase

Developing an Adaptive Management and Monitoring Program consists of set up (planning) and iterative (process) phases (Figure 3.1). Although the two phases are addressed separately below, the individual elements are not necessarily sequential and frequently occur simultaneously during the se-up phase.

Figure 3.1 Illustration of the two phases of adaptive management and monitoring (modified from Williams et al., 2007).



3.1 Conceptual model development

Conceptual models that summarize the source/controlling factor relationship, and the hypothesized effects on the habitat of the protected species are helpful in making the link to potential management activities. To be most useful in an adaptive management framework, conceptual models will express, in visual schematic shorthand, a summary of our understanding of the ecosystem processes linked to the abundance and distribution of the species of interest. The models attempt to identify key case-effect relationships that provide the basis for monitoring specific ecological attributes and assist in identifying appropriate conservation measures. These conceptual models also aid in highlighting where and at what scale uncertainties exist (for example, as is often the case, the model indicates multiple causes producing a similar effect) and identifying where different management alternatives might be implemented. From their design, testable hypotheses can be framed. Figures 3.2 and 3.3 are sample conceptual models for over-water structures and log rafts. These models and the others developed for each covered activity can be expanded and with further detailed added as empirical information is collected.

Source, controlling mechanisms, and effects are identified in the overwater structure conceptual model (Figure 3.2) Also included are activities associated with the source- such as propeller wash or dredge maintenance for an overwater structure such as a dock. The associated activities are included under the "source" category (Pressures-Covered Activity in the illustration). Other broader environmental uncertainties, such as climate change, which would influence the controlling factors are identified in Table 3.1. These pressures may have similar direct and indirect effects as those hypothesized for the source activity, underscoring the need for monitoring reference sites and before-after comparisons. Both direct and indirect effects that can result from installation of an overwater structure are indicated. Direct effects have a direct causal relationship with the source activity and can have immediate impacts to habitat can cause indirect effects, which may cycle back to influence the controlling factors; or cause further indirect effects.

Figure 3.2 Conceptual model: overwater structures**.**

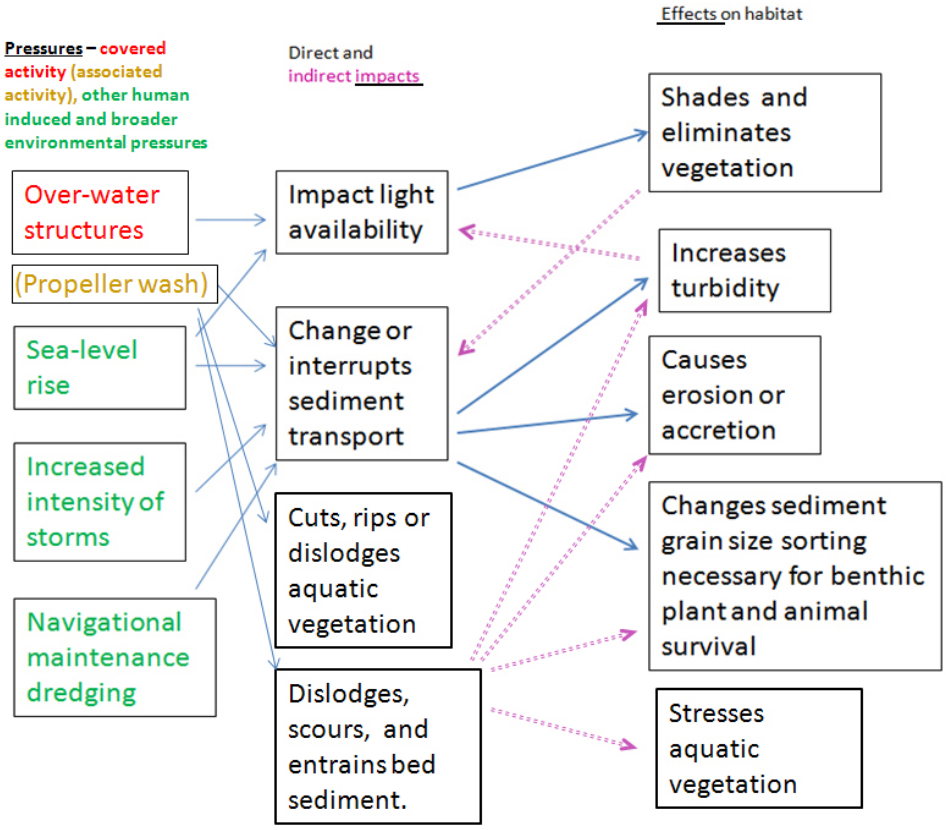
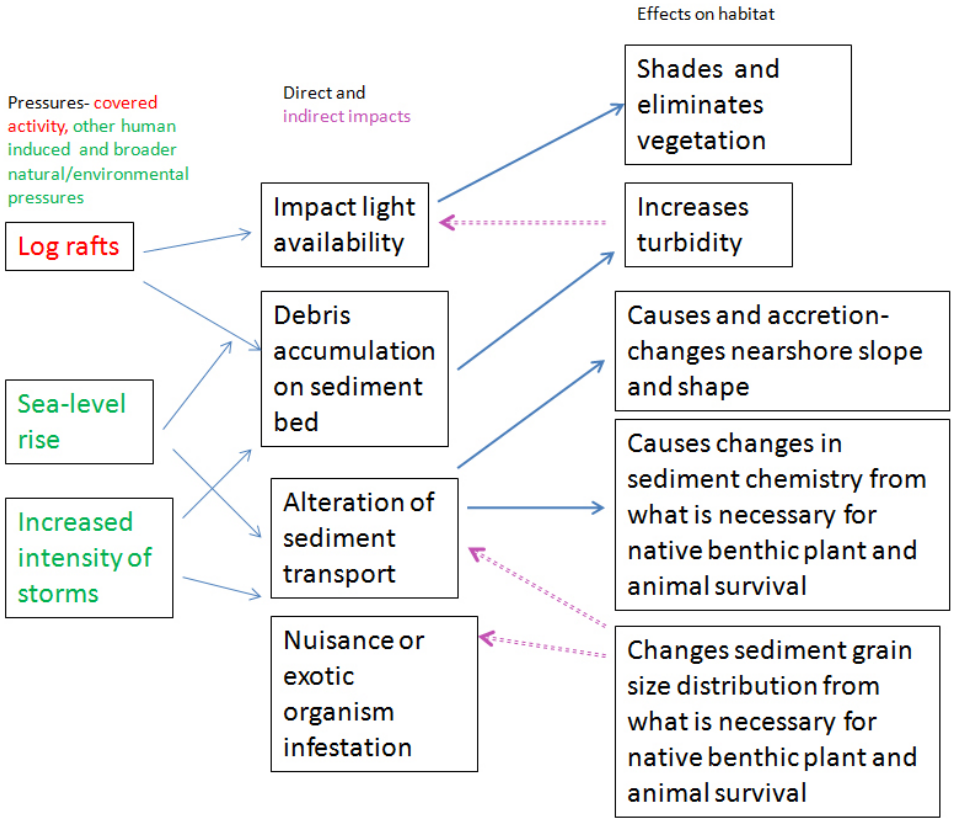


Figure 3.3 Log raft conceptual model



3.2 Uncertainty

A number of system-wide scientific uncertainties provide the context in which the site-level conservation measures will be applied. Large-scale, program-level uncertainties such as those in Table 3.1 limit the ability to predict accurate ecological responses to proposed actions and need to be prioritized and factored into the design of experiments, as well as decision making to ensure the success of the program. The list will be detailed and refined by the Technical Team during the setup phase of the process.

Table 3.1 - Program level uncertainty**.**

Programmatic Uncertainty	Approach to Ensure Success
Climate change, sea-level rise, increased storm frequency.	Require control sites for all project-scale and targeted monitoring.
Exotic species invasion	Incorporate reporting from Washington state exotic species work group and University of Washington/United States Department of Agriculture Exotic species modeling for the Current Research Information System (CRIS).
Catastrophic event (earthquake, volcanic eruption, oil spill, nearshore or submarine landslides)	Design opportunity for intake of data and information from independent research from other agencies including Washington Department of Ecology, United States Geological Survey, and the Army Corps of Engineers.

Uncertainty related to specific conservation measures and strategies was addressed by first evaluating the sources of uncertainty, and then determining how the uncertainty could be addressed through monitoring. Conceptual models (Section 3.1) assisted in identifying knowledge gaps regarding the relationship between covered activities, potential impacts on habitat from the activities, and effectively avoiding impacts through application of the proposed management actions.

The prioritization process filtered out broad policy-based measures and concentrated on those that applied measurable parameters, with measures developed from scientific sources considered most appropriate for a scientifically-based adaptive management program. These conservation measures have specific metrics (e.g. buffer distances, percentage ambient light requirements) or operational procedures (floats must use embedded anchors) designed to avoid or minimize impacts to habitat.

An understanding of the assumptions used in interpreting the cited research and rationale used in developing the conservation measures helped define sources of uncertainties associated with each measure. Uncertainty was grouped similarly to using the categories developed by Janssen et al (2003).

- Incomplete information.
- Natural variability.
- Model structure/approximations.
- Data limitations, sampling or analytical errors.
- Missing variables.
- Best professional judgment regarding extrapolation, interpretation or weighting of data input or results.
- Imprecision in defining objectives or assumptions.

This categorization helped to identify how uncertainties could be addressed through monitoring. For example, where ‘incomplete information’ is identified as a source of uncertainty, the monitoring plan would be designed to gather the missing data. Where uncertainty is associated

with ‘natural variability,’ representative sampling across the range of natural conditions could be incorporated into the monitoring.

Table 3.2 summarizes the preliminary research proposed in this plan. Attachment A illustrates the full list of measures assessed, their classification (programmatic vs. activity specific), and monitoring elements. Further evaluation to determine whether to apply more passive or active adaptive management techniques for each measure will be undertaken by the Technical Team. This will involve an assessment of the relative level of uncertainty (low to high) associated with the listed measures, and whether the proposed experimental approaches are possible given the time, budgetary and political support available. Upon completion of the Technical Team’s evaluation, experimentation will be undertaken beginning with the highest priorities. Work on each priority will continue for a minimum cycle of two years per measure, with priorities re-evaluated every 10 years throughout the term of the habitat conservation plan. Attachment B outlines the strategy for the first 10 years of the plan.

Washington DNR has focused its baseline sampling on parameters that serve as good indicators for detecting habitat change associated with the specified activities: bathymetry, sediment characteristics (grain size, sorting), aquatic vegetation density and distribution, and benthic invertebrate assemblages. Effects to aquatic vegetation and benthic habitat received the highest priority for systematic observation for baseline, reference and targeted comparative studies.

Table 3.2 – Preliminary Research Proposal

Impact	Goal	Measure/s Elements	Uncertainty	Monitoring Elements
Prop Scour	Avoid damage to native aquatic vegetation	Docks with non-motorized boats - 8-meter (25 ft) buffer from the edge of the structure or the maximum distance shade will be cast by the structure, whichever is larger. Docks with motorized boats: - Vertical buffer greater than 2 meters (7 ft) of water separating the vessel from the vegetative canopy at the lowest low water within the diameter of the vessel's turning circle - Vertical buffer less than 2 meters (7 ft) within the diameter of the turning circle: A horizontal buffer distance of either 8 meters (25 ft) from the outside of the vessel; the maximum distance shade will be cast by the structure; or the diameter of the turning circle (3.5 times the length of the longest vessel), whichever is greater.	- Natural variability in vegetation distribution and density. - Existing shade models use a point source with limited consideration of light refraction in water. - Data limitations associated with photosynthetically active radiation (PAR) requirements for vegetation species. - Variability of optical depth. - Missing variables: Average boat size turning radius is applied - Buffer distance based on best professional judgment. - Impacts to unvegetated substrate. - Impacts associated with varying boat drafts.	*Baseline, control, and post installation:* Aquatic vegetation density and distribution; Bathymetry at site and within buffer area of structure; Sediment grain size characterization; Benthic invertebrate community composition and density.
Structural Shading	Minimize vegetative shading	Renovate structures to allow at least 30 percent of ambient light to reach the vegetative canopy.	- Natural variability of light requirements among different species of aquatic vegetation. - Value determined via best professional judgment, precautionary principal.	*Baseline, control, and post installation*: Aquatic vegetation density and distribution; Bathymetry at site and within buffer area of structure; Sediment grain size characterization; Benthic invertebrate community composition and density.

Impact	Goal	Measure/s Elements	Uncertainty	Monitoring Elements
	Minimize shading	Docks greater than 1.5 meters (5 ft) in width: - Unobstructed grating over at least 50 percent of the surface area, with 60 percent of the grated area unobstructed. Docks less than 1.5 meters (5 ft) in width: - Unobstructed grating over at least 30 percent of the surface area, with 60 percent of the grated area unobstructed. - Gangways must be 100 percent grated, with 60 percent of the grated area unobstructed.	- Natural variability in vegetation distribution and density. - Existing shade models use a point source with limited consideration of light refraction in water. - Data limitations associated with photosynthetically active radiation (PAR) requirements for vegetation species. - Variability of optical depth.	*Baseline, control, and post installation*: Aquatic vegetation density and distribution; Bathymetry at site and within buffer area of structure; Sediment grain size characterization; Benthic invertebrate community composition and density.
Increased Sedimentation	Avoid turbidity impacts on surf smelt and sand lance spawning habitat.	- A buffer of at least 0.6 meters (2 ft) vertical separation from the tidal elevation of the spawning bed or a buffer of 55 meters (180) ft horizontal distance from the lower edge of the surf smelt/sand lance spawning habitat zone for all in-water work with the potential to increase suspended sediments during spawning windows. - In-water work may occur during an outgoing tide when the water line is below 1.5 to 1.8 meters (5 to 6 ft MLLW).	- Natural variability in sediment characteristics, geomorphology, and nearshore currents. - Data limitations associated with alteration of geomorphology and sediment and impacts to species characteristics have not been well studies. - Buffer determined via best professional judgment, precautionary principal.	*Baseline, control, and post installation*: Bathymetry; extent, grain size and level of turbidity (NTU or mg/l); Sediment grain size; Benthic invertebrate community composition and density.

Impact	Goal	Measure/s Elements	Uncertainty	Monitoring Elements
	Avoid sedimentation and nutrient impacts to native aquatic vegetation.	Buffer distances calculated as the extent of the chronic and acute mixing zones defined in the current National Pollutant Discharge Elimination System (NPDES) permit.	- Incomplete information related to effects from nutrients on aquatic vegetation and benthic communities. - Mixing zone model considers dispersal of pollutants but not trapping of effluent particulates by macroalgae. - Missing variables related to biochemical and biophysical effects of flocculants on reproductive success. - Current outfalls siting relies on water quality standards for protecting human and aquatic organism health.	*Baseline and control*: Bathymetric survey within radial distance and down drift of discharge head; Bed surface grain size and sorting; Aquatic vegetation density and distribution; Assessment of aquatic vegetation epiphyte coverage. *Post installation – project site and control:* Bathymetric surveys to assess for any evidence of scour; No exceedances of identified standards; Changes within and beyond the established buffer for Sediment characteristics; Aquatic vegetation density and distribution; Fine sediment accumulation on aquatic vegetation and sediment bottom; Aquatic vegetation epiphyte loads.
Altered Substrate	Avoid/minimize physical/chemical alteration of the substrate.	- New and expanded log booming and storage activities must be sited at least 60 meters (200 ft) from existing native aquatic vegetation. - New and expanded finfish pens must be sited at least 150 meters (492 ft) from existing native aquatic vegetation	- Natural variability in flushing rates and geomorphology, and transport or accumulation of waste. - Best professional judgment, use of precautionary principle for effects from bark accumulation and effects to infaunal (wood waste and netpens).	*Baseline, control, and post installation*: Sediment characteristics within and beyond established buffer; Benthic infauna; Sediment total organic carbon; Aquatic vegetation density and distribution. *Wood waste only (baseline, control and post installation):* Bathymetry at, and down drift of log booming area; Flow modeling to determine extent of wood debris transport and deposition.

Impact	Goal	Measure/s Elements	Uncertainty	Monitoring Elements
Introduced of Toxins	Avoid/minimize contamination	No creosote, chromate copper arsenate, or pentachlorophenol treated wood, or other comparably toxic compounds may be used as part of the decking, pilings, or other components of any in-water structures.	Best professional judgment, use of precautionary principle	*Baseline, control, and post installation:* Benthic infauna sampling; Aquatic vegetation density and distribution; Physical and biological characterization of control sites.

3.3 Development of management alternative matrices

The initial management actions to be implemented for the Adaptive Management and Monitoring Program are the conservation measures presented in the main body of the habitat conservation plan. After the Technical Team agrees upon the goals and objectives for each monitoring element, and further detailed and refined the conceptual models for the elements, work will begin to on developing alternative management options for the existing measures. The alternatives will take the form of matrices that help to organize the relevant information and link the management alternative with hypotheses, performance criteria, triggers, and expected outcomes.

Once monitoring has commenced and a sampled parameter attains a trigger threshold, the Technical Team will be able to utilize the developed alternatives so changes can be immediately implemented. As the management alternatives are implemented, they will be added and adjusted to include a range of future scenarios and performance expectations.

The following is an example of a simplified management alternatives matrix for one of the covered activities: overwater structures. The matrix will be further developed by the Technical Team to specifically identify the habitat metric for each ecosystem, and to include proposed targets and timeframes for each set of management alternatives.

Table 3.3 Example management alternatives matrix for overwater structures.

Covered Activity	Direct and Indirect Impact	Habitat Metric (timeframe)	Management Alternative 1	Management Alternative 2
New overwater structures	Shades vegetation	Maintain the density and distribution of the (selected indicator) aquatic vegetation species for 3 years.	- No covered moorage or boat houses. - Grating on dock over 50% of surface area. - Apply maximum boat height to determine buffer using shade-extent model. - Linear buffer distance of 4.5 times the maximum boat length.	- Increase or decrease percentage of grating required on dock surface. - Increase or decrease duration of sun altitude considered in shade-extent model. - Apply a different linear distance buffer.
	Cuts rips or dislodges aquatic vegetation	Maintain density and vigor of aquatic vegetation.	- Vertical buffer of 1.5 meters (5 ft water depth) from surface of vegetation from lowest low water. - Floats, rafts and mooring buoys must use embedded anchors and midline floats to prevent dragging through vegetation.	Vegetated areas signed as 'no boat turning' zone.
Existing overwater structures	Shades vegetation	Increase density and distribution of indicator aquatic vegetation species.	Existing structures not at adequate buffer must be renovated to allow 30% of ambient light to reach sediment surface and 90% to reach water surface.	Change minimum ambient light requirement.

Covered Activity	Direct and Indirect Impact	Habitat Metric (timeframe)	Management Alternative 1	Management Alternative 2
	Changes or interrupts sediment transport	No sediment in-filling or creation of scour holes (indicated in bathymetric surveys for 5 years).	Maintain dredge basins to prevent trapping of sediment or creation of deep pockets in turning areas.	Apply sediment transport model to areas dredging hot spots.

3.4 Developing monitoring plans

Based uncertainties, proposed conservation measures, and the critical habitat needs of the covered species, preliminary baseline sampling will be undertaken by science staff from Washington DNR. Aquatics Sampling for sediment characteristics, bathymetry, benthic community characterization, forage fish presence, and aquatic vegetation density and distribution is being initiated at a number of state-owned aquatic lands marine and lake sites. Criteria used in geographically scoping baseline site selection include:

1. Areas that provide habitat for listed species.
2. Areas subject to frequent covered or programmatic activity authorization requests.
3. Areas included in existing status and trends level monitoring.

The components of baseline sampling include identification of reference site and data collection from these sites. With this collection of baseline data, an understanding of the natural variability for each parameter will be estimated, which will allow sampling designs including sample number, spatial, and temporal extents to be proposed. From here decision criteria can then be developed. Adaptive management 'thresholds' will be proposed which, when reached, trigger the need to change management actions. The adaptive management threshold will be chosen well before the estimated 'critical endpoint'—the point beyond which change is irreversible. This will provide enough opportunity to monitor indicator response to a changed management action. An example of such decision criteria might be "$\geq$ 20% loss of sediment volume in the bed beneath or adjacent to an authorized activity" a need to evaluate effectiveness of conservation measures where the 'critical endpoint' has been defined as "change of 40% or more in sediment volume is one standard deviation beyond the documented natural variability over a three year time period."

The habitat conservation plan uses habitat monitoring as a substitute for species counts and will quantify the impact of covered activities as the amount of each species' habitat affected. Monitoring will therefore focus on surveying and assessing changes to quantity and quality of covered species habitat on state-owned aquatic lands as opposed to monitoring changes to species populations. Habitat quantity and quality will be measured by indicator metrics that have support in the scientific literature such as total area of nearshore native aquatic vegetation, change in bank slope bathymetry or loss of native benthic diversity. Aspects fundamental to the monitoring include substituting habitat proxies for species counts and designing the monitoring to address uncertainty at multiple scales and intensities.

3.4.1 Monitoring scale

Monitoring will occur at several scales to address different kinds of questions, with data associated with general system-scale processes tracked to understand the context in which covered activities are occurring and to support programmatic decisions. For example, a catastrophic event such as a volcano eruption that deposits enough fine ash into rivers and lakes making areas uninhabitable by listed species. Catastrophic events may require a programmatic response to monitoring protocol—such as a change in the geographic focus of monitoring. Alternatively, scour holes indicated by bathymetric surveys in a specific embayment within a buffer distance around a marina would indicate a need for project-level management.

Sampling protocols developed for the Adaptive Management and Monitoring Program will adhere to the following principles:

- Power analysis will be conducted to determine the minimum number of sample units required for detection. Sampling designs with insufficient power to distinguish true change from natural variability can provide misleading results.
- Modeling and estimates of detection probability will be incorporated into the design when rare or sparse populations are relied on for indicator metrics.
- Supplement systematic sampling with opportunistic sampling and take advantage of extreme events as experiments.

Status and trends level monitoring

Monitoring for status and trends will occur at the programmatic scale. This will include pilot-testing for long-term monitoring approaches and will be designed for early warning detection. For example, a gradual declining trend of eelgrass in a large embayment can only be detected if monitoring occurs frequently enough and across a broad enough spatial extent to capture the change. Because the geographic scope for monitoring encompasses all state-owned aquatic lands, the work will need to be strategically divided to allow representative sampling from the various eco-regions given the limited staff and funding resources available. Washington DNR will identify existing monitoring programs and data-gathering efforts and wherever possible integrate them into the status and trends work. While some existing programs may provide fundamental data for the Adaptive Management and Monitoring Program, in other cases the work may be incorporated with modified protocols, sampling design or assessment methods.

Decision criteria developed for this scale of monitoring will include critical assessment endpoints and time frames that may direct adjustment of habitat conservation plan programmatic measures.

Project-level monitoring

Project-level monitoring will be required at individual sites to ensure that the conservation measures are effective. As with status and trends monitoring, decision criteria will include time frames and critical assessment endpoints to direct changes in future management actions. Project level monitoring will also be required for any compensatory mitigation authorized on state-owned aquatic lands.

Targeted studies

Targeted studies are more intensive than the project-level monitoring and will be triggered based on the agreed-upon decision criteria. Such criteria may involve scale of projects (e.g. number of acres impacted) or anticipated intensity of impacts. These studies require resource commitments from the other interested parties. Stakeholder input by and agreement with other interested parties in developing the decision criteria is essential. These studies will be designed to decrease uncertainty of specific management measures and will involve specific hypotheses, variable treatments, before, after, and control sampling.

3.5 Data management plan

The data management plan will be developed that includes a description of the acceptable data formats, storage, and backup security and include the following elements:

- A schedule for data stream intake or reporting. Data format and reporting schedule will vary depending on the habitat metric being measured.
- A method and schedule for data sharing that is detailed and agreed upon before baseline sampling is undertaken.
- Established a data review team to ensure quality control/quality assurance procedures are consistently followed.
- Acceptable data formats will be established to allow a seamless flow of data into the assessment phase.

3.6 Assessment methods and decision criteria

Assessment approaches and data analysis methods need to be designed to assist in adaptive management decision- making to avoid straying into analytical techniques that focus on addressing more broad ecological cause-and-effect questions. As important as gaining an improved understanding of ecosystem function is, the primary focus of Adaptive Management and Monitoring Program assessment is to verify that the monitoring data can provide the information necessary to assess performance of the elements of the habitat conservation plan. The assessment needs to be able to evaluate progress through time and identify which issues require a management response.

The assessment will address uncertainty regarding management impacts through comparison of baseline, project and reference site data. If data or information from any existing monitoring programs is incorporated into the Adaptive Management and Monitoring Program for status and trends/program-level monitoring, the assessment methods for these programs will be fully evaluated for how well these approaches address the decision-making needs of the program. If existing assessment methods are adequate as is, or with slight modification, the need for pilot testing of monitoring and assessment approaches is minimized.

Thoughtfully developed and agreed-upon decision criteria is fundamental to selection of the assessment approach. Using the conceptual models (Section 3.1, Conceptual Model Development), management alternatives matrices (Section 3.3 Develop Management Alternatives

Matrix), and prioritized uncertainties (Section 3.2, Prioritized Uncertainty) as a guide, the Technical Team will develop and quantify decision criteria for:

- Early warning indicators for program-wide adjustments (e.g. a catastrophe that induces a crash in a habitat indicator metric might trigger selection of a different habitat metric).
- Project scale assessment performance measures, (e.g. what change in aquatic plant density and distribution measured over what time frame is considered inherent natural variability of the population?).
- Project-scale critical endpoints (e.g. at what point is a decrease in a measured indicator considered irreversible?).
- Triggers for requiring intensive targeted studies (e.g. a marina of >X boat slips will only be authorized on state-owned aquatic lands if a targeted study regarding buffer distances is executed).

Thresholds and triggers describe monitoring values and other factors such as time periods that indicate the need to address a performance issue. To set thresholds, scientists use monitoring data assessments, indicator value predictions, and coordination with management regarding appropriate timeframes to allow for management alternatives analysis. This is the approach the Technical Team will apply to determine what action to take to avoid threat to covered species habitat.

Development of the assessment methods and decision criteria will be done in a manner that focuses on the following design elements:

- Ensuring that all experimental scales (status and trends, site-level, targeted studies) are incorporated to ensure adequate power to discern treatment effects from natural variability.
- Incorporation of safety margins for implementation of management alternatives before critical endpoints—when negative results or impacts are likely reversible.
- The ability to efficiently include newly emergent, relevant scientific information into the decision process.

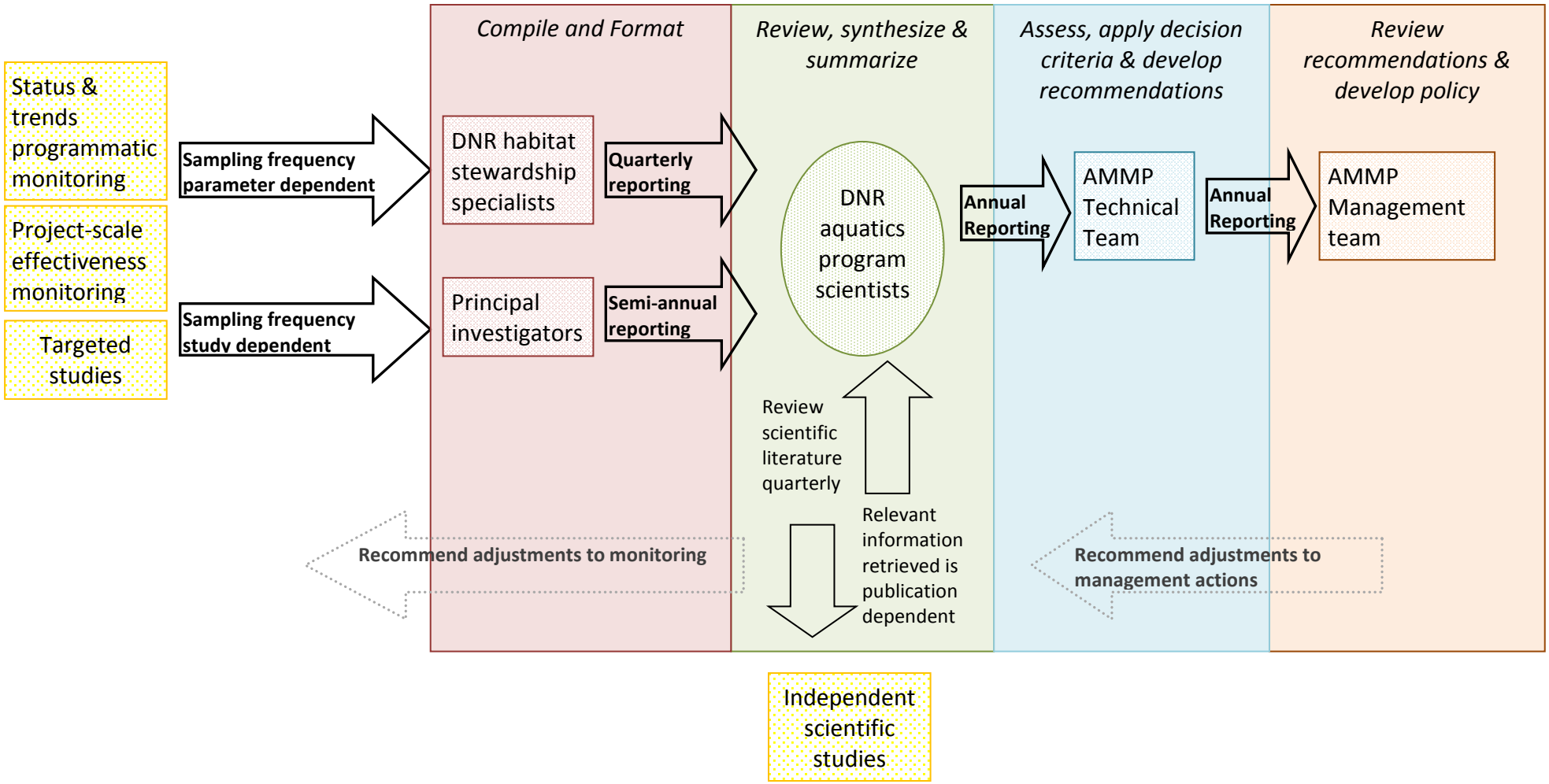
4. Adaptive Management and Monitoring Program Iterative Phase

As management alternatives, monitoring, assessment, and decision criteria are implemented improve our understanding , an iterative cycle of decision making, monitoring, and assessment will evolve. The sequence of activities is repeated over the course of implementing management actions. Throughout the repetition, learning occurs and the management strategies are adjusted based on what is learned.

To successfully link the monitoring to decision-making, a transparent, tightly-scheduled reporting system must be established prior to data gathering for monitoring. This Reporting-Feedback Framework will include a clear delineation of the responsible reporting entities, as well as the report review teams for all the required reports. This will include at a minimum, the project and program level monitoring reports (which may consist of just raw data in tabular or plot format), the targeted experiment findings, annual and multi-year assessment, and trend reports. It will also include timeframes and deadlines for scientists and managers to discuss any performance issues reported, evaluate and select management options, and recommend adjustments to management actions. Figure 4.1 is an illustration of a Reporting-Feedback Framework.

The cycle will continue either until the defined endpoint is reached or until all uncertainty regarding the ecological functions and management alternatives is eliminated.

Figure 4.1 Reporting-feedback framework.



5. References

Department of the Interior. U.S. Fish and Wildlife Service. Department of Commerce. National Oceanic and Atmospheric Administration. 2000. Availability of a Final Addendum to the Handbook for Habitat Conservation Planning and Incidental Take Permitting Process; Notice. Federal Register / Vol. 65, No. 106 / Thursday, June 1, 2000 / Notices. pg 35245.

Holling, C.S., editor. 1978. *Adaptive Environmental Assessment and Management*. John Wiley & Sons., New York.

Janssen P.H.M., Petersen A.C., van der Sluijs J.P., Risbey J.S., Ravetz J.R. 2003: RIVM/MNP Guidance for Uncertainty Assessment and Communication: Quickscan Hints & Actions List. RIVM/MNP Guidance for Uncertainty Assessment and Communication Series, Volume 2. RIVM, Bilthoven, 2003.

Johnson, B. L. 1999. Introduction to the special feature: adaptive management—scientifically sound, socially challenged? *Conservation Ecology* **3**(1):10.

Lee, K. N. 1999. Appraising Adaptive Management. Conservation Ecology 3(2):3.Lawrence, P.A. and Bennett, J., Improved planning and management in coastal environments using an adaptive management framework. *Water. Journal of the Australian Water Association*, 29(6), September/October, 2002.

Lee, K.N.,200.2 Appraising adaptive management, *Conservation Ecology*, 3(2), 3, 2002.

Morrison, M. L. 2000. Facilitating development of Multiple-species Conservation Reserves and Habitat Conservation Plans: A synthesis of recommendations. *Environmental Management* vol 26:S1:3-6

Murray, C. and Marmorek, D.R. 2004. Adaptive Management: A spoonful of Rigour Helps the Uncertainty Go Down 16th *International Annual Meeting of the Society for Ecological Restoration*, Victoria, British Columbia, Canada August 23-27th, 2004.

Murray, C. and Nelitz,M. 2008. Review of Diavik and EKATI Adaptive Management Plans. Prepared by ESSA Technologies Ltd., Vancouver BC for Fisheries and Oceans Canada, Yellowknife, NT 23p

National Oceanic Atmospheric Administration (NOAA) Fisheries Service. 2007. Adaptive Management for ESA-Listed Salmon and Steelhead Recovery: Decision Framework and Monitoring Guidance Prepared by Northwest Region and Northwest Fisheries Science Center. Seattle, WA. 56p.

Noss, R.F. and Cooerrider, A.Y. 1994. *Saving Nature's Legacy: Protecting and Restoring Biodiversity*. Island Press. Washington D.C.

Scholes, R.J. and von Maltitz, G. 2007. GEF Desertification Indicators Meeting, Jan 8-9,2007, Rome Italy

Stankey, G.H., Clark, R.N, Bormann, B.T. 2005, Adaptive management of natural resources:theory, concepts and management institutions. Gen. Tech Rep. PNW-GTR-654. Portland, OR: U.S. Department of Agriculture, Forest Service, Pacific Northwest Research Station 73p

Susskind, L. Camacho, A.E. and Schenk, T. 2010, Collaborative planning and adaptive management in Glen Canyon: A cautionary Tale *Columbia Journal of Environmental Law*, March 2010 vol 38:1:1-55

United States Army Corps of Engineers (USACE). 2010. Draft Comprehensive Everglades Restoration Plan (CERP) Adaptive Management Guidelines Integration version 3.2. Written in partnership with South Florida Water Management District. For current information see http://www.evergladesplan.org/pm/progr_data_mgmt.aspx

United States Department of Agriculture, Forest Service: U.S. Department of the Interior, Bureau of Land Management [USDA USDI] 1994. Record of Decision for amendments to Forest Service and Bureau of Land Management planning documents within the range of the Northern spotted owl, Attachment A: standards and guidelines.

Walkerden, G. 2005. Adaptive management planning projects as conflict resolution processes *Ecology and Society* 11(1): 48.

Walters, C. 1986. Adaptive Management of Renewable Resources. Macmillan,New York.

Williams, B.K., R.C. Szaro and C.D. Shapiro 2007 *Adaptive Management: The U.S. Department of the Interior Technical Guide. Adaptive Management Working Group,* U.S. Department of the Interior, Washington D.C.

6. Attachments

Attachment – Uncertainty Prioritization.

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
1	Programmatic	New and expanded docks, wharves, piers, marinas, rafts, floats, shipyards and terminals must be at least a specified buffer distance from existing native aquatic vegetation attached to or rooted in substrate. The buffer distance for structures, docks, piers, wharves, rafts and floats not associated with motorized watercraft is either 8 meters (25 ft) from the edge of the structure or the maximum distance shade will be cast by the structure, whichever is larger. To avoid prop dredging and prop scour associated with motorized watercraft. For docks, piers, wharves, rafts and floats associated with motorized watercraft, the horizontal buffer distance for structures associated with watercraft is 8 meters (25 ft) from the outside of the vessel whenever there is a vertical buffer of 2 meters (7 ft) of water above the vegetative canopy at the lowest low water within the diameter of the turning circle. When the vertical buffer is less than 2 meters (7 ft) within the diameter of the	- Natural variability- Aquatic vegetation native to different ecosystems have different PAR requirements and different levels of resilience or vulnerability to boat operations and activities. - Model structure or approximations- Most available shade models use a point source with limited consideration of light refraction in water. - Data limitations, sampling or analytical errors - Average daily PAR requirements have been empirically derived for a limited number of plants; optical depth varies with water clarity and increased shade will have varying effects depending on a combination of the bio requirements and physical limitations at a site. - Missing variables-. Average boat size turning radius is applied - Best professional judgment- Buffer distance from overwater structure and	Baseline sampling prior to construction for: - Aquatic vegetation density and distribution. - Bathymetry at site and within buffer area of structure. - Sediment grain size characterization. - Benthic invertebrate community composition and density. - Physical and biological characterization of control sites. Post construction monitoring at project and control site for change in: - Bathymetry. - Aquatic vegetation density and distribution. - Sediment grain size. - Benthic invertebrate community composition and density.

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
		turning circle, the horizontal buffer distance will be either 8 meters (25 ft) from the outside of the vessel, the maximum distance shade will be cast by the structure, or the diameter of the turning circle, whichever is greater. For this measure the turning circle is defined as 3.5 times the length of the longest vessel to use the structure.	boat is based on estimated impacts to aquatic vegetation from shade and operations. - Imprecision in defining objectives or assumptions - It is not clear how a buffer distance from vegetation necessarily protects the nearshore substrate from disturbance. This disturbance would still occur to unvegetated sediment near the structure.	
2	Programmatic	Existing docks, piers, rafts and floats that are not located at the appropriate buffer distance from existing native aquatic vegetation attached to or rooted in substrate must be moved, or renovated so that they allow at least 30 percent of ambient light to reach the vegetative canopy. The value of 30 percent was chosen because it is the minimum light value required by vegetation protected under this habitat conservation plan. Timeframes for relocation and renovation will be based on the expected lifespan of the materials used in the structure. Ambient light is measured as	- Natural variability- Light requirements vary among different species of aquatic vegetation. - Best professional judgment- Apply precautionary principle; Fresh et al. (2006) report a relationship between improved eelgrass bed quality and increased grating is detectable only when a threshold of at least 50% grating is achieved.	Baseline sampling Prior to modification of overwater structure for: - Aquatic vegetation density and distribution. - Bathymetry at site and within buffer area of structure. - Sediment grain size characterization. - Benthic invertebrate community composition and density. - Physical and biological characterization of control sites. Post modification monitoring at project and control site for

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
		the amount of light between the wavelengths of 400 to 700 nanometers, the photosynthetically active range.		change in: - Bathymetry. - Aquatic vegetation density and distribution. - Sediment grain size. - Benthic invertebrate community composition and density.
3	Programmatic	For sites adjacent to sand lance and surf smelt spawning areas all in-water work that has the potential to increase suspended sediments in the spawning area during the spawning period, will require a buffer of at least 0.6 meters (2 ft) vertical separation from the tidal elevation of the spawning bed or a buffer of 55 meters (180) ft horizontal distance from the lower edge of the surf smelt/sand lance spawning habitat zone. In-water work may occur during an outgoing tide when the water line is below the lower edge of a surf smelt/sand lance spawning habitat zone (1.5 to 1.8 meters or 5 to 6 ft MLLW).	- Natural variability-Sediment characteristics, geomorphology, and nearshore currents vary by site in marine areas of the state. - Data limitations, sampling or analytical errors – Direct and indirect effects to forage fish spawning from activities that alter site geomorphology and sediment characteristics have not been well studies. - Best professional judgment-Precautionary principle is applied to require distances and depth needed between aquaculture activities and forage fish area to minimize sediment disturbance that may cause harm to spawning forage fish.	Baseline sampling prior to establishing an activity that has the potential to increase turbidity for: - Bathymetry at site and within buffer area. - Sediment grain size characterization. - The extent, grain size and level of turbidity (NTU or mg/l). - Benthic invertebrate community composition and density. - Physical and biological characterization of control sites. Post establishment monitoring at the project and control site for change in: - Bathymetry. - The extent, grain size

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
				and level of turbidity (NTU or mg/l), including time frame of elevated levels, generated by the activity. - Sediment grain size. - Benthic invertebrate community composition and density.
4	Programmatic	New outfalls must be located at a distance from existing, native aquatic vegetation attached to or rooted in the substrate sufficient to avoid impacts to said vegetation.	- Incomplete information- Direct impacts from nutrients in the water column to aquatic vegetation and benthic community not well studied. - Model structure or approximations- Model considers dispersal of pollutants in water column- does not consider trapping of effluent particulates by macroalgae. - Missing variables- Effluent from secondary water treatment plants contains high levels of nutrients (nitrogen and phosphorus) in the water as well as bound organics in a flocculant form. While nutrient loading in water can have biochemical effects on aquatic vegetation, flocculants can	Prior to installation of outfall: - Bathymetric survey within radial distance and down drift of discharge head. - Baseline sampling for: ▪ Bed surface grain size and sorting. ▪ Aquatic vegetation density and distribution. ▪ Assessment of aquatic vegetation epiphyte coverage. ▪ Physical and biological characterization of control sites. ▪ Benthic invertebrate community composition. and density.

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements

			have biophysical impacts when leaves and seeds are coated that prevents or stresses reproductive success.
			- Best professional judgment- Current outfalls siting relies on water quality standards for protecting human and aquatic organism health.
				Post outfall installation monitoring at project and control site:
				- Bathymetric surveys to assess for any evidence of scour.
				- No exceedances of identified standards.
				- Changes within and beyond the established buffer for:
				  - Sediment characteristics.
				  - Aquatic vegetation density and distribution.
				  - Benthic invertebrate community composition.
				  - Fine sediment accumulation/siltation on aquatic vegetation and sediment bottom.
				  - Aquatic vegetation epiphyte loads.

5	Overwater structures	To minimize prop dredging and prop scour associated with motorized watercraft, the horizontal buffer distance for structures associated with watercraft is 8 meters (25 ft) from the outside of the vessel	See uncertainty for Relative Priority #1	See uncertainty for Relative Priority #1

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
		whenever there is a vertical buffer of 2 meters (7 ft) of water above the vegetative canopy at the lowest low water within the diameter of the turning circle. When the vertical buffer is less than 2 meters (7 ft), the horizontal buffer distance will be either 8 meters (25 ft) from the outside of the vessel, the maximum distance shade will be cast by the structure, or the diameter of the turning circle, whichever is greater. For this measure the turning circle is defined as 3.5 times the length of the longest vessel to use the structure		
6	Overwater structures	The portions of piers, elevated docks, and gangways that are over the nearshore/littoral area must have unobstructed grating over at least 50 percent of the surface area. Floating docks 1.5 meters (5 ft) or greater in width, must have unobstructed grating over at least 50 percent of the surface. Floating docks less than 1.5 meters (5 ft) in width must have unobstructed grating over at least 30 percent of the surface. All grating material must have at least 60 percent functional open space. Grating	See uncertainty for Relative Priority #1	See uncertainty for Relative Priority #1

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
		requirements can also be met if the combination of grated surface area and grating open space are equal to or better than the above standards.		
7	Overwater structures	Gangways must incorporate 100 percent grating with 60 percent functional open space.	See uncertainty for Relative Priority #1	See uncertainty for Relative Priority #1
8	Programmatic	No creosote, chromate copper arsenate, or pentachlorophenol treated wood, or other comparably toxic compounds may be used as part of the decking, pilings, or other components of any in-water structures such as docks, wharves, piers, marinas, rafts, floats, shipyards and terminals. Treated wood may only be used for above water structural framing and may not be used as decking, pilings or for any other uses. During maintenance, existing treated wood must be replaced with alternative materials such as untreated wood, steel, concrete, or recycled plastic, or encased in a manner that prevents metals, hydrocarbons and other toxins from leaching out.	Best professional judgment- Apply precautionary principle. Treated wood structures placed in or over flowing waters will leach copper and a variety of other toxic compounds directly into the water (Weis and Weis 1996, Brooks 2000, FPL 2000, Hingston et al. 2001, Poston 2001, NOAA 2003). Benthic organisms may uptake and be impacted by these contaminants.	Baseline sampling prior to replacement of treated wood: - Benthic infauna sampling - Aquatic vegetation density and distribution. - Physical and biological characterization of control sites. Monitoring post replacement for change in: - Benthic infauna - Aquatic vegetation density and distribution.
9	Log Booming	New and expanded log booming	- Natural variability-	Baseline sampling prior to

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
	and Storage	and storage activities must be kept at least 60 meters (200 ft) from existing native aquatic vegetation attached to or rooted in substrate.	Variability in flushing rate, geomorphology of shore and bathymetry of nearshore will affect transport and accumulation of woodwaste, vulnerability to impacts differs among different species of aquatic vegetation. - Best professional judgment- Apply precautionary principle- Pease (1974) reports bark debris covered the sediment bottom within a radius ranging from 50 ft up to 200 ft at the two oldest active dumping sites studied.	log storage/booming: - Characterization of sediment grain size and sorting. - Benthic infauna. - Hydrologic current or drift in the area. - Sediment total organic carbon. - Bathymetry at, and down drift of log booming area. - Aquatic vegetation density and distribution. - Flow modeling to determine extent of wood debris transport and deposition. - Physical and biological characterization of control sites. Monitoring post activity commencement project and control site: - Bathymetric surveys to ensure scour impacts do not exceed accepted standards. - Extent of wood debris deposition. - Sediment total organic carbon - Changes in:

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
				▪ Sediment characteristics within and beyond established buffer. ▪ Aquatic vegetation density and distribution within and beyond established buffer ▪ Accumulation of fine sediment within and beyond established buffer. ▪ Aquatic vegetation density and distribution beyond buffer edge.
10	Programmatic	New and expanded finfish aquaculture netpens must be located at least 150 meters (492 ft) from existing native aquatic vegetation attached to or rooted in substrate.	- Natural variability-Variability in flushing rate, geomorphology of shore and bathymetry of nearshore will affect the rate of accumulation of fish waste and feed, vulnerability to impacts differs among different species of aquatic vegetation. - Best professional judgment-Apply precautionary principle-Caroll et al. 2003 "detected environmental effects(faunal) up to several hundred meters	Baseline sampling prior to installation of net pens: - Sediment grain size and sorting characterization. - Sediment total organic carbon. - Benthic infauna - Aquatic vegetation density and distribution. - Physical and biological characterization of control sites. Post installation monitoring within and beyond established buffer at both the project and control site for

Relative Priority	Measure Classification	Measure	Highlighted Uncertainty	Monitoring Elements
			from the fish farm." Mussel raft impacts similar to finfish netpen impacts.	change in: - Sediment characteristics. - Sediment total organic carbon - Aquatic vegetation density and distribution - Fine sediment accumulation/siltation

Appendix G. Protecting *Core Remaining Habitat* for At-risk Species on State-owned Aquatic Lands

Table of Contents

Appendix G. Protecting Core Remaining Habitat for At-risk Species on State-owned Aquatic Lands G-1

1.0 Washington DNR's intent G-3

2.0 State aquatic lands ownership and Washington DNR management G-3

3.0 Process used to delineate remaining habitat G-4

4.0 Species and associated habitat G-5

4.1 Western pond turtle G-5

4.2 Oregon spotted frog G-14

References G-20

List of Figures and Tables

Figures

Figure 1. Process used to delineate and recommend potential remaining habitat protections for vulnerable species identified in Table 1. ..... G-4

Figure 2. Aerial photo of Columbia River looking east: Franz Lake National Wildlife Refuge is in the foreground; Beacon Rock State Park lies beyond G-7

Figure 3. Aerial view of Columbia River shorelands and bedlands adjacent to Beacon Rock State Park. Map of Beacon Rock turtle habitat complex G-8

Figure 4. Aerial view of Columbia River shorelands and bedlands adjacent to Beacon Rock State Park G-9

Figure 5. Aerial view of Columbia River shorelands and bedlands adjacent to Pierce National Wildlife Refuge G-9

Figure 6. Area of proposed protection of state-owned aquatic lands adjacent to the Beacon Rock turtle habitat complex G-12

Figure 7. Shoreline master program environmental designations for Black Lake and the upper section of Black River, Thurston County, WA G-17

Figure 8. Shoreline master program environmental designations for the lower section of Black River, Thurston County, WA G-18

Tables

Table 1. Species covered under the Aquatic Lands Habitat Conservation Plan with protections for core remaining habitat G-1

Table 2. Species considered that did not meet the definition of core remaining habitat G-2

Appendix G. Protecting *Core Remaining Habitat* for At-risk Species on State-owned Aquatic Lands

Under the Aquatic Lands Habitat Conservation Plan, the Washington State Department of Natural Resources (Washington DNR) proposes to protect the last core remaining habitat on state-owned aquatic lands for at-risk species covered under the habitat conservation plan (Table 1). These species have limited breeding habitat statewide, their current populations are small and vulnerable to extirpation, or their state populations are rapidly declining.

Table 1. Species covered under the Aquatic Lands Habitat Conservation Plan with protections for core remaining habitat.

Species	Habitat on or Immediately Adjacent to State-owned Aquatic Lands?	Federal Listing Status	State Listing Status	Natural Heritage Rank	Discrete Habitat Locations for Protection?
Western pond turtle (*Actinemys marmorata*)	Yes	Species of concern	Endangered	G3G4,S1	Yes
Oregon spotted frog (*Rana pretiosa*)	Yes	Candidate	Endangered	G2,S1	Yes

Washington DNR defines core remaining habitat as locations of known habitat for species covered under the habitat conservation plan that meet all of the criteria below:

1. Washington DNR management authority can be confirmed either on, or immediately adjacent to, known habitat.
2. Species warrant protection by virtue of their listing status or rank as one (or more) of the following:
   a. Species is federally listed as endangered or threatened.
   b. Species is state-listed as endangered or threatened.
   c. Species has a state rank of S1 or S2, as defined by the Washington Natural Heritage program.
3. Species have relatively small geographic ranges, discrete documented habitat locations, or are known to fulfill critical life history requirements for the species.

A species must meet all three components in order to be considered.
While Washington DNR initially identified nine species for potential protection under this program (Tables 1 and 2), only two meet the criteria above and are currently on this list (Table 1). Washington DNR envisions that species may be added or removed from this list in the future if additional information is revealed that warrants a change based on these three criteria.

Table 2. Species considered that did not meet the definition of core remaining habitat.

Species	Habitat on or Immediately Adjacent to State-owned Aquatic Lands?	Federal Listing Status	State Listing Status	Natural Heritage Rank	Discrete Habitat Locations for Protection?
Western snowy plover (*Charadrius alexandrinus nivosus*)	No	Threatened	Endangered	G4, S1	Yes
Northern leopard frog (*Rana pipiens*)	No	Species of concern	Endangered	G5, S1	Yes
Pacific lamprey (*Entosphenus tridentata*)	Yes	Species of concern	Monitored	G4, S3-S4	No
Columbia spotted frog (*Rana luteiventris*)	Yes	Not listed	Candidate	G4,S4	Yes
Marbled murrelet (*Brachyramphus marmoratus*)	Yes[1]	Threatened	Threatened	G3G4, S3	No[2]
Harlequin duck (Histrionicus histrionicus)	Yes[3]	Not listed	Not listed	S4, S2B	No[4]
Common loon (*Gavia immer*)	No	Not listed	Sensitive	G5, S2B, S4N	Yes

Species that met the criteria in every way except for occurring on state-owned aquatic lands included:

- Western snowy plover
- Northern leopard frog
- Common loon

Species that didn't meet the listing or ranking requirement of the definition included:

[1] Documented *at sea* foraging habitat on state-owned aquatic lands during breeding season.

[2] Foraging habitat in nearshore and offshore marine areas has been identified at a coarse scale (at sea survey sampling segments); discrete locations at a finer scale, or foraging *hot spots*, have not been identified to date.

[3] Harlequin ducks breed in fast-moving mountain streams and thus are not known to nest on state-owned aquatic lands. It is likely that in some areas, adult and juvenile birds may forage on state-owned aquatic lands during the breeding season; however, specific locations are unknown.

- Pacific lamprey
- Columbia spotted frog

Species without discrete habitat locations identified included:

- Harlequin duck
- Marbled murrelet
- Pacific lamprey

While many salmonid species are federally or state listed, Washington DNR excluded these in the definition of core remaining habitat for the following reasons:

1. Salmonids use extremely large ranges, for which stringent protections would not allow Washington DNR to carry out its aquatic management authority (described in Chapter 1 of the habitat conservation plan).
2. Many of the standards and programmatic measures included in Chapter 5 of the habitat conservation plan are aimed at protecting critical life history requirements of species that rely on nearshore environments, particularly salmonids. This includes in-water work timing restrictions, protection of native aquatic vegetation, ambient light requirements, protection of forage fish spawning substrate, and other measures described in Chapter 5 of this habitat conservation plan.

1.0 Washington DNR's intent

Where these species use state-owned aquatic lands, Washington DNR will contribute to the recovery and protection of core remaining habitat by implementing specific habitat protection strategies.

Washington DNR will prohibit use authorizations on state-owned aquatic lands that will negatively affect core remaining habitat as defined in this plan. Washington DNR will also prohibit use authorizations that result in impacts to natural habitat value and function. Such impacts include physical disturbance or disruption of potential breeding, foraging, and basking habitat, or disruption of natural, effective juvenile dispersal in these areas. In addition, Washington DNR will prohibit use authorizations on state-owned aquatic lands shown to negatively affect core remaining habitat value and function on lands that are adjacent to state-owned aquatic lands.

Over the course of the incidental take permit, Washington DNR will use the adaptive management component of this HCP to develop additional, specific management actions for any new areas identified as core remaining habitat for species covered under the habitat conservation plan.

2.0 State aquatic land ownership and Washington DNR management

To define Washington DNR's management authority and apply the long-term habitat protection goals for remaining habitat species, Washington DNR first determines aquatic ownership for parcels of tidelands, shorelands, and bedlands where remaining habitat may be located. To

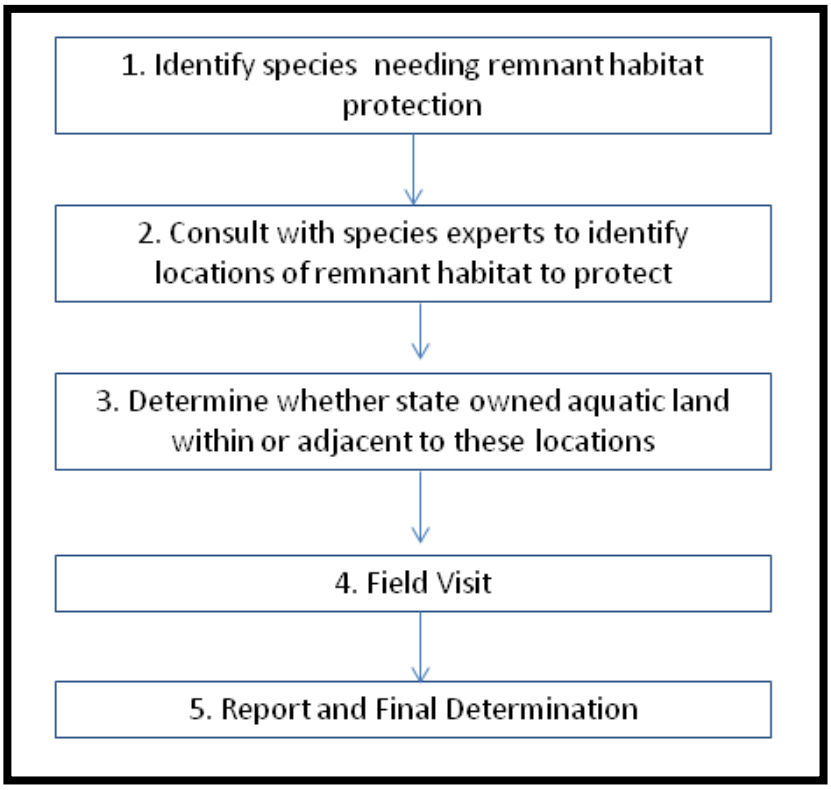
determine ownership, Washington DNR reviews existing ownership records, or conducts a navigability-for-title assessment for water bodies.[4] Washington DNR staff review records of aquatic land parcel sales, exchanges, or other agreements since statehood. The navigability-for-title assessment and ownership transactions assist Washington DNR in defining the boundaries of state-owned aquatic lands, where necessary.

Washington DNR will manage all navigable bedlands, shorelands, and tidelands not recorded as transferred or sold until, or unless, additional evidence is brought forward indicating that they are not state-owned aquatic lands.

3.0 Process Used to Delineate Remaining Habitat

Washington DNR follows a process outlined in Figure 1 to identify potential remaining (remnant)habitat for protection under the habitat conservation plan. A brief description of remaining habitat is provided for each species.

Figure 1. Process used to delineate and recommend potential remaining(remnant) habitat protections for vulnerable species identified in Table 1.



[4] *Navigability for title*: A determination of navigability for property title purposes.

4.0 Species and Associated Habitat

4.1 Western pond turtle *(Actinemys marmorata)*

Introduction and background

The Western pond turtle (also known as the Pacific pond turtle) has a state listing of endangered, and a federal listing of species of concern. Threats include destruction of native habitat; bioaccumulation of pollutants; increased water temperatures; concentrations of heavy metals, salts and petroleum products in sediments and water column; fill; bank armoring; sediment disturbance; predation by bullfrogs and warm water fishes; and taking and harassing animals in the wild.

Western pond turtle. Photo: CaliforniaHerps.com

Within Washington State, western pond turtles historically occurred in the Puget Trough ecoregion and in the Columbia River Gorge from sea level up to elevations near 300 meters (984 feet) (Hays et al., 1999; Hallock & McAllister, 2005). There are four populations in the Columbia River Gorge, two naturally occurring and two that have been established through reintroductions. There are two populations in Puget Sound that have been established through reintroductions.

A recovery plan for this species suggests the importance of captive breeding and re-introduction, as well as protection of current habitat and protection of adjacent and potential future habitat (Hays et al., 1999). The recovery plan lists the Columbia River population as distinct from the Willamette/Puget Trough population. The Columbia Gorge population evolved under free-flowing river conditions with natural ponds, wetlands, and riparian habitat in Washington that would have been well-connected to upland ponds. Dam impoundment has permanently changed these conditions by altering the frequency and magnitude of flood events that contribute to habitat, and by reducing remaining habitat to isolated upland ponds. Railroad grading and fill have cut off access to the river in many places, compromising traditional migration and dispersal routes to other potential areas.

General Habitat Description

The western pond turtle occupies ponds, wetlands, and backwater portions of lakes and rivers containing warm water. Turtles use logs and vegetation mats as haul out basking habitat. Nesting occurs in unconsolidated, well-drained substrate (such as gravel, sand, and dirt) adjacent to breeding ponds. South-facing aspects, such as riparian areas along the river, may provide greater warmth for incubation. Western pond turtles use rivers for migration and dispersal, typically during flood stage. River water temperatures are generally too cold for turtles (Hays et al., 1999).

Western Pond Turtle Habitat

Columbia River sites

In the fall of 2010, Washington DNR staff consulted with herpetologists Marc Hayes and Lisa Hallock of the Washington Department of Fish and Wildlife to identify current locations of key habitat for the turtle. Initially, they identified sites at which turtle reintroductions have previously occurred, including three sites in Skamania County and a fourth in Klickitat County:

1. Beacon Rock State Park.
2. Pierce National Wildlife Refuge.
3. Bergen Road, which is a mosaic of public and private lands near Carson, Washington.
4. Sondino Ponds (including Balch Lake, which is owned by WDFW). Sondino Ponds, the one site in Klickitat County, has the largest naturally occurring population of western pond turtles.

Of these four sites, only one location had the potential for state-owned aquatic land managed by Washington DNR: Beacon Rock State Park and the adjacent Pierce National Wildlife Refuge.

State aquatic land ownership and DNR management

Washington DNR staff, aquatic land surveys, and aquatic parcel data support the conclusion that although extensive shoreline alteration has occurred at Beacon Rock State Park and Pierce National Wildlife Refuge, Washington DNR can assert state ownership over some portion of upland riparian habitat, shorelands, and all the bedlands. The source of shoreline alteration is unknown (whether natural or human caused) and is ongoing. The Franz Lake National Wildlife Refuge is located west of Beacon Rock State Park and is also adjacent to state-owned aquatic lands.

Habitat assessment and land use

Washington DNR staff conducted a field visit on October 13, 2011, visiting four sites (Beacon Rock State Park, Pierce National Wildlife Refuge, Bergen Road, and Sondino Ponds). David Anderson, Washington Department of Fish and Wildlife district wildlife biologist (Region Five), was present for the site visits at Beacon Rock State Park, Pierce National Wildlife Refuge, and Bergen Road.

Figure 2 shows the Beacon Rock/Pierce National Wildlife Refuge turtle habitat complex. This is the primary wetland complex providing potential and current turtle habitat on the Washington side of the Columbia River.

Figure 2. Aerial photo of Columbia River looking east: Franz Lake National Wildlife Refuge is in the foreground; Beacon Rock State Park lies beyond.

Photo: Washington State Department of Ecology Coastal Atlas.

Figure 3. Aerial view of Columbia River shorelands and bedlands adjacent to Beacon Rock State Park. Map of Beacon Rock turtle habitat complex.

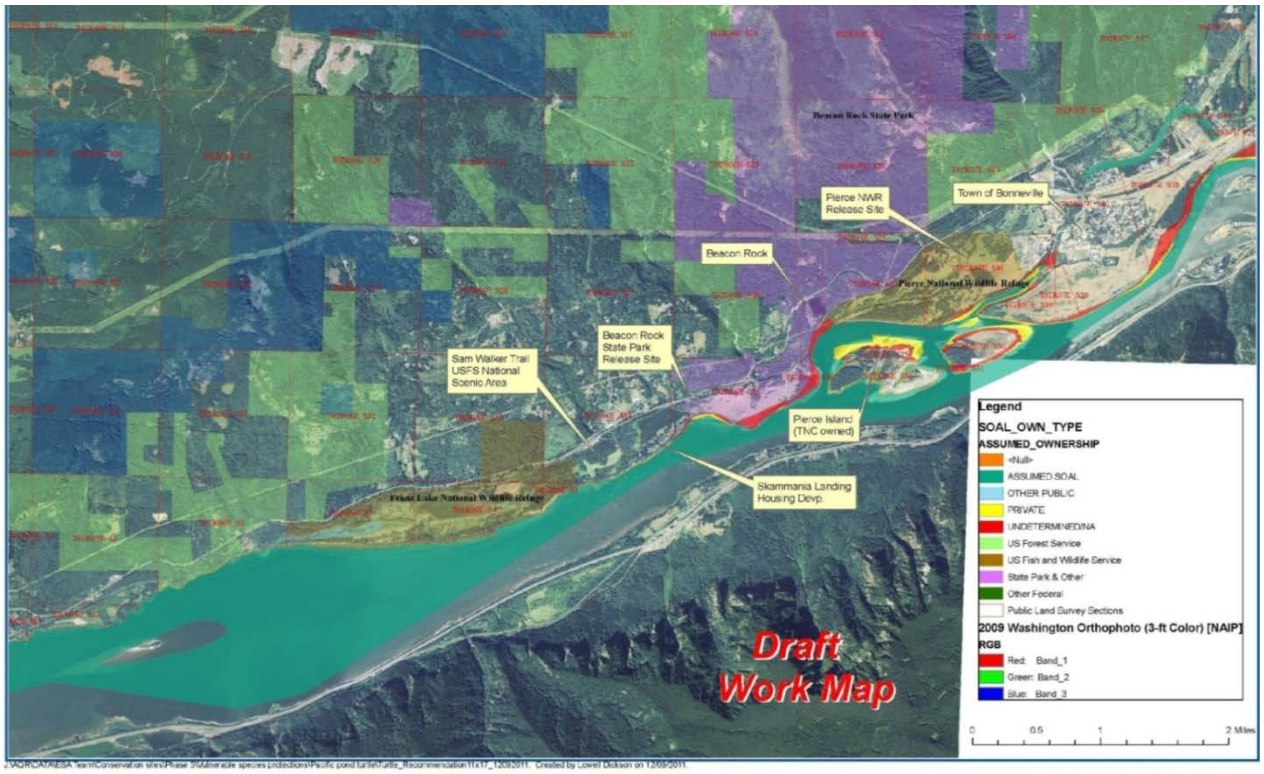


Figure 4. Aerial view of Columbia River shorelands and bedlands adjacent to Beacon Rock State Park.

Figure 5. Aerial view of Columbia River shorelands and bedlands adjacent to Pierce National Wildlife Refuge.

Photo: Washington State Department of Ecology Coastal Atlas.

Washington Department of Fish and Wildlife staff identified Beacon Rock State Park and adjacent Pierce National Wildlife Refuge as being the primary location for, and providing the highest quality of, protected turtle habitat for the Columbia Gorge turtle population in Skamania County (Figures 3, 4 and 5). This relatively large complex of low-lying wetland areas with ample upland and riparian nesting areas on publicly owned land (State Parks, National Wildlife Refuges, and the Columbia Gorge Scenic Area) provides irreplaceable breeding, foraging, basking, and rearing habitat for this reintroduced population. The Washington State Recovery Plan for the Pacific Pond Turtle (Hays et al. 1999) requires wetland areas such as this as a key habitat component for recovery in the Gorge.[5] Two of the four sub-populations in the Columbia River Gorge are currently located here, including a population at Beacon Rock initially reintroduced in 2007.

Turtles occupy both Beacon Rock State Park and Pierce National Wildlife Refuge where water temperatures are warmer than the river (an important feature), and logs and floating vegetation are present for basking.

Washington Department of Fish and Wildlife Biologist David Anderson suggests that riparian areas along the Columbia River shorelands within a few hundred meters of the breeding ponds provide potential nesting habitat, particularly on the warmer, south-facing aspects that support warmer soil conditions for egg development.

Submerged shorelands and bedlands of state-owned aquatic lands would provide habitat function during a brief period of migration and dispersal, typically during spring flood events. Pierce National Wildlife Refuge often floods significantly in spring, allowing dispersal corridors from reintroduction ponds out into the river, presumably dispersing down river to slower water (wetland) areas, such as Franz Lake National Wildlife Refuge. Little information exists on the topic of needs of dispersing turtles during flood migration events.

The Franz Lake National Wildlife Refuge—located west of Beacon Rock State Park—is managed for waterfowl, primarily swans, and supports potential future habitat for turtles as populations increase and turtles migrate down river. This location may one day provide a western anchor point in this extensive wetland complex.

Adjacent to Franz Lake National Wildlife Refuge and fronting the Columbia River, the Sam Walker Trail Access (U.S. Forest Service, National Scenic Area) provides a potentially important stretch of federally owned riparian and wetland area suitable for future turtle habitat.

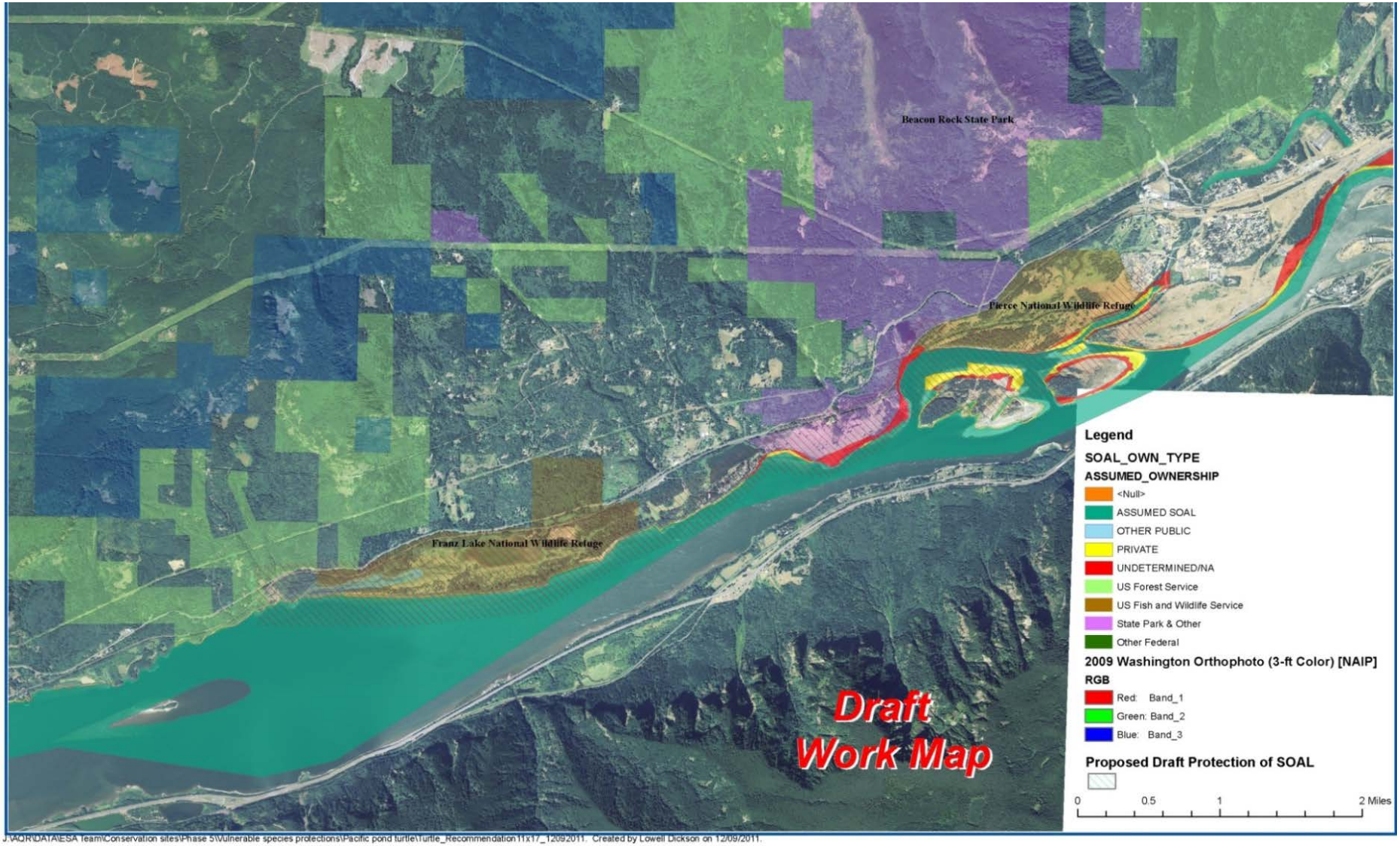
All four of the sites are located within the Columbia River Gorge National Scenic Area. The majority of this area along the Columbia River is designated under Skamania County's Shoreline Management Act as open space with three small sections zoned as residential (Figure 3). A few small areas are zoned for small woodland or forest (Columbia Gorge National Scenic Area, 2007).

[5] Recovery Objectives:
The western pond turtle will be considered for downlisting to state threatened status when:

1. The Puget Sound/Puget Trough recovery zone supports at least two subpopulations of more than 200 western pond turtles, comprises no more than 70 percent adults (>120 millimeter carapace length) that are sustained through natural recruitment. One of the two subpopulations must inhabit a wetland complex that includes more than two wetlands.
2. The Columbia River Gorge recovery zone supports at least three subpopulations of more than 200 western pond turtles, comprised of no more than 70 percent adults (>120 millimeter carapace length) that are sustained through natural recruitment. Two of the three subpopulations must inhabit wetland complexes of more than two wetlands.
3. The wetland and surrounding upland nesting habitat is secure from development and excessive human disturbance

One of the residential areas includes a shoreline housing development—Skamania Landing—that contains roughly 30 to 40 riverfront lots directly west of the turtle release site at Beacon Rock State Park. The development maintains a levee, creating an adjacent pond with water supplied by a creek. David Anderson, Washington Department of Fish and Wildlife biologist, recalled anecdotal stories of residents seeing turtles on their lawns. It is unknown to what extent turtles currently use the lake during the summer.

Figure 6. Area of proposed protection of state-owned aquatic lands adjacent to the Beacon Rock turtle habitat complex. (proposed area seen in diagonal cross-hatching).



Management recommendations

Protection should include all bedlands and shorelands managed by Washington DNR, from the eastern boundary of the Pierce National Wildlife Refuge (town of North Bonneville) to the western boundary of the Franz National Wildlife Refuge (see Figure 5). The goal of limiting uses of this remaining habitat located on state-owned aquatic lands is to reduce human disturbance to western pond turtles during breeding and migration and to further protect any riparian habitat on state-owned aquatic lands.

Western pond turtle remaining habitat characterization

The following habitats will be quantified for their occurrence on state-owned aquatic lands of Beacon Rock State Park and adjacent lands of the Pierce National Wildlife Refuge (Figure 7) on an annual basis, with changes documented:

1. Basking habitat: Banks and adjacent backwater habitats with relatively slow current and emergent basking habitats—including solid rock, boulders, cobbles, gravel, sand, mud flats, downed logs, submerged branches, nearshore vegetation, emergent floating vegetation, submerged aquatic vegetation, and other introduced structures.
2. Nesting habitat: Riparian areas along shorelands, particularly on south-facing aspects within a few hundred meters of the breeding ponds.
3. Underwater refugia: Rocks of various sizes, submerged logs or branches, submerged vegetation, and holes and undercut areas along banks.
4. Other aquatic habitat: Riverine, permanent, and ephemeral wetlands.
5. Overwintering habitat: Muddy substrate in lakes or ponds.
6. Dispersal corridors: Connectivity between terrestrial and submerged habitats.

Identification of habitat enhancement opportunities will be included.

Washington DNR management strategies on state-owned aquatic lands

Washington DNR will contribute to the recovery of remaining western pond turtle populations along the Columbia River in Washington by prohibiting new use authorizations on state-owned aquatic lands at the Beacon Rock habitat complex (Figure 5) that negatively affect turtle habitat (habitat elements 1 through 6, above). Negative effects include physical disturbance or disruption of potential breeding, foraging and basking habitat, or disruption of natural effective juvenile dispersal in these areas (for example, non-essential flood control measures). In addition, Washington DNR will not authorize the following activities on state-owned aquatic lands shown to impact habitat function:

1. Outfalls and discharges that may cause localized reductions in water and sediment quality, resulting in increased turbidity, reduced foraging efficiency, diminished habitat quality, and increased potential for bioaccumulation of pollutants.

2. Habitat loss from construction of roadways, bridges, and docks.
3. Stormwater runoff.
4. Nearshore activities, such as fill and bank armoring, sediment disturbance, and utility line construction that might alter shallow-water lake and stream tributary habitats.

4.2 Oregon Spotted Frog *(Rana pretiosa)*

Introduction and background

The Oregon spotted frog has a state listing of endangered and a federal listing as a candidate species under the Endangered Species Act. Threats to the Oregon spotted frog include destruction and modification of habitat, predation by non-native fish and bullfrogs, disease, and successional habitat loss of wetlands (Hallock 2013).

Oregon spotted frog.
Photo: Washington DNR, 2007

Hallock (2013) states that the historic range of the frog extends from British Columbia through the Puget Trough and Willamette Valley into Northern California. Washington's remaining populations of Oregon spotted frogs occupy wetlands connected to riverine systems.

The perennial creeks and associated network of intermittent tributaries provide aquatic connectivity between breeding sites, active season habitat and overwintering habitat. In Washington they are known to persist in the following drainages:

- Sumas River
- Black Slough
- Samish River
- Black River
- Outlet Creek
- Trout Lake Creek

Of the six populations currently known to occur in Washington, two are in the Black River watershed in Thurston County and two are in Klickitat County

General habitat description

Oregon spotted frogs are highly aquatic. They typically occupy marshes; marshy edges of ponds and lakes; shallow, slow-moving waters of streams with emergent vegetation; and bottom substrate with dead and decaying vegetation (Nordstrom & Riener, 1997).

Habitat at Black Lake and Black River: State aquatic

land ownership and Washington DNR management

The shorelands and bedlands in the southern area of Black Lake proposed for protection have a status of definitely navigable and are state-owned. The Black River has a status of *definitely navigable* and the bedlands and shorelands to within four miles of the shores of Black Lake are state-owned (Figures 8 and 9). The remaining four miles of the Black River up to the shores of Black Lake have a status of *probably navigable* and are probably owned by the state. The northern half of the Black River flows through the Black River unit managed by the U.S. Fish and Wildlife Service as part of the Nisqually National Wildlife Refuge. The U.S. Fish and Wildlife Service owns 526 hectares (1,300 acres) within the approved boundary of the 1,603-hectare (3,960-acre) Black River unit. This unit includes wetlands and riparian habitats, as well as a portion of the uplands along the Black River. The U.S. Fish and Wildlife Service manages the area to protect biological diversity and support fish, birds, and species that depend on wetlands; the Black River unit includes three of the known Oregon spotted frog locations in Washington (U.S. Fish and Wildlife Service, 2012).

Habitat and land use description

The area proposed for management by Washington DNR in this plan includes the very southern portion of Black Lake and northern portion of Black River, located in Water Resource Inventory Areas 13 (Deschutes) and 23 (Upper Chehalis) respectively. The area with identified remaining habitat includes the very southern portion of Black Lake, which forms the headwaters of the Black River, and the Black River extending to the border of the Chehalis Indian Reservation (Figure 8).

Black Lake is located in central Thurston County. The river drains southwest from the south end of Black Lake into the Chehalis River near Oakville in Grays Harbor County. The Black River drainage is approximately 378 square kilometers (144 square miles), with 272 square kilometers (105 square miles) in Thurston County; the remainder of the Black River basin is located in Grays Harbor County. In general, the Black River is a slow-flowing river with a broad floodplain that supports one of the largest remaining intact riparian wetland systems in western Washington (Figures 8 and 9). Most flooding along the main stem of the river is inundation flooding with low velocity of the flood water (Thurston County, 2012; Washington State Department of Ecology, 2012). Much of the area adjacent to the river is wetland or subject to periodic flooding that prohibits or restricts development near the river.

Black River is part of a larger water quality improvement project for the watershed.[6] Water quality concerns include high temperatures and low dissolved oxygen, both of which are associated with low summer flows and non-point pollution from adjacent rural land uses (Ecology, 2004; Thurston County, 2009). Thurston County considers water quality in Black Lake to be fair, citing moderate to high nutrient concentrations, which often result in nuisance blue-green algae growth in late summer and fall (Thurston County, 2005).

Thurston County designated the majority of the Black River shoreline as natural under its Shoreline Master Program, with small portions designated as *rural conservancy*. Natural designations protect areas of intact shoreline function with minimal degradation and restrict land use to low-intensity uses that maintain ecological function and processes. Rural conservancy

[6] Also called a total maximum daily load, which identifies limits on specific pollutants that can be discharged to a water body.

designations apply to areas outside incorporated municipalities and urban growth areas and provide for sustained resource use, public access, and recreation, while protecting ecologic function (Thurston County, 2009) (Figures 7 and 8). Land owned by the U.S. Fish and Wildlife Service within the Black River unit are currently closed to public access; the river is open and accessible to the public by boat only.

Figure 7. Shoreline master program environmental designations for Black Lake and the upper section of Black River, Thurston County, WA.

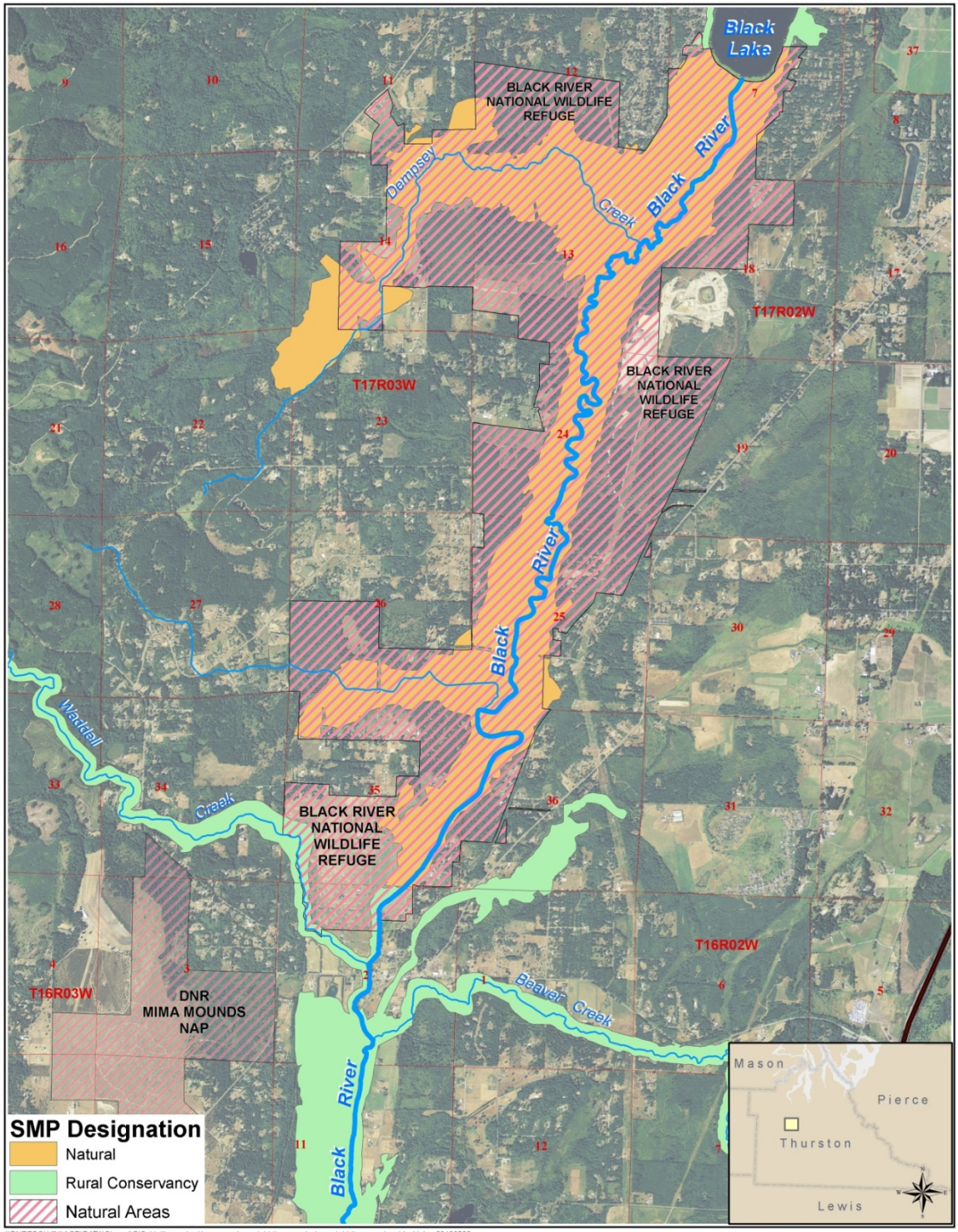
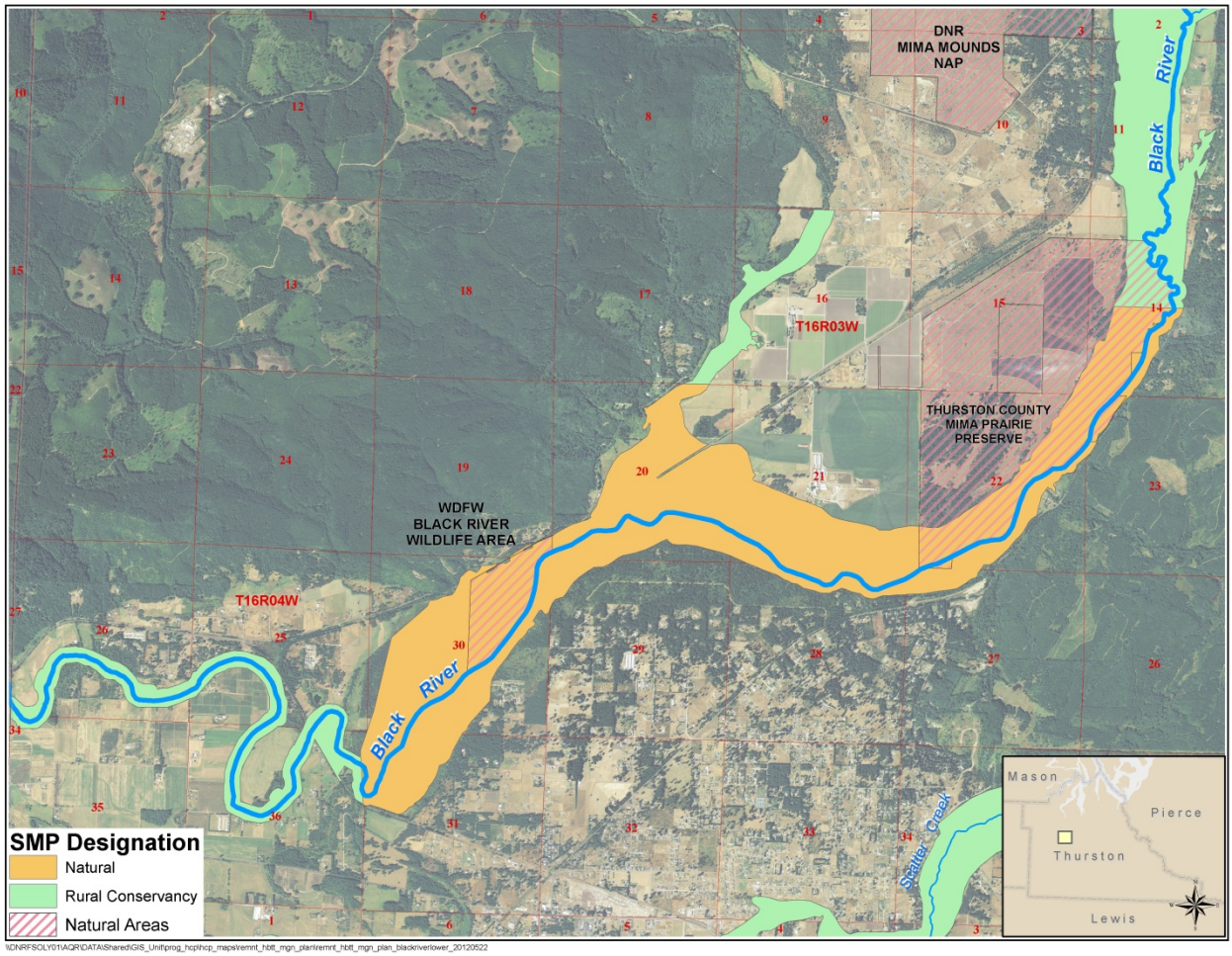


Figure 8. Shoreline master program environmental designations for the lower section of Black River, Thurston County, WA.



Management Recommendations

Washington DNR's management strategies for the Oregon spotted frog habitat in the southern portion of Black Lake and the Black River will follow Thurston County's Shoreline Master Program (Thurston County, 2009). Specifically, habitat protection strategies will align with the county's recommended restoration plans, shoreline inventory and characterizations, and land use designations from the county's updated shoreline master program. The county's land use designations and the U.S. Fish and Wildlife Service's management objectives are consistent with the goals of protecting remaining habitat for the Oregon spotted frog in these areas. This will provide Washington DNR with the greatest opportunity for successful, long-term protection of remaining habitat where ecological function has been determined to be relatively intact for the Oregon spotted frog in these water bodies.

Oregon spotted frog remaining habitat characterization of southern Black Lake and Black River

1. Basking: Logs and sunny vegetated banks.
2. Breeding: Depths less than 30 centimeters (12 inches); short vegetation; and still water—not likely to occur on state lands, though may perhaps occur on lands immediately adjacent to state lands.
3. Overwintering habitat: Aerobic mud in at least 1 foot of water; dense, rooted vegetation. Surface exposure: 50 percent to 75 percent exposed sediment (25 to 50 percent vegetative cover).
4. Connectivity: Marshes and deep pools.
5. Refugia: Sedges, rushes, grasses (including sedge- and hardhack (Spiraea douglasii)), shallow water organic debris, and deeper pools.

Washington DNR management strategies for State-owned Aquatic Lands

Implementation of management strategies will contribute to the protection and recovery of remaining Oregon spotted frog habitat by prohibiting any new use authorization shown to have negative effects on spotted frog habitat on state-owned aquatic lands in the Black River basin. Negative effects include physical disturbance or disruption of potential breeding, foraging, and basking habitat, or disruption of natural, effective juvenile dispersal in these areas. Washington DNR will not authorize the following activities shown to impact habitat function (Nordstrom & Riener, 1997):

1. Draining, dredging, or altering riparian areas and wetlands.
2. Activities that will result in impacts to local hydrology from adjacent managed uplands.
3. Alteration of muddy substrate used for hibernation.
4. Stormwater runoff.
5. Removal of basking habitat.
6. Herbicide and pesticide use in areas inhabited by the Oregon spotted frog.

References

Columbia River Gorge National Scenic Area. 2007. Quadrangle Map Locator. Available at: http://www.gorgevitalsigns.org/QuadLoc/.

Hallock, L.A., and K.R. McAllister. 2005. Western Pond Turtle. Washington Herp Atlas. Accessed June 11, 2005. Available at: http://www1.dnr.wa.gov/nhp/refdesk/herp/

Hallock L.A. Biologist, Washington Department of Fish and Wildlife. Personal communication. 2011.

Hallock, L.A. 2013. Draft State of Washington Oregon Spotted Frog Recovery Plan. Washington Department of Fish and Wildlife, Olympia, WA . Available at http://wdfw.wa.gov/publications/01505/wdfw01505.pdf

Hays, D. W., McAllister, K. R., Richardson, S.A. and D. W. Stinson. 1999. Washington State Recovery Plan for the Western Pond Turtle. Washington Department of Fish and Wildlife, Olympia, WA. 66 pp.

Nordstrom, N., and K. Riener. 1997. Oregon Spotted Frog (Pages 6-1 to 6-12) in E. M. Larsen, ed.. Management recommendations for Washington's priority species, Volume III: Amphibians and Reptiles. Washington Department of Fish and Wildlife, Olympia, WA. 122 pp

Thurston County. 2005. Department of Health. Water Resources Monitoring Report 2004 - 2005: WRIA 13 – Budd/Deschutes. Accessed June 2012. Available at: http://www.co.thurston.wa.us/health/ehrp/pdf/AR03-05/AR03-05_BuddWS.pdf

Thurston County. 2009. Shoreline Master Program Update Shoreline Analysis and Characterization. July 14, 2009. Available at: http://www.co.thurston.wa.us/planning/shoreline/shoreline-inventory.html

Thurston County. 2012. Thurston County Emergency Management, Flood Stage Monitoring data on Black River, accessed June 2012. Available at: http://www.co.thurston.wa.us/em/Rivers/BlackRiver.htm

United States Fish and Wildlife Services. 2012. Nisqually National Wildlife Refuge – Black River Unit. Website. Accessed 2012. Available at: http://www.fws.gov/nisqually/management/bru_general.html

Washington State Department of Natural Resources. Aquatic Resources Program Habitat Conservation Plan Covered Species Technical Paper. August 2007. Available on file, Olympia, Washington.

Washington State Department of Ecology. 2004. The Chehalis/Grays Harbor Watershed Dissolved Oxygen (DO), Temperature, and Fecal Coliform Bacteria TMDL: Detailed Implementation (Cleanup) Plan. Rountry, D. Water Quality Program, Olympia, WA. Available at: http://www.ecy.wa.gov/programs/wq/tmdl/ChehalisRvrTMDLSummary.html

Washington State Department of Ecology. 2012. River and Stream Flow Monitoring Data page. Accessed June 2012. Available at https://fortress.wa.gov/ecy/wrx/wrx/flows/station.asp?sta=23E060#block3

Appendix H
Compliance
Monitoring Plan

Table of Contents

Appendix H. Compliance Monitoring Plan H-1

1.0 Introduction **H-1**
2.0 Compliance monitoring design **H-1**
2.1 Paper audit **H-1**
2.2 Field audit **H-1**
2.3 Statistical design **H-2**
2.3.1 First year of monitoring H-2
2.3.2 Subsequent years of monitoring H-2
2.4 Monitoring procedure **H-**3
2.4.1 Paper audit H-3
2.4.2 Field audit H-3
2.5 Monitoring schedules **H-4**
2.5.1 Paper audit H-4
2.5.2 Field audit H-4
3.0 Reporting **H-4**
4.0 Non-Compliance **H-4**

Appendix H. Compliance Monitoring Plan

1.0 Introduction

Compliance monitoring for the Aquatic Lands Habitat Conservation Plan is intended to verify and document that Washington DNR is complying with the incidental take permit, habitat conservation plan, and Implementing Agreement. This monitoring not only determines where and when identified conservation strategies are being implemented, it also allows an assessment of how well the Washington State Department of Natural Resources (Washington DNR) is moving toward accomplishing the biological goals and objectives of the habitat conservation plan and if they are being implemented in a timely manner.

The conservation strategies of the habitat conservation plan are primarily based on avoiding and minimizing impacts to covered species. Compliance monitoring takes the form of an environmental audit and focuses on ensuring first, that the authorizing instruments for covered activities (e.g., lease, license) stipulate the measures to be taken to avoid and minimize impacts to covered species and their habitats; and second, that the operating conservation program described in Section 5.2 is being carried out as specified in the habitat conservation plan.

Monitoring methods will consist of yearly audits of both the use authorizations (agreements) signed by Washington DNR and field implementation of the stipulated provisions. Compliance monitoring will assess the proportion of agreements containing habitat conservation plan conservation measures, and the proportion of the stipulated measures implemented within the leasehold[1].

2.0 Compliance monitoring design

2.1 Paper audit

The paper audit is designed to assess whether conservation strategies, standards and activity-specific conservation measures are being incorporated into agreements in a manner consistent with the habitat conservation plan, incidental take permit, and Implementing Agreement.

2.2 Field audit

The field audit is designed to assess whether conservation strategies, standards and activity-specific conservation measures defined through the paper audit are being implemented on the ground.

[1] The term leasehold is used throughout this document as a generic term for sites at which Washington DNR has authorized the use of state-owned aquatic land.

2.3 Statistical design

Each of the three Aquatics Districts will separately monitor each of the authorized activities to which strategies, standards, and conservation measures can be applied. Authorized activities are defined as all the agreements signed since the habitat conservation plan went into effect for that activity within that district. The purpose of the statistical design is to produce estimates of the rate of compliance for each activity within each district, as well as for the agency as a whole. It is expected that in the early years of the habitat conservation plan the population size for most activities in a district will be equal to the sample size. As monitoring the entire population avoids errors associated with sample estimates, in such instances the entire population will be monitored.

During the first year of compliance monitoring, all agreements covered by the habitat conservation plan will fall into a single category within each population: those that have not yet have been monitored. After the first year there will be multiple categories within each population: agreements that have not yet been monitored; agreements that have been monitored and determined to be in compliance; and agreements that have been monitored and determined to be out of compliance.

2.3.1 First year of monitoring

Compliance monitoring will begin the first year after the incidental take permit is signed. Both paper and field audits will take place in that year, although the number of activities that can undergo a field audit will be limited by the necessity of allowing time for the implementation of conservation measures. An implementation deadline will be established for each conservation measure in the authorizing agreement, and the field audit of any given structure will not take place until the applicable implementation deadlines have passed. However, some activities will have implementation deadlines of less than one year and will undergo a field audit the first year.

Estimation of sample size

As all agreements undergoing compliance monitoring in the first year will fall into a single category, those that have not yet been monitored, the sample design for compliance monitoring in the first year will be simple random sampling for a finite population.

2.3.2 Subsequent years of monitoring

Paper audit population and sample size

After the first full year of auditing agreement files, two categories of agreements will be formed within each population: habitat conservation plan-covered agreements signed the previous year and not yet monitored; and agreements previously monitored and determined to be out of compliance. To account for differing variability in the proportion of compliance between the two categories, the sampling design for the paper audit will then change to stratified random sampling with a finite population size. As the stipulations incorporated into the agreements will not change without undergoing a formal change to the document, the third category of agreements, those that have been monitored and found to be in compliance, will not be included in subsequent paper audits without a change in agreement status.

Field audit population and sample size

After the first year of field audits, three categories of agreements will be monitored for compliance:

1. Agreements covered under the habitat conservation plan that are past the implementation deadlines but have not yet been sampled;
2. Agreements previously monitored and determined to be out of compliance; and
3. Agreements previously monitored and determined to be in compliance. Physical structures can be damaged by storms or normal wear and tear and it is important to ensure that repairs and maintenance by the lessee continue to adhere to the stipulations of the habitat conservation plan.

To account for differing variability in the proportion of compliance between the three categories and a higher proportion of agreements in the third population, the design will be changed to stratified random sampling to identify a finite sampling size.

2.4 Monitoring procedure

2.4.1 Paper audit

Following the sample selection, the files selected for monitoring will be examined for complete documentation of the applied conservation measures. This is defined through a conservation measure selection report, maintenance letter, memo, or other correspondence that defines the applicable conservation measures. For the agreement to be considered in compliance with the incidental take permit, it must contain the appropriate conservation measures as defined in the Operating Conservation Program (Section 5-2). Implementation of the Operating Conservation Program will also be part of the paper audit, with compliance based on submissions by the lessee documenting accomplishments (e.g., number of derelict structures removed) or progress towards the specified measures (e.g., securing of funds).

Should the audit find that requirements are consistently being misinterpreted, Washington DNR will refer the measure to the Adaptive Management and Monitoring Technical Team for refinement to eliminate the confusion.

2.4.2 Field audit

Following the sample selection, onsite visits will be held and the presence or absence of all applicable conservation measures will be recorded. Conservation measures with a quantifiable standard that must be met will be quantified and a determination made if the standard has been met. Any exceeding of standards will also be recorded.

As with the paper audit, requirements that are consistently and similarly misinterpreted will be referred to the Adaptive Management and Monitoring Technical Team for refinement to eliminate confusion.

2.5 Monitoring schedules

2.5.1 Paper audit

The process of auditing the incorporation of conservation measures into use agreements will begin three months after the close of the reporting period and be completed within an additional three months.

2.5.2 Field audit

With careful planning, the field audit can occur throughout the year. Measures that comprise best management practices (e.g., signage, maintaining spill kits) can be monitored at any time, with audits for biological and environmental measures (e.g., light levels, presence of aquatic vegetation) done at specific times of the year. The audit will be completed one month after the close of the reporting period

3.0 Reporting

The results of both the paper and field audits will be presented as percent compliant by key measures/strategies, activity and ecoregion and reported on an annual basis with the report completed in March of the following year. The first annual compliance monitoring report will be completed in March of the first full year after the incidental take permit is signed and include only the results of the paper audit. Reports for the next five years will also be completed in March, but will describe:

- The population and sampling sizes used.
- Changes in the sampling or statistical protocol.
- The total percentage of agreements in compliance.
- Percentage of agreements in compliance by key measures/strategies, activity and ecoregion.
- Which conservation measures were found out of compliance.
- Progress and accomplishments in implementing stewardship measures.
- And will outline any suggested improvements in the protocol for the following year.

The cycle and content of the reports can be re-evaluated by NOAA Fisheries, U.S. Fish and Wildlife Service, and Washington DNR at any time.

4.0 Non-Compliance

When an authorized user does not comply with the terms, conditions and actions specified in the authorizing agreement, Washington DNR will issue a notice of non-compliance to the responsible party in accordance with the agreement. The notice will identify the area of non-compliance, provide reference to the applicable provisions in the authorization document and identify what is

necessary to correct the non-compliance and the period in which the correction must be completed. Usually the correction period is 30 or 60 days, but Washington DNR will allow a longer correction period if correction is impossible in 30 or 60 days. After the correction period expires, agency staff will conduct another site inspection and verify that the authorized user has resolved the non-compliance. These actions will be documented by Washington DNR as they occur.

If the authorized user does not correct the non-compliance, Washington DNR will pursue all rights and remedies available in law to resolve the issue. Washington DNR can exercise the following options for non-compliance with a land-use authorization agreement:

- Exercise its right of re-entry under the agreement to restore natural resources or the state-owned aquatic lands without terminating the agreement.
- Terminate the agreement and evict the responsible party in accordance with the terms of the agreement and state law. The evicted party would be liable for removal of all improvements and restoration of the property to its pre-agreement condition or, depending on the terms of the agreement, the condition before construction of improvements.
- Sue for damages under additional contract or tort claims, if appropriate in the circumstances.
- Ask local law enforcement to bring misdemeanor charges against the responsible party in some circumstances (RCW 79.02.330).

Appendix I
Meeting Habitat Conservation Plan Goals Through the Operating Conservation Program

Table of Contents

Appendix I – Meeting Habitat Conservation Plan Goals Through the Operating Conservation Program I-1

Goal 1. Avoid or minimize effects on covered species and their habitats I-1

Goal 2. Identify and protect habitats that are important to covered species I-2

Goal 3. Improve and restore habitat quality to compensate for unavoidable effects of covered activities I-3

Part 1. Activity-specific conservation measures I-3
Overwater structures I-3
Shellfish aquaculture I-7
Log booming and storage I-10

Part 2. Washington DNR standards and programmatic measures and associated habitat conservation goals I-12

Reference I-14

Appendix I- Meeting Habitat Conservation Plan Goals Through the Operating Conservation Program

The Washington State Department of Natural Resources (Washington DNR) identified the goals and objectives of the Aquatic Lands Habitat Conservation Plan in Chapter 5, Section 1. These goals are also listed on the following pages. Chapter 5, Section 2 of the plan identifies the *conservation measures* specific to each covered activity. Chapter 5, Section 2 also identifies the *standards* and *programmatic measures* that will be applied to *all uses* of state-owned aquatic lands, including not only the activities that are covered under the habitat conservation plan, but also activities that are not. Appendix J identifies which of the conservation measures, standards and programmatic measures meet the goals and associated objectives of the habitat conservation plan. This appendix is broken into two parts:

Part 1 identifies which of the activity-specific conservation measures contribute to Goals 1 and 2. Implementation of these conservation measures will be required for all use authorizations issued for activities covered under the habitat conservation plan.

Part 2 identifies the standards and programmatic measures that contribute to Goals 1, 2, and 3. Standards and programmatic measures apply to all uses of state-owned aquatic lands, including not only the activities that are covered under the habitat conservation plan, but also activities that are not.

The following are the three goals of the aquatic lands habitat conservation plan and associated objectives:

Goal 1. Avoid or minimize effects on covered species and their habitats

Authorized activities on state-owned lands have the potential to affect species covered under this habitat conservation plan, their habitat, and ecosystem processes that shape habitat (such as sediment transport and light transmission).

Objectives

- Avoid or minimize impacts to water and sediment quality.
- Avoid or minimize alteration of natural, habitat-forming processes, such as wave and current energy, and sediment transport.

- Avoid or minimize alterations to, and loss of, physical habitat features (for example, connectivity and substrate composition) and biological communities that support the covered species (such as native, submerged, aquatic vegetation and prey resources).
- Avoid or minimize disturbance and displacement of, or harm to, species covered under the Habitat conservation plan.
- Avoid or minimize permanent and temporary loss of habitat.

Goal 2. Identify and protect habitats that are important to covered species

Washington DNR will identify and protect habitats that directly or indirectly support species covered under this HCP.

Objectives

1. Identify state-owned aquatic lands that are important to species covered under the habitat conservation plan and prioritize them for protection, restoration, or habitat creation.
2. Avoid future impacts from uses authorized by Washington DNR that affect the value and function of the habitat of covered species whose populations in Washington state are either extremely vulnerable or limited to small home ranges.

Goal 3. Improve and restore habitat quality to compensate for unavoidable effects of covered activities

Beyond avoiding and minimizing direct and indirect effects from authorized activities, Washington DNR will compensate for unavoidable impacts from DNR-authorized activities. This objective will be met through the implementation of this plan's programmatic measures, as identified in Chapter 5, Section 2.3.

Objectives

1. Restore or improve habitat in areas where natural habitat functions and habitat-forming processes have been altered.
2. Identify and reduce or eliminate sources of habitat degradation.

Part 1. Activity-specific conservation measures

Overwater structures

New and reconfigured overwater structures: Conservation measures established to avoid and minimize effects to covered species and their habitats **(Goal 1)**

1. Floating structures and boats must not rest on the substrate.
    a. New overwater structures must be located in water that is sufficiently deep to prevent the structure from grounding at the lowest low water. Alternatively, stoppers must be installed to prevent grounding; the bottom of the structure must remain at least 0.5 meters (1.5 feet) above the level of the substrate.
    b. Boat moorage systems must be deployed in a manner that prevents dragging of the vessel or line. Midline floats or other technologies that prevent the line from dragging and scouring must be used on anchor lines
2. At the time of application or reauthorization, applicants and lessees shall assess water drainage and runoff patterns, and shall develop and implement a plan to alter them, as necessary, to reduce direct inputs of contaminants and nutrients into state waters.
3. To prevent prop scour, boat mooring areas for new marinas, shipyards and terminals, docks, wharves, piers, mooring buoys, rafts, and floats must be located either where the water will be deeper than 2 meters (7 feet) at the lowest low water, or where it can be shown that prop scour will not adversely impact aquatic vegetation or increase suspended sediment loads.
4. Grounding of boats and the need for dredging must be avoided through the use of naturally deep water.
    a. Locate slips for deeper draft boats in deeper water, or moor deeper draft boats offshore.
    b. Orient new construction or expansions of complex facilities so that entrances align with natural channels.
    c. Extend piers and docks into naturally deep water.
5. Multiple element structures must maximize water flow to reduce effects on water quality. Measures to achieve this include but are not limited to:
    a. Locating facility openings in a manner that promotes flushing to prevent water stagnation and to prevent or reduce the need for dredging.
    b. Orienting docks with currents or prevailing winds to prevent trapping surface debris and oily residue.
    c. Maintaining dredged basins in a manner that prevents internal deeper pockets that can act as unflushed holding basins. Generally, depth should increase with distance from the shore.

6. The portions of piers and elevated docks that are over the nearshore (littoral) area must have unobstructed grating over 100 percent of the surface area. Floats that are 1.5 meters (5 feet) or greater in width, must have unobstructed grating over at least 50 percent of their surface. Floats less than 1.5 meters (5 feet) in width must have unobstructed grating over at least 30 percent of the surface. All grating material must have at least 60 percent functional open space. Grating requirements can also be met if the combination of grated surface area and percent functional open space of the grating material are equal or better (have less obstruction) than the above standards.
7. No-wake advisories must be posted and enforced in order to minimize effects on sediments and important habitats and to prevent stranding of juvenile fish.
8. Work on overwater structures and associated vessels that could introduce toxins into the water is prohibited, unless the following protective measures are enacted to prevent discharge to the water:
    a. In-water repair and refinishing of boats is limited to decks and superstructures.
    b. In-water hull scraping, or any process that removes paint from the boat hull underwater, is prohibited.
    c. Refinishing work from boats and temporary floats is prohibited, unless permitted by an industrial
    d. National Pollutant Discharge Elimination System (NPDES) permit.
    e. Dust, drip, and sand spill control measures, such as tarps placed to contain spills, are mandatory to ensure that there is no discharge to waterways.
9. The surface area of gangways must be constructed entirely of grating; the grating materials must have at least 60 percent functional open space.
10. Marinas, shipyards, and terminals must incorporate and post best management practices to prevent the release of chemical contaminants, wastewater (grey and black water), garbage, and other pollutants, as specified in *Resource Manual for Pollution Prevention in Marinas* (Washington State Department of Ecology, 1998). As those guidelines are updated or new regulatory standards are established by the Washington State Department of Ecology or any future agency charged with water quality regulation, the most current guidance or standard will apply.
11. Docks and marinas with moorage for more than 10 boats must have a written plan that identifies sewage management, including options for disposing of wastewater from vessels that have holding tanks or portable toilets and availability of upland restroom facilities.
12. Docks and marinas with moorage for 5 to 10 boats that lack a pumpout, must clearly post the location of the nearest sewage pumpout facility and upland restroom.
13. Skirting is prohibited. When existing structures undergo maintenance or repair, or when the structure is reauthorized (whichever comes first), the replaced portions must meet these standards.
14. Floating homes are considered *water-oriented uses*. Washington DNR will only authorize new, expanded, or additional nonwater-dependent uses or water-oriented uses in the exceptional circumstances defined under Section 332-30-137 of the Washington Administrative Code, and when compatible with water-dependent uses existing in or planned for the area. Water-oriented uses are those that, historically, depended upon a waterfront location, but can be located away from the waterfront. Examples include, but are not limited to, wood products manufacturing, watercraft sales, and house boats. See

Section 79.105.060(25) of the Revised Code of Washington and Section 332-30-106(77) Washington Administrative Code.

15. Washington DNR may authorize the maintenance, repair, replacement, remodeling, and reauthorization of existing floating homes, as long as there is no net increase in the exterior dimensions (footprint). A minor increase in the net footprint may be allowed when necessary to comply with federal, state, or local building, health, and safety codes. Washington DNR will not authorize new or additional floating homes in new locations.
16. Floating or suspended watercraft lifts must be located greater than 2.7 meters (9 feet) waterward from ordinary high water or a sufficient distance that they do not ground at any time. For covered watercraft lifts, the lowest edge of the canopy must be at least 2.5 meters (8 feet) above the ordinary high water elevation, with the canopy oriented in a north-south direction to the maximum extent practicable. While joint-use watercraft lifts are encouraged, only one canopy will be authorized for each lift.
17. New or renovated ramps and launches in marine waters must have an elevated design or be level with the beach slope within the nearshore area. For an elevated design, the height above the substrate within the nearshore area must be sufficient to minimize the obstruction of currents, minimize the alteration of sediment transport, and eliminate the accumulation of drift logs and debris under the ramps. In instances where the substrate is suitable for forage fish spawning, the structure must also span the spawning area with a gangway or other design feature that avoids placing any portion of the structure in the spawning area.
18. Private recreational docks must meet the standards of the Aquatic Lands Habitat Conservation Plan. In cases in which a more protective restriction applies from a regulatory entity, Washington DNR will defer to that standard.
19. New covered moorage and boat houses will not be allowed on state-owned aquatic lands. Where Washington DNR determines that existing covered moorage, covered watercraft lifts, and boathouses are impacting predicted habitats for covered species and their prey, the structures must be moved from the nearshore (littoral) area to deeper water or removed without replacement either when the structure is in need of repair or replacement, or when the authorization expires, whichever occurs first. In areas not identified as predicted habitat for covered species or their prey, the structures must be replaced or renovated with structures that maximize light transmission within a period defined in the authorizing agreement. Where covered moorage, boathouses, and covered watercraft lifts are allowed to continue, the replacement structures must include translucent or transparent roofing materials over at least 50 percent of the roof surface and 100 percent of horizontal surfaces; these materials must be rated by the manufacturer as having 85 percent or greater light transmittance. No side walls or barrier curtains are allowed.
20. For existing overwater structures, the authorizing document will define a schedule for removal of the structure or renovation to maximize light transmission. The authorization will identify the appropriate construction materials and light transmission levels.
21. New and expanded docks, wharves, piers, marinas, rafts, shipyards, and terminals must be at least a specified buffer distance from existing native aquatic vegetation attached to or rooted in substrate.
22. For structures not associated with watercraft, the buffer distance between the edge of the structure and native aquatic vegetation is either 8 meters (25 feet), or the maximum distance shade will be cast by the structure, whichever is larger.

23. For structures associated with motorized watercraft, the applicable conservation measure to avoid dredging and scour caused by propellers is as follows:
    a. In areas where there is a vertical distance of 2 meters (7 feet) of water above the vegetative canopy at the lowest low water within the diameter of the vessel turning circle, the buffer distance between the outside of the vessel and the vegetation is 8 meters (25 feet). For this measure, the turning circle is defined as 3.5 times the length of the longest vessel to use the structure.
    b. In areas where the vertical distance of water above the vegetative canopy at the lowest low water is less than 2 meters (7 feet) within the diameter of the turning circle, the buffer distance will be either 8 meters (25 feet) from the outside of the vessel, the maximum distance that shade will be cast by the structure, or the diameter of the turning circle, whichever is greater. For this measure, the turning circle is defined as 3.5 times the length of the longest vessel to use the structure.

New and existing overwater structures: Conservation measures established to identify and protect habitats important to covered species **(Goal 2)**

1. Unless the aquatic vegetation present at a site can be accurately delineated from available information, proponents of new activities will be required to conduct a vegetation survey to determine the location of aquatic vegetation on a proposed leasehold.
2. New or renovated ramps and launches in marine waters must have an elevated design or be level with the beach slope within the nearshore area. For an elevated design, the height above the substrate within the nearshore area must be sufficient to minimize the obstruction of currents, minimize the alteration of sediment transport, and eliminate the accumulation of drift logs and debris under the ramps. In instances where the substrate is suitable for forage fish spawning, the structure must also span the spawning area with a gangway or other design feature that avoids placing any portion of the structure in the spawning area.
3. New or renovated nearshore buildings must be at least a specified buffer distance from existing native aquatic vegetation attached to or rooted in substrate. The buffer between the building and the aquatic vegetation must be equal to or greater than the longest shadow cast by the structure.
4. New and expanded docks, wharves, piers, marinas, rafts, shipyards and terminals must be at least a specified buffer distance from existing native aquatic vegetation attached to or rooted in substrate.

Shellfish aquaculture

Shellfish aquaculture: Conservation measures established to avoid and minimize effects to covered species and their habitats **(Goal 1)**

1. Predator-exclusion devices such as nets or polyvinyl chloride (PVC) pipe must be installed securely so they do not break free and litter surrounding areas.
2. Intertidal areas must not be used for long-term storage of materials such as bags, marker stakes, rebar, or nets. Materials to be stored for longer than seven days shall be stored above the high tide line. The site will be kept clean of litter. All excess or unsecured material and trash must be removed from state-owned aquatic lands prior to the next incoming tide.
3. Gravel used for amending the substrate must first be washed in an upland location where wash water is not discharged to surface waters.
4. Operators of vehicles or machinery must reduce contamination from vehicles and equipment used on state-owned aquatic lands. This should be achieved by the following means:
    a. All pump intakes (for geoduck harvest, washing down gear, etc.) that use seawater should be screened in accordance with criteria established by NOAA Fisheries and Washington Department of Fish and Wildlife. (Note: This does not apply to work boat motor intakes (jet pumps).
    b. Wash water from all-terrain vehicles (ATVs) must be treated to remove contaminants before it is discharged.
5. Vehicles shall be stored, fueled and maintained in a vehicle staging area placed 150 feet or more from any stream, water body, or wetland. Where this is not possible, documentation that explains the circumstances must be provided to Washington DNR, written approval from DNR must be obtained, and the operators must have a spill prevention plan and maintain a spill prevention kit, which shall be readily available. To detect fuel leaks, operators shall inspect daily all vehicles operated within 150 feet of any stream, water body, or wetland before the vehicle is allowed to leave the vehicle staging area. Any leaks detected should be repaired in the vehicle staging area before the vehicle resumes operation. Operators must document inspections in a record that is available for review upon request by Washington DNR.
6. Fuels and other toxic materials must be stored in a location and in a manner that ensures that they do not pose a risk of contaminating intertidal or nearshore areas. This can be achieved by:
    a. Maintaining pumps, boat motors, and other equipment in good condition, without leaks.
    b. Storing equipment free of fuel or in secure containment areas where any accidental leaks will be contained.
    c. Containing and cleaning up spills of fuels or other fluids without delay. Absorbent materials must be available on site for this purpose.
    d. Removing broken-down vehicles promptly from beaches and intertidal areas.
    e. Periodically washing vehicles in an appropriate upland location to ensure that they are free of oil and other toxic fluids.

Shellfish aquaculture: Conservation measures established to identify and protect habitats important to covered species **(Goal 2)**

1. If mechanical and hydraulic harvest, grading, cleaning, tilling, harrowing or other bed preparation activities are proposed within a mapped tidal reference area and outside the specified work windows for Pacific herring, Washington DNR will require the work area to be surveyed for the presence of herring spawn. Vegetation, substrate, and aquaculture materials shall be inspected by trained and certified personnel. If Pacific herring spawn is present, these activities are prohibited in the areas where spawning has occurred until such time as the eggs have hatched and herring spawn is no longer present.
2. Activities that disturb the spawning substrate of documented surf smelt and sand lance spawning areas—above 1.5 to 1.8 meters (5 to 6 feet) mean lower low water (MLLW), as defined by local tidal datums—may not occur during the no-work window of the species that use the site. Alternatively, Washington DNR may authorize shellfish growers to work within the no-work window, provided that the growers monitor for surf smelt or sand lance spawn to evaluate if the area is spawning habitat and whether spawning is occurring. If the results indicate forage fish or spawn are present, work will be halted for 14 days to allow eggs to hatch. Work may be resumed once a subsequent survey shows no viable eggs are present. All monitoring work shall be conducted in accordance with Washington Department of Fish and Wildlife protocols using workers certified by the agency to conduct this work.
3. Beach access routes to shellfish aquaculture leaseholds for vehicles, equipment, or personnel on foot will be established to minimize impacts to sensitive aquatic resources, such as forage fish spawning areas and aquatic vegetation. Specific access methods will be defined by the lessee in conjunction with Washington DNR and designated in the lease.
4. For existing leases containing native aquatic vegetation (as defined in Chapter 5, Section 2.2 of this habitat conservation plan), the following applies:[1]
   a. Buffers and adaptive management for native aquatic vegetation shall only apply to expanded footprints of existing leases or lease renewals which have new footprints.
   b. In the case of new areas of existing leases or new leases[2] with native aquatic vegetation, longlines or other similar culture systems that are suspended, but attached to the bottom culture of oysters, may be allowed: The lines may be attached to or rooted in substrate if a distance of 1.5 meters (5 feet) is maintained between each line. Alternatively, groups of two to four lines may be spaced 0.3 to 0.8 meters (1–2.5 feet) apart, provided that an open space of 10 feet is left between each group.
5. For new leases with native aquatic vegetation: In the case of new or expanded leases (outside of an existing leased area) in which leased areas contain native aquatic vegetation, the culture of species or use of methods other than suspension above and attachment to the bottom culture of oysters must comply with one of the following conservation measures:

[1] For this measure, native aquatic vegetation exists prior to placement of aquaculture. If native aquatic vegetation migrates to the site after aquaculture has begun, these conservation measures do not apply.

[2] *New leases* as used in these conservation measures include only leases of new areas that have not been previously subject to shellfish aquaculture.

a. Setback option: Uncontained bottom culture of oysters (single or clusters), higher concentrations of culture systems, shade-creating systems, alternative species, higher density bottom culture, and mechanical harvest methods of cultivation must not be placed within 8 m (25 ft) of existing native aquatic vegetation attached to or rooted in substrate. Washington DNR will consider buffers of less than 8 m on a case-by-case basis through the adaptive management option, provided that monitoring is included.[3]

b. Adaptive management option: Uncontained bottom culture of oysters (single or clusters), higher concentrations of culture systems, shade-creating systems, alternative species, higher density bottom culture and mechanical harvest methods of cultivation in areas with native aquatic vegetation will be evaluated through adaptive management. Such adaptive management evaluation shall monitor adverse impacts on species covered under the habitat conservation plan. Results will inform revisions to conservation measures based on observed impacts to species covered under the habitat conservation plan.

6. Water access to shellfish aquaculture leaseholds will be established to the extent practicable to minimize impacts to sensitive aquatic resources, such as forage fish spawning areas and aquatic vegetation. Specific access methods will be defined by the lessee in conjunction with Washington DNR and will address the following items as is practical:

   a. Minimize the grounding of work boats and barges in native aquatic vegetation (defined in Chapter 5, Section 2.2) that is attached to or rooted in substrate.

   b. Prevent anchors, chains, and ropes from dragging on the bottom in native aquatic vegetation that is attached to or rooted in substrate.

   c. Moor and operate boats and barges to minimize impacts from propeller scour or anchoring on native aquatic vegetation that is attached to or rooted in substrate.

Shellfish aquaculture floating rafts: Conservation measures established to avoid and minimize effects to covered species and their habitats **(Goal 1)**

1. Benthic surveys will be conducted to ensure the bottom dwelling organisms are not adversely impacted in a way that causes harm to species covered under the habitat conservation plan.
2. Installation of floating structures would necessarily occur over a period of time, and may occur in phases to make sure the area has the productive capacity to sustain additional three-dimensional shellfish culture. Each phase will proceed based on evidence provided by the shellfish grower that the increase in shellfish production is not damaging the ecological health as it relates to species covered under this habitat conservation plan.
3. To prevent adverse impacts to habitat-forming processes or features and biological communities critical to the species covered in this habitat conservation plan, the

[3] Final buffers will be based upon science available at inception of the National Environmental Protection Act (NEPA) process.

following conservation measures will be applied to all new and expanded shellfish floating raft culture activities:

a. Floating shellfish rafts shall not be located above existing aquatic vegetation (native eelgrass or kelp) and shall be located with an appropriate buffer to avoid shading or deposition of materials from the aquaculture operation.

b. Benthic surveys will be conducted to ensure the bottom dwelling organisms are not adversely impacted in a way that causes harm to species covered under the habitat conservation plan.

c. Predator-exclusion devices such as nets or PVC pipes must be installed securely so they do not break free and litter surrounding areas.

Shellfish aquaculture floating rafts: Conservation measures established to identify and protect habitats important to covered species **(Goal 2)**

1. Floating shellfish rafts shall not be located above existing aquatic vegetation (such as native eelgrass or kelp).
2. . Harvest and replanting of shellfish areas will be allowed on situations where vegetation grows within, or encroaches on, a shellfish growing area that was originally situated so that an appropriate buffer separated it from the native aquatic vegetation.

Log booming and storage

Log booming and storage: Conservation measures established to avoid and minimize effects to covered species and their habitats **(Goal 1)**

1. At the time that Washington DNR reauthorizes a previously allowed use, existing log booming and storage facilities must be moved or reconfigured as necessary to reduce impacts to nearshore (littoral) areas. Where navigational and harbor line designations allow, facilities must be moved beyond the nearshore (littoral) area and out of areas that are documented as habitat important to covered species.
2. Operators must monitor log handling facilities to ensure that logs are not grounding. If grounding is occurring, either the facility must be moved to deeper water, or the leasehold must be reconfigured.
3. Where the infrastructure exists, lessees shall be required to debark logs prior to placing them in the water.
4. If debarking infrastructure is not available the following measures are required:
   a. Bundle logs prior to water transport and storage; store only bundled logs in water.
   b. Assemble bundles, sort individual logs, or break bundles apart in upland areas away from water.
   c. Maintain a containment boom to collect floating debris, and retain all wood debris for disposal at an appropriate upland location.

   d. Use a crane to move logs into the water from barges, rather than roll the logs off of barges, which loosens the bark.
   e. Retain all loose bark and wood debris that accumulates on transport vessels and dispose of it at an upland location.
5. Operators must implement measures to prevent chains and ropes on anchorage, mooring, and containment boom systems from dragging on the bottom. Measures include, but are not limited to, the use of embedded anchors and midline floats.
6. Log handling facilities must control and properly dispose of wood waste at all log handling sites, including upland operations. Control methods include limiting accumulations around transfer sites, constructing bark trash boxes at log dump racks, and installing trash containment screens.
7. Lessees shall complete underwater surveys for wood debris to determine rates of accumulation. This must be done at the beginning of the authorization term, at predefined intervals during the term, and at the termination of the agreement. The surveys must include the leasehold and areas outside the leasehold boundary that may have been impacted by the use, and they must be performed according to standardized protocols defined by Washington DNR. Based on the rate of accumulation, interim cleanup may be required during the authorization term in order to reduce the scale and cost of cleanup required at the close out of the authorization. Interim cleanup would be required based on the weight of evidence from the required surveys, including total accumulation of wood debris and the percent of the substrate covered with wood debris. When the agreement is terminated, the weight of evidence will also be used to determine the extent to which material must be removed.
8. New and expanded log transfer sites and in-water storage facilities will not be established in areas that do not meet state or federal water or sediment quality standards.
9. Proponents of new and expanded log booming and storage authorizations shall conduct underwater surveys to establish baseline benthic conditions prior to approval for the facility. Surveys shall be performed according to Washington DNR-approved sampling plans sufficient to characterize the chemical and physical properties of the surface and subsurface sediment.
10. To avoid impacts to nearshore and shoreline areas, new log booming and storage facilities will not be allowed unless located outside the littoral zone or where the activity has historically occurred in the nearshore.

Log booming and storage: Conservation measures established to identify and protect habitats important to covered species **(Goal 2)**

1. At the time that Washington DNR reauthorizes a previously allowed use, existing log booming and storage facilities must be moved or reconfigured as necessary to reduce impacts to nearshore (littoral) areas. Where navigational and harbor line designations allow, facilities must be moved beyond the nearshore (littoral) area and out of areas that are documented as habitat important to species covered under the aquatic lands habitat conservation plan.

Part 2 – Washington DNR standards and programmatic measures and associated habitat conservation plan goals

Standards[4] for all State-owned Aquatic Lands	Aquatic Lands Habitat Conservation Plan Goals
Artificial lighting	Goal 1: Avoid and minimize effects to covered species and their habitats
Bank armoring	Goal 1: Avoid and minimize effects to covered species and their habitats
Breakwaters	Goal 1: Avoid and minimize effects to covered species and their habitats
Covered species work windows	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species
Derelict structures and abandoned equipment	Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Dredging and sediment removal	Goal 1: Avoid and minimize effects to covered species and their habitats
Fill	Goal 1: Avoid and minimize effects to covered species and their habitats
Foam material	Goal 1: Avoid and minimize effects to covered species and their habitats
Pesticide application	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species
Pressure washing	Goal 1: Avoid and minimize effects to covered species and their habitats
Tires	Goal 1: Avoid and minimize effects to covered species and their habitats
Treated wood	Goal 1: Avoid and minimize effects to covered species and their habitats
Salmon early life stages	Goal 1: Avoid and minimize effects to covered species and their habitats

[4] Standards that apply to all uses of state-owned aquatic lands.

Programmatic Measures[5]	Habitat Conservation Plan Operating Conservation Program Goals
Protection of native aquatic vegetation (NAV)	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Removal of derelict vessels from state-owned aquatic lands	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Protection of forage fish spawning habitat	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species
Managing and creating aquatic reserves	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Conservation leasing on state-owned aquatic lands	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species
Commissioner's orders	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Restoration of aquatic lands	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities
Aquatic landscape prioritization	Goal 1: Avoid and minimize effects to covered species and their habitats Goal 2: Identify and protect habitats important to covered species Goal 3: Improve and restore habitat quality to compensate for unavoidable effects of covered activities

[5] Agency programs designed to restore or protect aquatic habitat, independent of activity-specific land use authorizations.

References

Washington State Department of Ecology. 1998. *Resource Manual for Pollution Prevention in Marinas.* Publication 9811. Washington State Department of Ecology, Olympia,

Appendix J
Technical Memorandum: Operational Definition of an Eelgrass *(Zostera marina)* Bed

Table of Contents

Appendix J. Technical Memorandum: Operational Definition of an Eelgrass *(Zostera marina)* Bed J-1

Introduction **J-1**
Goal **J-1**
Objectives and constraints **J-2**
Background **J-2**
Currently used or proposed criteria for eelgrass presence and edge J-2
Scientific literature relevant to the definition of minimum eelgrass presence..... J-4
Summary of available data relevant to the definition of Eelgrass Edge **J-8**
Summary of relevant findings **J-25**
Proposed criteria..... **J-25**
Conservation approaches..... **J-28**
Recommendations..... **J-28**
Next Steps..... **J-29**
References..... **J-31**

Figures

Figure 1. Illustrates SeagrassNet transect placement, measurement to bed edge, and furthest shoot distance J-9
Figure 1a. Schematic of SeagrassNet site and distance to edge of bed (black line) and furthest shoot distance (orange line) J-10
Figure 2. Mean eelgrass shoot density from annual grab sampling by region. 2000-2012 ..... J-13
Figure 3. Eelgrass monitoring, Maury Island, north patch 2005, 2008, 2009 ..... J-16
Figure 4. Eelgrass monitoring, Maury Island, south patch, 2005, 2008, and 2009 ..... J-17
Figure 5. Eelgrass Monitoring, Maury Island, Control Patch, 2005, 2008, and 2009 ..... J-18
Figure 6. Schematic depicting two distinct, intact, contiguous eelgrass areas J-27

Tables

Table 1. Existing criteria for defining eelgrass presence and bed edge J-3
Table 2. Summary table: Values of eelgrass metrics associated with ecological attributes from the review of literature J-7
Table 3. Furthest shoot distance, Dumas Bay, SeagrassNet site J-11
Table 4. Change in edge and furthest shoot location, Dumas Bay, SeagrassNet site..... J-11
Table 5. Shoot density and percent cover at Dumas Bay, SeagrassNet site..... J-12

Table 6. Eelgrass area and mean density at Maury island gravel site J-15
Table 7. Edge migration and shoot distance in eelgrass patches at Maury Island gravel site J-20
Table 8. Minimum area and shoot density for eelgrass persistence at Maury Island gravel site J-20
Table 9. Eelgrass morphology metrics..... J-21
Table 10. Compilation of eelgrass densities measured throughout Washington J-22
Table 11. Criteria for eelgrass bed edge and beyond..... J-26
Table 12. Metrics relevant for developing buffers J-28

Appendix J. Technical Memorandum: Operational Definition of an Eelgrass *(Zostera marina)* Bed

Introduction

Proposed habitat conservation measures aimed at minimizing or avoiding impacts to eelgrass (*Zostera marina*) are currently being discussed among representatives of Washington's shellfish aquaculture industry and management and aquatics program staff of the Washington State Department of Natural Resources (Washington DNR). Questions have emerged from these discussions regarding what constitutes an edge of eelgrass bed: What minimum presence of eelgrass shoots comprise the edge of a bed? Are groups of non-contiguous eelgrass presence considered the edge of one larger bed, or are they treated as independent bed edges? Is there a minimum time during which observable shoots must persist in an area to be considered a bed? The answers to these questions will have direct effects on activities that are constrained because of their proximity to eelgrass beds.

In an effort to address these questions, a technical workgroup was convened with the goal of establishing criteria for defining an eelgrass bed. Workgroup participants included scientists and technical representatives from the Washington DNR Aquatics program, U.S. Fish and Wildlife Service, NOAA Fisheries, University of Washington, Northwest Indian Fisheries Commission, Point-No-Point Treaty Council, Squaxin Island Tribe, and shellfish aquaculture industry. This technical memorandum summarizes the information discussed at the meetings, reviews analyses of available data, proposes criteria for defining an eelgrass bed, and recommends metrics that should be considered when developing conservation measures with the intent to minimize and avoid impacts to eelgrass beds.

Goal

The overall goal is to determine the criteria for an operational definition of the minimum presence of eelgrass necessary to be considered a bed edge. The definition must be sufficient for site-level application for the sustainable management of eelgrass. It must allow for repeatable delineation of the beds, so that any impacts from activities authorized by Washington DNR in marine tidelands can be avoided or minimized with the application of appropriate conservation measures.

Objectives and constraints

- The eelgrass edge criteria must be applicable at the project or site scale (on the order of 0.1–10 acres). This definition must be precise enough to provide a basis for siting of projects on state-owned aquatic land parcels where eelgrass is present.
- Experienced environmental scientists must be able to apply the criteria using common survey methods and equipment.
- While a definition based on ecological principles is preferable, in the absence of conclusive scientific evidence, an operational definition based on best available scientific information will suffice, so long as it is understood that this will be adaptively managed as information is gathered through implementation and monitoring.

Background

Currently used or proposed criteria for eelgrass presence and bed edge

In response to the accumulation of scientific evidence demonstrating the importance of eelgrass to nearshore ecological function, entities tasked with sustainable stewardship of coastal habitats are striving to maintain and restore eelgrass (Orth et al., 2006; Phillips, 1984; Thom et al., 2008). This challenge requires the ability to delineate beds and to measure current status and change in the edge over time. Table 1 summarizes various eelgrass bed and edge criteria and identifies the agency or entity that has implemented or proposed each. Some of these definitions are proposed based on local empirical data; others are based on knowledge of a specific ecological function of the eelgrass (e.g. fish refugia). Some were developed for research or resource management purposes, while others were developed for regulatory implementation.

Table 1. Existing criteria for defining eelgrass presence and bed edge.

Implementation agency, entity, rule, or policy	Contiguous bed and bed edge criteria
Washington DNR Habitat Stewardship—Eelgrass Surveying Criteria	Contiguous separation distance ≤ 1 m. Minimum shoot density 3 shoots/m^2.
Washington DNR Submerged Vegetation Monitoring Program	Any eelgrass presence within a 1-m^2 area along the length of a video transect that is continuously sampled at approximately 1-m intervals until no presence is detected. A single shoot within a 0.1-m^2 grab sample.
U.S. Army Corps of Engineers Regional General Permit-6	An area of tidal substrate supporting eelgrass covering a minimum of 25% of the substrate.
Tampa Bay Estuary Program—Proposed Definition	A *seagrass bed* is ≥ 10% cover within a 10–30-m long transect line. The *zone of eelgrass occurrence* is defined as 1 shoot/m^2 for at least 10 m along a line transect (Virnstein *et al.*, 1998).
Alaska Sea Grant	A *persistent patch* of eelgrass from qualitative observations requires ≥ 50 shoots/m^2 (Wyllie-Echeverria & Thom, 1994).
Massachusetts Division of Marine Fisheries	The *edge of the bed* is defined as having two points: 1) the distance to the end of the continuous meadow and 2) the distance to the last shoot (Evans & Leschen, 2010).
Seagrass Net	To be considered within the same bed, any eelgrass present within a 1-m^2 quadrat must be within ≤ 1 m distance of a nearby eelgrass presence. The edge or transition area is indicated by the distance of the furthest eelgrass shoot that is beyond this 1-m contiguous bed from a fixed point along a fixed transect. Eelgrass shoot counts (within 0.0625 m^2) and percent cover (in 0.25 m^2) is estimated in 12 randomly pre-selected quadrats along a 50-m transect (Short *et al.*, 2006).
Seagrass Watch	A single shoot within a 1-m^2 quadrat along a 50-m long transect constitutes presence. Both shoot counts and an estimate of percent cover are recorded (McKenzie *et al.*, 2003).
Ospar Commission	A *seagrass meadow* is defined as an area of at least 2 x 2 m covered in seagrass. If < 10 m exists between patches, they are considered of the same meadow. If a distance > 10 m exists between patches, they are of separate meadows (MARBIPP, 2006).

Scientific literature relevant to the definition of minimum eelgrass presence

When developing a scientifically based definition of the minimum eelgrass presence needed to constitute an edge, the following points should be considered.

- In many areas, eelgrass occurs as a compound grouping of non-contiguous areas. (Fonseca & Bell, 1998). A separation distance criterion must be established to determine how to group these non-contiguous areas.
- The minimum detectable quantity of eelgrass depends on the sampling method used, but most site-scale sampling methods are able to detect eelgrass to the individual shoot. A minimum threshold that constitutes an accepted eelgrass presence (e.g. single shoot, area of specified shoot density, or percent cover) must be defined.
- Eelgrass morphological structure consists of above-ground shoots as well as below-ground rhizomes. The below-ground portion of the plant is often of larger dimension and mass than the visible, above-ground portion.
- Eelgrass presence affects the scope of habitat provision (benthic invertebrates, fish, or birds) (Hirst & Atrill, 2008).
- Eelgrass presence parameters (area and density) affect the ability of eelgrass to stabilize sediment and trap suspended particulates (Koch, 2001).
- Eelgrass biomass, area, and density affect the level of primary productivity and the contribution of the eelgrass to the detrital food web.
- Persistence of the vegetated area is another issue: A minimum eelgrass presence may be needed for an eelgrass unit to remain present year after year. Interannual cross- and long-shore variability of seagrass bed edges has been documented (Frederiksen et al., 2004; Marbà & Duarte, 1995; Grette Associates, 2005, 2008, 2009).
- Resilience of the vegetated area is a factor: A minimum residual eelgrass presence or density may be required to re-establish an area after it has experienced a disturbance (natural or anthropogenic).
- Distances between eelgrass shoots affect seed dispersal and successful gene flow.

These considerations relating to eelgrass attributes are important in understanding the ecological function of an eelgrass bed. Scientific studies with specific metrics regarding ecological attributes and functions of eelgrass beds are summarized below. This information was reviewed and discussed in the workgroup meetings when the participants considered the development of criteria for determining the minimum size, density, and persistence of an eelgrass bed edge.

Habitat

- Fonseca *et al.* (1998) observed that eelgrass present in areas as small as 1–2 m^2 had greater numbers of fish, shrimp, and crab than adjacent unvegetated areas.
- A study comparing benthic infaunal biodiversity of *Zostera* vegetated patches (ranging in size from 0.24 m^2 to 17 m^2) and unvegetated intertidal substrate areas found that all *Zostera* patches supported a higher level of biodiversity than bare sand, and neither the patch size nor mean shoot density had any impact on the level of diversity (Hirst & Attrill, 2008).

- In the United Kingdom, Eelgrass fragmentation was examined for its role in benthic infauna community composition by comparing infaunal communities in a continuous 2.3 ha meadow to the composition of patches 6–9 m^2 (Frost *et al.*, 1999). Communities differed as a result of small changes in species abundance, but not in diversity; however, polychaetes generally associated with unvegetated habitats (such as *Magelona mirabilis*) were found to be more common in the fragmented bed than in continuous beds.
- Neither patch size, nor location of sampling within patches (edge or central) exerted as much influence on the infaunal community as sediment composition (Frost *et al.*, 1999). Total abundance did not differ between patch sizes in univariate analyses. Multivariate analyses, on the other hand, showed that the species that contributed most to the difference in assemblage composition between patches were more abundant at the edge. In particular, the nematodes *Capitella capitata* and *Spio filicornis*—species tolerant of random disturbance (stochastic events)—were more abundant in samples collected at the edge of beds than in samples collected from the interior of the beds.
- An examination of fish and amphipod abundance across seagrass areas (*Halodule wrightii*) ranging from 5 to 93 m^2 in size suggested no consistent relationship between faunal abundance and patch size (Bell *et al.*, 2001).
- Based on a study of varying eelgrass densities (140 to 660 shoots/m^2), no significant differences in the number of fishes sampled were detected between eelgrass plots (Wyllie-Echeverria *et al.*, 2002, as cited in Blackmon *et al.*, 2006).
- It has been shown that throughout the Puget Sound, eelgrass habitat is used by juvenile salmonids, but no indication of how this habitat is used based on the density and structure of the eelgrass beds has been provided (Blackmon *et al.*, 2006).
- Epibenthic faunal abundance was closely related to eelgrass presence and shoot development when unvegetated, transplanted, recently seed-colonized, and mature eelgrass habitats in North Carolina were compared (Fonseca *et al.*, 1990).
- Blue crab survival in the Chesapeake Bay was found to vary with the size and complexity of eelgrass patches (Hovel & Lipcius, 2001, as cited in Blackmon *et al.*, 2006). Juvenile blue crab density decreased as patch size increased, and greater habitat fragmentation improved blue crab survival, because the fragmentation resulted in an increase in seagrass edge habitat. Crab density was significantly lower, however, in isolated patches separated by large areas of unvegetated habitats.
- In a New Zealand study, seagrass patch variables (patch size, percent cover, and biomass) explained only 3–4 percent of the variation in benthic community, while landscape variables (fractal geometry, patch isolation) and wave exposure explained 62.5 percent of the variation in faunal abundance data (Turner *et al.*, 1999).

Sediment characteristics

- Both above and below ground, eelgrass structure contributes to sediment stabilization: Above-ground shoots have the capacity to reduce water flow, which lowers the velocity of the flow on the sediment substrate, thus reducing the amount of sediment that can be entrained and transported (Fonseca el al., 2006).
- Eelgrass acts as a sediment sink, with above-ground shoots trapping sediment and particulates from the water column and below-ground rhizomes and roots anchoring sediment. This can result in sediment accretion that changes the bathymetry, causing mounding in areas around seagrass (Walker, 1999).

- The capacity of eelgrass to accrete sediment increases with increasing patch size. The magnitude of slowing current velocity and accreting sediment is based on the density of the eelgrass shoots, hydrodynamic conditions of the area, and depth of the water column above the plants (Koch, 2001). Changes in physical conditions trap nutrients and stabilize habitats that are necessary for seagrass growth and recruitment. Elimination of newly developed small patches will slow or entirely inhibit the development of larger, more extensive patches (Kendrick et al., 2005).
- Patches as small as 0.3 m and 1.0 m along the axis of current flow were capable of significantly reducing the velocity of the current relative to bare mud-flat habitat (Fonseca & Koehl, 2006). Eelgrass has been shown to attenuate 43 percent of wave energy in a 1-m long vegetated transect (Fonseca & Cahalan, 1992).
- A significant difference in median grain size and sorting coefficient was observed when contiguous and fragmented eelgrass areas were compared, and median grain size was found to be the variable that best explains multivariate community patterns (Frost et al., 1999).

Primary productivity/contribution to food web

Seagrasses can act as short-term sinks for refractory carbon: 1–2 years for above-ground biomass and 4–6 years for below-ground biomass (Mateo, 2006). Eelgrass has the capacity to survive and maintain actively growing perennial populations even in its northern-most limit. It does this by storing excess carbohydrates in the rhizomes during the dark winter. There is, therefore, important ecological function being provided by below-ground structure that may be laterally distant from the visible above-ground shoots (Duarte et al., 2002).

Persistence

In plots established outside a continuous vegetated meadow, patch mortality was observed to decrease as the size (area) and age of the patch increased, and only patches with more than 32 shoots survived. The critical minimum patch area required for survivorship varied seasonally (Olesen & Sand-Jensen, 1994).

Fonseca and Bell (1998) found that eelgrass areas with less than 50-percent cover were less stable than those with greater percent cover.

Resilience

Compared with seedlings, surviving adult plants and small patches may contribute considerably to recolonization of a dieback area, as these plants have faster elongation and branching rates and a lower mortality rate than seedlings (Greve et al., 2005).

Reproduction

There are differences in the relative importance of sexual and clonal portions of eelgrass life history that must be considered when attempting to set management standards for protection and maintenance of genetic structure (Table 2).

Seed Dispersal Distance and Transport Time

- Ninety-five percent of pollination occurs within 15 m of the source. Eighty-three percent of seeds are dispersed within 5 m of the source and 100 percent within 50 m (Ruckelshaus, 1996).
- Pollen is viable for only 7–48 hours (de Cock, 1980; Cox et al., 1992).
- Once buried in sediment, seeds of eelgrass can remain dormant for one to two months (Moore et al., 1993).
- Reproductive shoots carrying maturing seeds can be carried by currents or consumed by water fowl and transported long distances (kilometers).
- Germination rates range between 5 and 20 percent, with 80 percent of the seedling's germination within a 5-m diameter of the source (Orth et al., 1994). Germination rates were found to depend not on seed-density, but on patch size (Orth et al., 2003).

Genetic Neighborhood

- In a study of genetic diversity and patch size, with patches ranging from 0.25 m^2 to 440 m^2, Ruckelshaus (1996) found that genetic diversity was inversely related to patch size. Genetic diversity tended to be higher in intertidal areas that had smaller patch sizes and were more prone to disturbance.
- Ruckelshaus (1994) found that a distance of four meters around a plant was adequate to genetically separate individual plants.

Table 2. Summary table: Values of eelgrass metrics associated with ecological attributes from the review of literature.

Ecological attribute	Eelgrass metric	Value
Benthic Habitat	Minimum area of eelgrass presence that affects habitat value	1–2 m^2 (Fonseca *et al.*, 1998) 0.24 m^2 (Hirst & Attrill, 2008)
Sediment Stability	Minimum area of eelgrass to significantly reduce current velocity	0.3 m^2 (Fonseca & Koehl, 2006)
Seed Dispersal	Seed dispersal distance	5 m (Ruckelshaus, 1996)
Genetic Diversity	Distance at which plants can be genetically distinguished	4 m (Ruckelshaus, 1994)
Vegetative Reproduction	Mean rhizome growth rate	26 cm/yr (Marbà & Duarte, 1998; Sintes *et al.*, 2006)
Persistence	Minimum eelgrass density associated with persistence	> 32 shoots per patch area (Olesen & Sand-Jensen, 1994)

Ecological attribute	Eelgrass metric	Value
	Eelgrass cover associated with greater persistence	> 50% cover (Fonseca & Bell, 1998)

Summary of available data relevant to the definition of eelgrass edge

Existing eelgrass data available to the staff of Washington DNR were evaluated to see if any patterns in eelgrass density, patchiness, or persistence emerged, or if perhaps there was any indication that further investigation of these data might be useful in developing eelgrass bed criteria. The four data sources described below include the Dumas Bay SeagrassNet site, the Submerged Vegetation Monitoring Program density grab samples, mitigation monitoring data from a Maury Island site, and plant morphology data from the Washington DNR stressor project.

Dumas Bay SeagrassNet site

SeagrassNet is a worldwide ecological monitoring program that documents the status of seagrass resources. The program began in 2001 in the western Pacific and now includes 115 sites in 32 countries. It has a global monitoring protocol and web-based data reporting system. A SeagrassNet site was established in Dumas Bay in Washington's Puget Sound in May of 2008. SeagrassNet sampling protocol requires that three fixed transects be established in an area of seagrass presence that is representative of or typical for the area. The fixed transects run along the shore, parallel to the beach. Transect A is located approximately one meter into the contiguous eelgrass from the shoreward edge. Transect C is one meter into the contiguous eelgrass from the waterward edge. Transect B runs through the center of the contiguous eelgrass (Figure 1).

Contiguous is defined as any eelgrass shoot that is within one meter or less of another eelgrass shoot. Furthest shoot data were compiled and analyzed from the Dumas Bay SeagrassNet site. The furthest (last, terminal) shoot is measured from three points (0, 25, and 50 m) perpendicular from the shallow (transect A) shoreward and deep (transect C) seaward transects (Figure 1a). The distance to the edge of the area of contiguous eelgrass (where the space between shoots is equal to or less than one meter) is also measured from these points. Data is collected quarterly.

Figure 1. Illustrates SeagrassNet transect placement, measurement to bed edge, and furthest shoot distance.

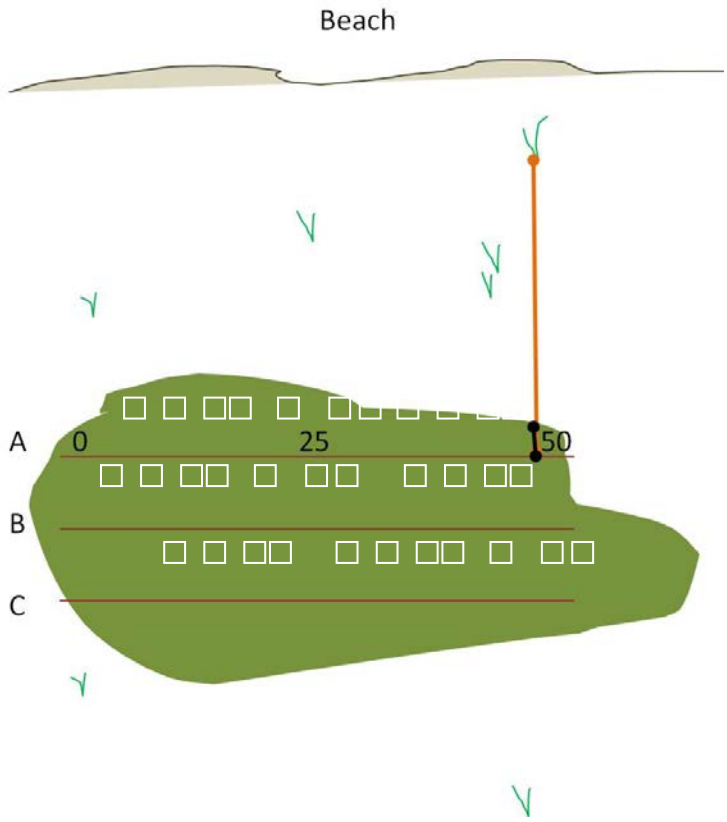
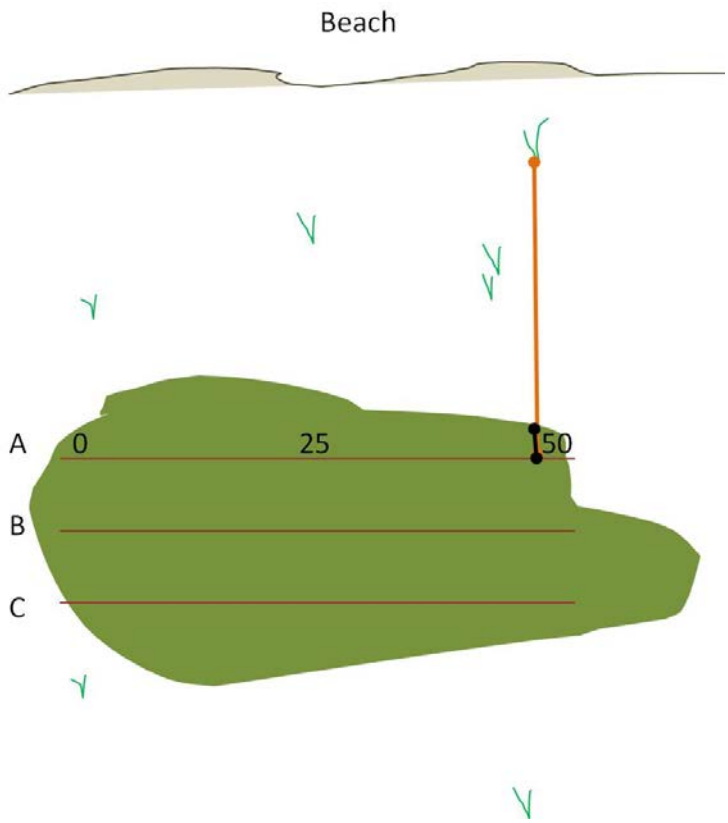


Figure 1a. Schematic of SeagrassNet site and distance to edge of bed (black line) and furthest shoot distance (orange line). (Diagram not to scale).



From May 2008 through January 2011, thirteen sampling events occurred. There were not enough sample times for the collection of furthest shoot data from the deep transect (transect C) to provide any meaningful information for the analysis. A basic evaluation of the furthest shoot data collected from the shallow transect (transect A) revealed the following:

Furthest shoot distance: Dumas Bay

Sparse, patchy eelgrass along the intertidal edge of larger contiguous eelgrass areas had been observed in the field by many of the workgroup participants. From the discussion, it seems that the size, distance from the contiguous eelgrass, and ephemeral nature of this eelgrass varies considerably. This prompted an examination of the available data to see whether any of these parameters might be quantified. Here, the furthest shoot refers to the single furthest shoot from the central area of the eelgrass.

- Furthest shoots were not present throughout the year; they were only present during the spring and summer sample times.
- When furthest shoots were present, they were located near the places they had been previously detected (the maximum change in furthest shoot distance was 5.3 m).
- The maximum distance of a furthest shoot from the contiguous edge was 8.9 m.
- The change in contiguous edge location over all sampling times (through all seasons) ranged from 0.4 m at the center position to 11.3 m at the left position.

- Net change from the first spring sampling (May 2008) to the most recent spring sampling (April 2010) was much smaller, ranging from 0.1 m at the center position to 1.7 m at the left position.

The results are summarized in Table 3 and Table 4.

Table 3. Furthest shoot distance, Dumas Bay, SeagrassNet site.

	Shallow transect furthest shoot distance (M)				n (# Times furthest shoots present)	n (# Times bed examined for furthest shoot)
	Max	**Min**	**Mean**	**Std dev**		
SeagrassNet Site, Dumas Bay May '08–Jan '11	8.9	1.8	6.6	2.3	7	34

Table 4. Change in edge and furthest shoot location, Dumas Bay, SeagrassNet site.

Position on Transect A	Max seasonal change in edge distance (m)	Max annual change in edge distance	Max change in furthest shoot distance (m)
Center	+0.4	+0.3	+1.5
Left	-11.3	-3.4	-1.7
Right	-6.1	+2.2	+5.3

This analysis provided some insight into the magnitude of changes in the edge and furthest shoot location, as well as the seasonality in the expansion and contraction of the edge and furthest shoot presence at this site. In addition, a pilot investigation of data from Washington DNR's Submerged Vegetation Monitoring Program was conducted to see what might be learned about furthest shoot distance from contiguous bed edge and what comparisons could be made among the different areas of Puget Sound. This preliminary analysis indicated that the furthest shoot distance could not be estimated using the Submerged Vegetation Monitoring Program's data. The program's data did not distinguish between a single blade in a square meter and thousands of shoots per meter. Further analysis of the data was therefore abandoned.

Eelgrass density: Dumas Bay

Eelgrass density and percent cover estimates were conducted at fixed random sites along three 50-m longshore transects at +1, 0, and -1.6 mean lower low water (MLLW) tidal elevations. Seasonal variability is apparent in density and percent cover, with maximum values observed in the spring and summer (data not shown). Interannual variability is also observed. This is apparent from the range in density and the standard errors reported only for the July samplings (the SeagrassNet site is sampled quarterly) of 2008–2011, as documented in Table 5.

Table 5. Shoot density and percent cover at Dumas Bay, SeagrassNet site.

Transect & Elevation (MLLW)	Date	Average Density (shoots/m^2)	SE (n)	Average % Cover	SE (n)
A, +1	July '08	597.3	277.7 (12)	28	12 (12)
A, +1	July '09	292.0	206.7 (12)	16	9 (12)
A, +1	July '10	184.0	97.9 (12)	12	6.8 (12)
A, +1	July '11	109.3	76.8 (12)	8	5 (12)
B, 0	July '08	769.6	175 (12)	46	6.6 (12)
B, 0	July '09	878.7	192.4 (12)	61	7.9 (12)
B, 0	July '10	892.0	135.6 (12)	72	9.7 (12)
B, 0	July '11	841.3	148 (12)	62	9.1 (12)
C, -1.6	July '08	210.7	32 (12)	46	6.2 (12)
C, -1.6	July '09	280.0	33 (12)	38	4.1 (12)
C, -1.6	July '10	186.7	29.6 (12)	28	4.9 (12)
C, -1.6	July '11	130.7	10.9 (12)	26	4.3 (12)

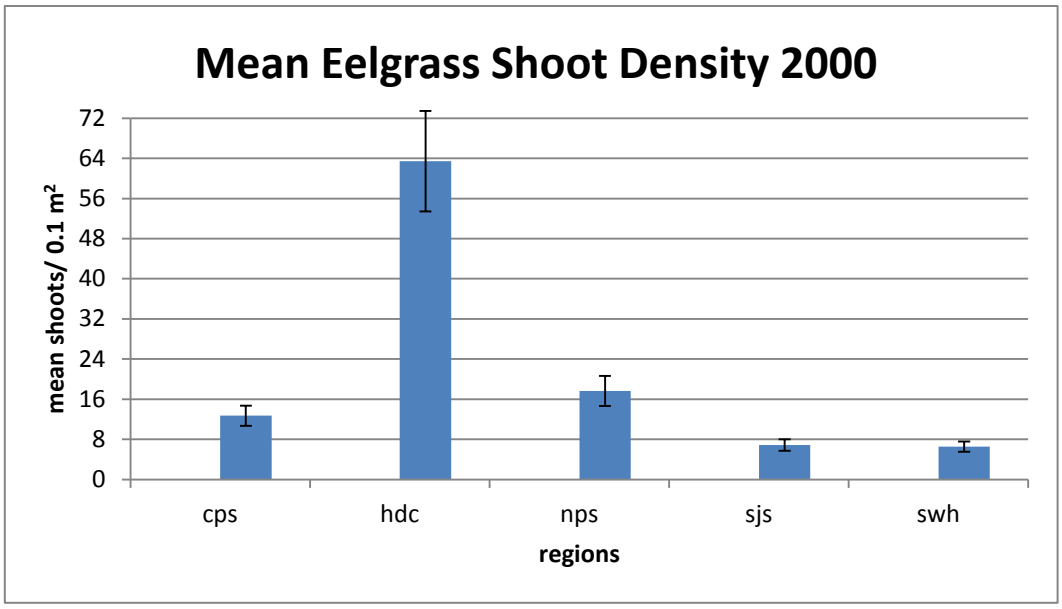
Submerged vegetation monitoring program: eelgrass shoot density

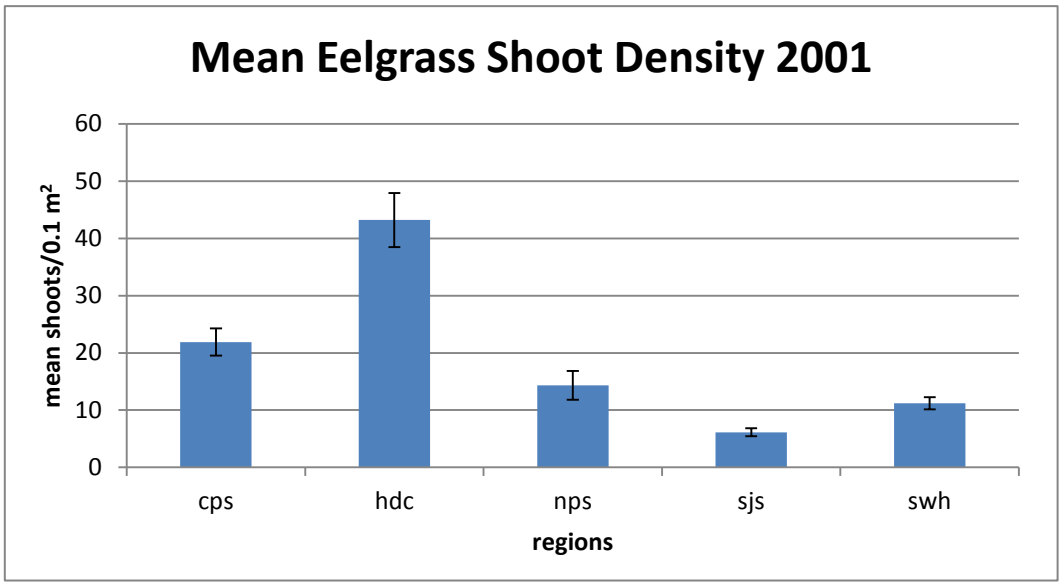
Environmental parameters influencing eelgrass plant structure and eelgrass density have been reported in scientific literature (Boese et al., 2003; Turner et al., 1999). Workgroup participants have also cited field observations of geographic differences in plant structure and density. This encouraged an examination of the available data on eelgrass shoot density, specifically to see if regional differences or variability in eelgrass density over time might be quantified.

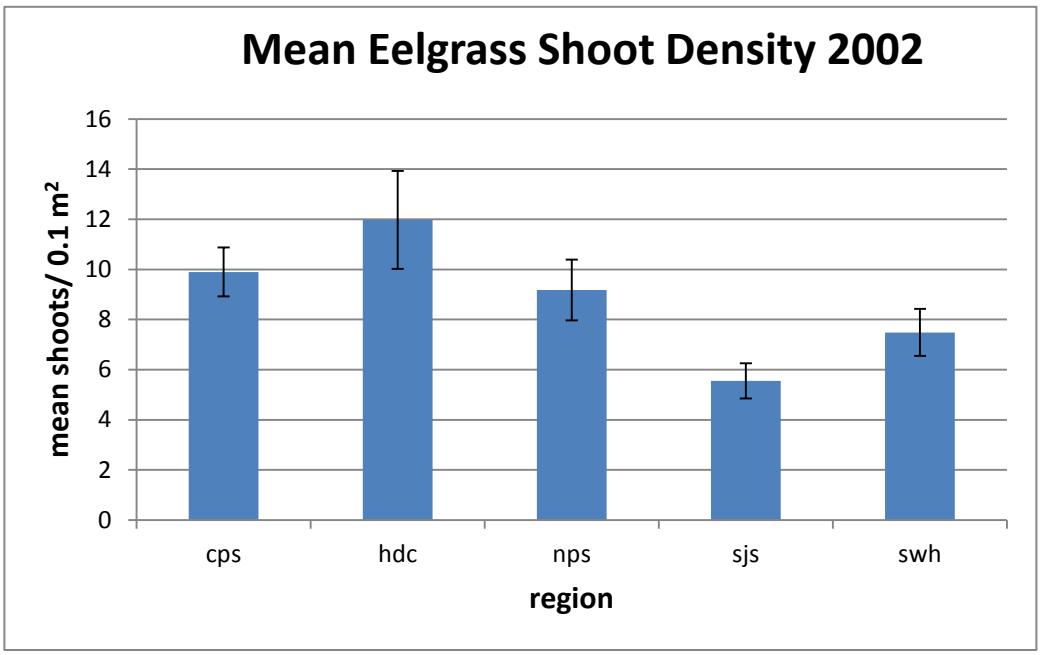
DNR grab sample density counts

Initial sampling for the Submerged Vegetation Monitoring Program included shoot density counts of grab samples collected with a van Veen sampler. An average of 23.9 shoots per sample, with a minimum of 1 shoot per unit area, was reported from 1,020 samples collected during 2000–2003. Sites sampled within each region were not necessarily sampled each year, although some sites were sampled in consecutive years. Sampling did not fall in the same period for each year either. While the absolute density numbers differed each year, visual observation of the data (see plots in Figure 2) does indicate a fairly consistent pattern of relative difference in shoot density among the five regions sampled, with Hood Canal (hdc) having the highest density, Central Puget Sound (cps) and North Puget Sound (nps) competing for second highest, and then South Whidbey (swh) and San Juan Island (sjs) with the lowest density.

Figure 2. Mean eelgrass shoot density from annual grab sampling by region, 2000–2002. Error bars are standard errors of the means.







Mitigation monitoring data: Maury Island

Eelgrass at a proposed project site on Maury Island was monitored intensely in 2005, 2008, and 2009 by the consulting firm Grette Associates LLC. Fixed grids with grid cell size of 1 x 1 m were established to encompass the entire eelgrass area. Dive survey sampling included eelgrass percent cover estimates within each square-meter grid cell, eelgrass density shoot counts within a 0.25 m^2 portion of each grid cell, and delineation of eelgrass presence in each square meter. Eelgrass survey maps from sample years 2005, 2008, and 2009 are reproduced in Figures 3–5 below, with eelgrass presence delineated and the density counts per 0.25 m^2 indicated within each grid cell. Sampling occurred during July for 2005 and 2008, and then in August for 2009. The images are from Northwest Aggregates: Maury Island Gravel Dock Annual Eelgrass Survey Reports, December 19, 2005, September 19, 2008, and December 15, 2009, prepared for Northwest Aggregates by Grette Associates LLC.

Eelgrass density: Maury Island

Close examination of the data from eelgrass monitoring of the north, south, and control patches (Figures 3–5) indicated differences in the stability of the three eelgrass areas. These findings are summarized in Table 6.

Table 6. Eelgrass area and mean density at Maury Island gravel site.

Patch Name	**Year**	**Area (m^2)**	*Net Change in Area (m^2) from '05 to '09*	**Average Density (shoots/m^2)**	*Net Change in Avg. Density (shoots/0.25m^2) from '05 to '09*
North	2005	126		77	
	2008	127		72	
	2009	85	-41	13	-64
South	2005	148		54	
	2008	152		56	
	2009	218	+70	28	-26
Control	2005	261		30	
	2008	256		37	
	2009	265	+4	26	-4

Figure 3. Eelgrass monitoring, Maury Island, north patch, 2005, 2008, 2009 (Grette Associates, 2005, 2008, 2009).

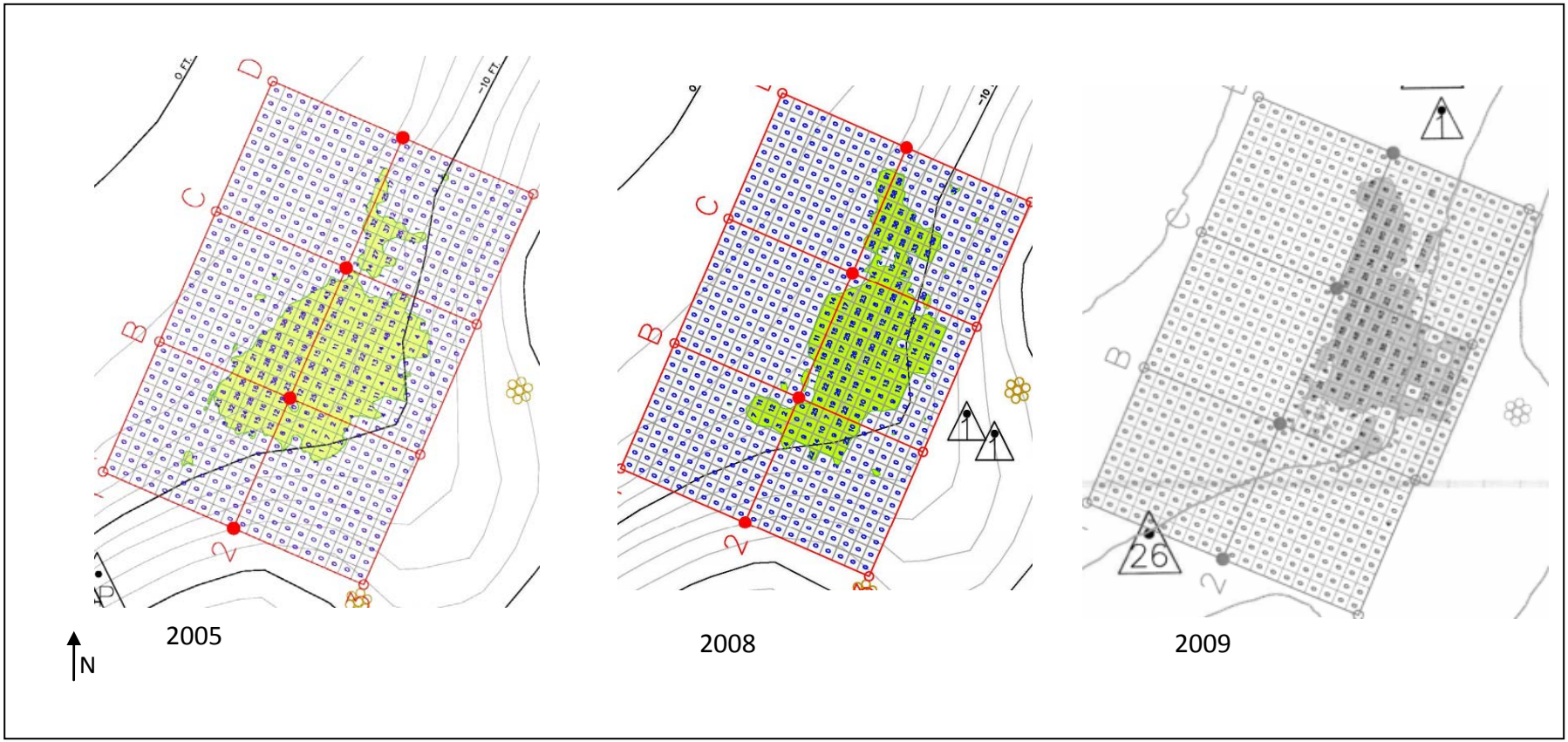


Figure 4. Eelgrass monitoring, Maury Island, south patch, 2005, 2008, and 2009 (Grette Associates, 2005, 2008, 2009).

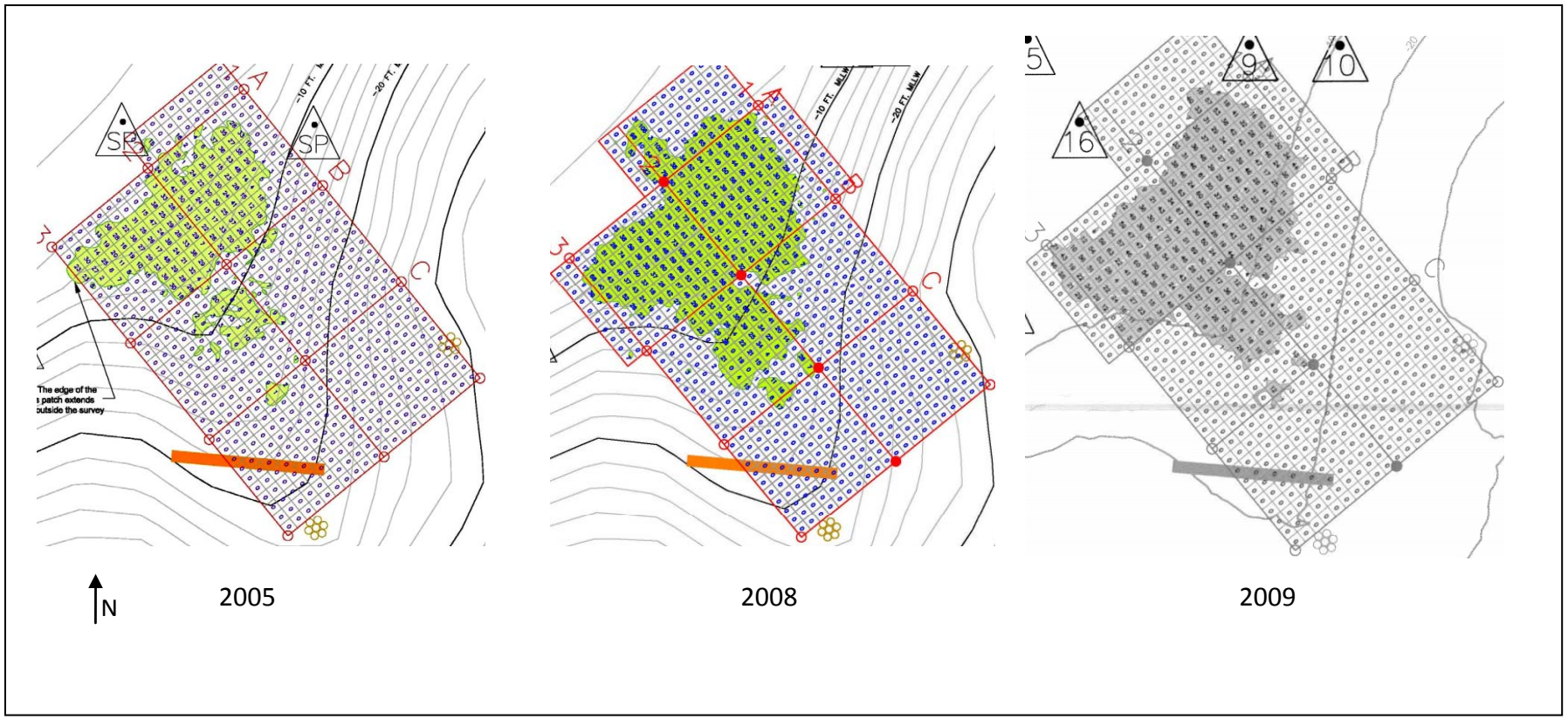
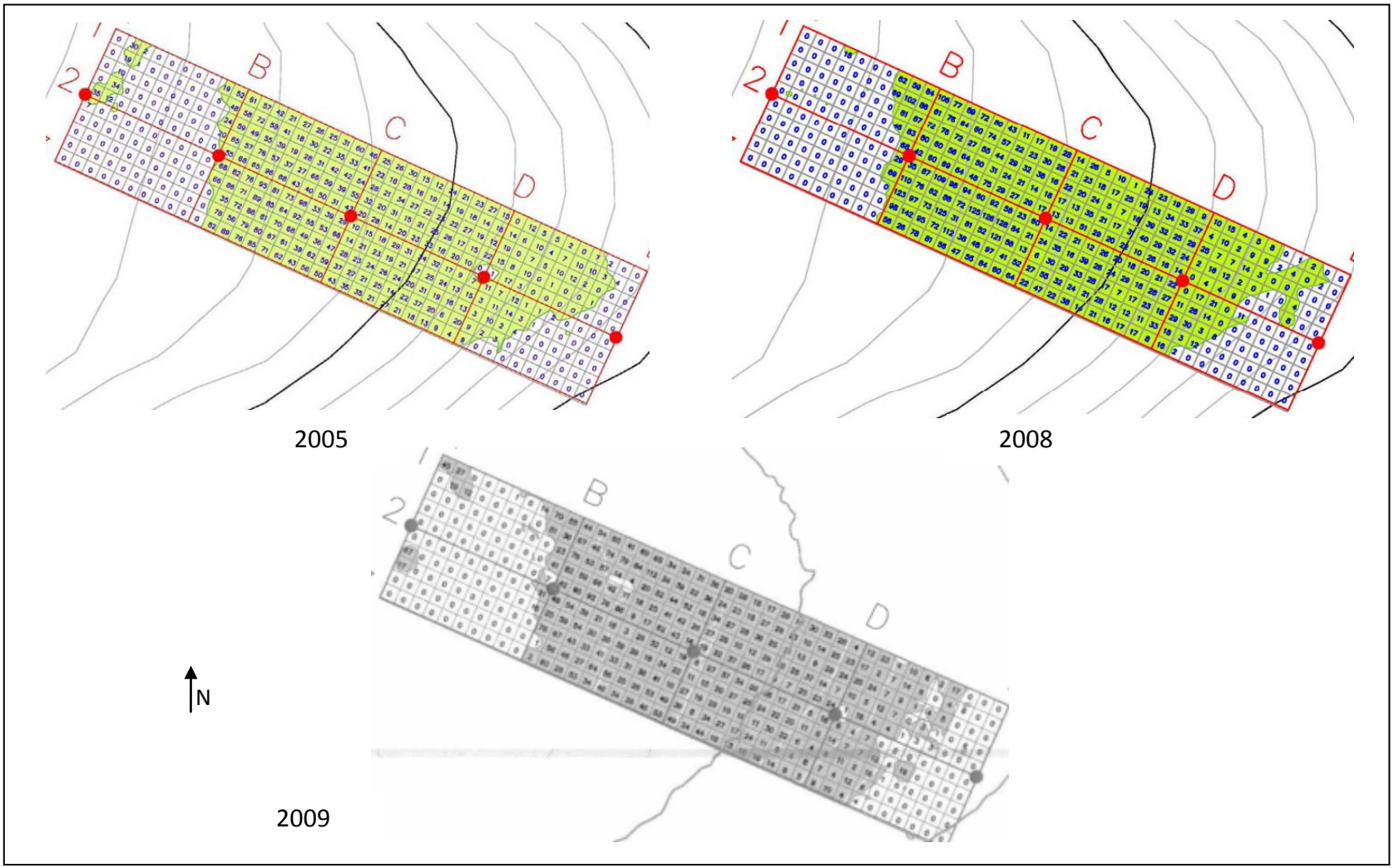


Figure 5. Eelgrass Monitoring, Maury Island, Control Patch, 2005, 2008, and 2009 (Grette Associates, 2005, 2008, 2009)



The apparent differences in contiguous eelgrass stability that the comparison of the control site to the other two eelgrass areas revealed may be an artifact of differences between the survey limits of the control site and those of the north and south sites: The control site survey was limited to a swath from a larger contiguous area, while the survey extents of the north and south sites contained the entire eelgrass presence in each case, and surveys increased if necessary to capture edge migration. Assessment of the comparison between the north and south sites and relative change for each of these two areas over time is not affected by this survey limitation.

The eelgrass area and average shoot density remained relatively stable at the control site (again, this may be an artifact of the extent of the survey for this site). The eelgrass area increased in the south site and decreased in the north site, while the average shoot density decreased in both north and south patches.

The eelgrass edge of the north site moved approximately two meters east between 2005 and 2008 (spreading out both north and south). The northward edge contracted approximately five meters from 2008 through 2009.

The western eelgrass edge of the south site migrated approximately two meters to the east (filling in the patchier northern portion) from 2005 to 2008. It continued to migrate approximately four more meters eastward between 2008 and 2009.

Migration of the control site edges cannot be accurately assessed, because the monitoring area does not contain the long-shore edges of that eelgrass area. It is apparent that smaller areas of eelgrass along the shoreward edge were ephemeral in size and shape.

Furthest shoot: Maury Island

When looking at the pattern of density in all sites for three years, gradual tapering off of the density toward the shallow edge is never observed. In fact, some of the highest density grid cells are located directly on the shallow edge. The decrease in density is slightly more gradual on the deeper edge, but only one to two meters before complete drop-off.

In the north, south, and control sites, furthest shoots were documented (shoots located beyond a meter distance of the contiguous eelgrass area) off the shallow and deep edges. A furthest shoot was not always present. When present, furthest shoot distances on the shoreward edges ranged from 1.1 m to 8.0 m. The furthest shoot distances on the seaward edges (when present) ranged from 2.1 m to 3.5 m. Table 7 summarizes the furthest shoot distances measured at these sites.

While eelgrass presence did not migrate beyond the location at which a furthest shoot was found (shoreward or seaward), eelgrass did migrate along shore to areas where no eelgrass had been found during the previous sample time.

Table 7. Edge migration and shoot distance in eelgrass patches at Maury Island gravel site.

Patch Name	Year Sampled	Edge Migration: Expansion, +, Contraction, -(m)	Shoreward Furthest Shoot Distance (m)	Seaward Furthest Shoot Distance (m)
North Patch	2005		1.7	_
	2008	+2 east	2.0	2.1
	2009	-5 north		
South Patch	2005		1.1	3.5
	2008	+ 2 east	_	_
	2009	+4 east		
Control Patch	2005		_	_
	2008		8.0	_
	2009		_	_

Eelgrass persistence: Maury Island

Persistence of eelgrass area and density was evaluated in the Maury Island data (Table 8) so that it could be compared with the estimates provided in the literature. Only eelgrass presence that had a maximum area of 2 x 2 m was included in the analysis. Eelgrass that persisted beyond a season was larger in area and had a higher average shoot density compared to eelgrass that did not persist. The area of eelgrass that persisted was at least 0.3 m^2, with minimum density of 3 shoots per 0.25m^2.

Table 8. Minimum area and shoot density for eelgrass persistence at Maury Island gravel site.

Patch	Shoot Density (shoots/0.25m^2)				Patch Area (m^2)			*n*
Persistence	*average*	*min*	*max*	*SE(n)*	*average*	*min*	*max*	
> 1 season	54.4	***3***	124	2.44	0.9	***0.3***	4.0	*10*
< 1 season	13.7	1	36	0.76	0.6	0.1	1.0	*14*

Plant morphology data: Washington DNR Eelgrass Stressor Project

Plant structure provides important ecological functions. Above-ground shoots can provide three-dimensional structure for fish refugia and for epiphyte and invertebrate attachment. Below-ground structure provides habitat for macroinvertebrate attachment and sediment stabilization. Morphology of the above- and below-ground structure of *Z. marina* differs with environmental factors, as has been documented (Turner et al., 1999; Frederiksen et al., 2004). Plant structure is relevant to the development of bed criteria, because the distance between the plants and the bed edge is influenced by the length of shoots and rhizomes. The results of the analysis of plant morphology data from Washington DNR's eelgrass stressor project are presented below (Table 9).

The average shoot length at four sites (SE = 1.4, n = 180) in Puget Sound was 53.1 cm, with an average maximum shoot length of 89.7 cm (SE = 6.5, n = 45)(Washington DNR unpublished data). Average rhizome length at these sites was 33.3 cm (SE = 2.9, n = 169), with an average maximum rhizome length of 68.4 cm (SE = 4.4, n = 43).

Table 9. Eelgrass morphology metrics.

Ecological Attribute	Eelgrass Metric	Value
Eelgrass Morphology	Shoot length	Average shoot lengths ranged from 53.1 cm to 89.7 cm (Washington DNR unpublished data)
	Rhizome length	Average rhizome length ranged from 33.3 cm to 68.4 cm (Washington DNR unpublished data)

Index of eelgrass densities in Puget Sound and Willapa Bay

Eelgrass densities measured throughout Puget Sound and Willapa Bay are presented in Table 10. In the workshops, it was suggested that when pre-construction eelgrass surveys are conducted for proposed projects, it may be possible to begin developing a spatially explicit index of patch densities for comparison. A preliminary compilation of eelgrass density data is presented in Table 10; the sample size and standard error are indicated when known. These data were largely drawn from scientific publications, but other sources include Washington DNR Aquatics program field surveys, and environmental evaluation reports required for proposed projects on state-owned aquatic lands. These data may be helpful to those who are developing mitigation performance standards and selecting reference sites. These data cannot be used to determine minimum patch size, because they are reported as means (most often with very large variation in the mean) or ranges of densities, with limited or no information on sample size.

Table 10. Compilation of eelgrass densities measured throughout Washington.

Location (elevation)	Date	Average or Range of Densities (shoots/m^2)	SE	n	Reference
Puget Sound					
Lummi Bay	Apr-May 2007	160.7		20	Yang (2011)
North Samish Bay	Apr-May 2007	157		20	Yang (2011)
South Samish Bay	Apr-May 2007	177.1		20	Yang (2011)
Padilla Bay	Apr-May 2007	207.8		20	Yang (2011)
Similk Bay	Apr-May 2007	78		20	Yang (2011)
Kayak Point	Apr-May 2007	50.7		20	Yang (2011)
North Hood Canal	Apr-May 2007	137.8		20	Yang (2011)
Dabob Bay, Hood Canal	Apr-May 2007	155.9		20	Yang (2011)
Edmonds	Apr-May 2007	89.1		20	Yang (2011)
Carkeek Park	Apr-May 2007	212.2		20	Yang (2011)
Golden Gardens	Apr-May 2007	156.4		20	Yang (2011)
Seabeck, Hood Canal	Apr-May 2007	277.1		20	Yang (2011)
Lynch Cove, Hood Canal	Apr-May 2007	76.2		20	Yang (2011)
Purdy Spit, Car Inlet	Apr-May 2007	260		20	Yang (2011)
Rocky Point, Case Inlet	Apr-07	150		20	Yang (2011)
	May-07	89		20	Yang (2011)
Union, Hood Canal	Apr-May 2007	81.5		20	Yang (2011)
Dumas Bay	Apr-May 2007	141.8		20	Yang (2011)

Location (elevation)	Date	Average or Range of Densities (shoots/m^2)	SE	n	Reference
Dumas Bay: Washington DNR SeagrassNet Site (-1.6 to +1 MLLW)	Apr-08	464.9	77.5	36	Washington DNR unpublished data
	Jul-08	525.9	87.6	36	DNR unpublished data
	Apr-09	479.5	79.9	36	DNR unpublished data
	Jul-09	483.6	80.6	36	DNR unpublished data
	Apr-10	352.4	58.7	36	DNR unpublished data
	Jul-10	420.9	70.2	36	DNR unpublished data
	Apr-11	392.2	66.4	36	DNR unpublished data
	Jul-11	360.4	60.1	36	DNR unpublished data
Post Point Outfall, Bellingham	2005	22–61			City of Bellingham (2005)
Golden Tides, Bellingham	Jun-06	28–39			Geomatrix (2007)
	Jul-08	29–88			Geomatrix (2008)
Taylor Ave. Dock, Bellingham	Jul-98	42–238		30	Talyor Assoc. (1998)
	2004	49–235			Anchor Env. (2004)
Shannon Pt., Bellingham	2009	5–50			ATSI (2010)

Location (elevation)	Date	Average or Range of Densities (shoots/m^2)	SE	n	Reference
Maury Island Gravel Site (North)	Jul-05	77			Grette Assoc. (2005)
	Jul-08	72			Grette Assoc (2008)
	Aug-09	13			Grette Assoc (2009)
Maury Island Gravel Site (South)	Jul-05	54			Grette Assoc. (2005)
	Jul-08	56			Grette Assoc (2008)
	Aug-09	28			Grette Assoc (2009)
Maury Island Gravel Site (Control)	Jul-05	30			Grette Assoc. (2005)
	Jul-08	37			Grette Assoc (2008)
	Aug-09	26			Grette Assoc (2009)
Willapa Bay					
Oysterville	Apr-May 2007	114.4		20	Yang (2011)
Oysterville (-0.5 to +1.5 MLLW)	Jul-07	290	14	20	Ruesink *et al.* (2010)
Stackpole (-0.5 to +1.5 MLLW)	Jul-07	353	39	20	Ruesink *et al.* (2010)
Stackpole Flats	2007	22.8	5.3	44	Ruesink *et al.* (2010)
Nahcotta (-0.5 to +1.5 MLLW)	Jul-07	69	7	20	Ruesink *et al.* (2010)
Parcel A., Willapa Bay	Apr-May 2007	100.3		20	Yang (2011)
Willapa Bay (7 Locations)	Jul-04	159.5	33.9	7	Ruesink *et al.* (2006)

Summary of relevant findings

- Changes in ecological function were observed where a very small area of eelgrass was present; differences in benthic community diversity were observed when a 0.24 m^2 sized area of eelgrass-vegetated substrate was compared to an unvegetated substrate. An eelgrass area of $0.3m^2$ was documented to have increased sediment trapping function when compared with unvegetated bottom.
- A minimum density of 3 shoots per 0.25 m^2 was necessary for an area of eelgrass to persist from one season to the next at a site in Puget Sound.
- With reported rhizome growth of 0.3 m per year and observed average rhizome lengths ranging from 0.3 to 0.7 m, a distance of 1 m would be necessary to ensure that the below-ground biomass of two adjacent shoots are captured when delineating a bed.
- Eelgrass edges at a site in Puget Sound were documented to migrate seasonally and annually. Maximum annual expansion to areas beyond the previously recorded edge was documented at 4 meters, while maximum annual contraction to areas of the previously recorded bed interior was up to 5 meters.
- Edge migration shoreward or seaward was always within the distance defined by the furthest shoot; however, edges also migrate along the shore, where the furthest shoot is not defined.
- Shoots greater than 1 meter from a contiguous eelgrass area have been documented appearing and disappearing seasonally and interannually.

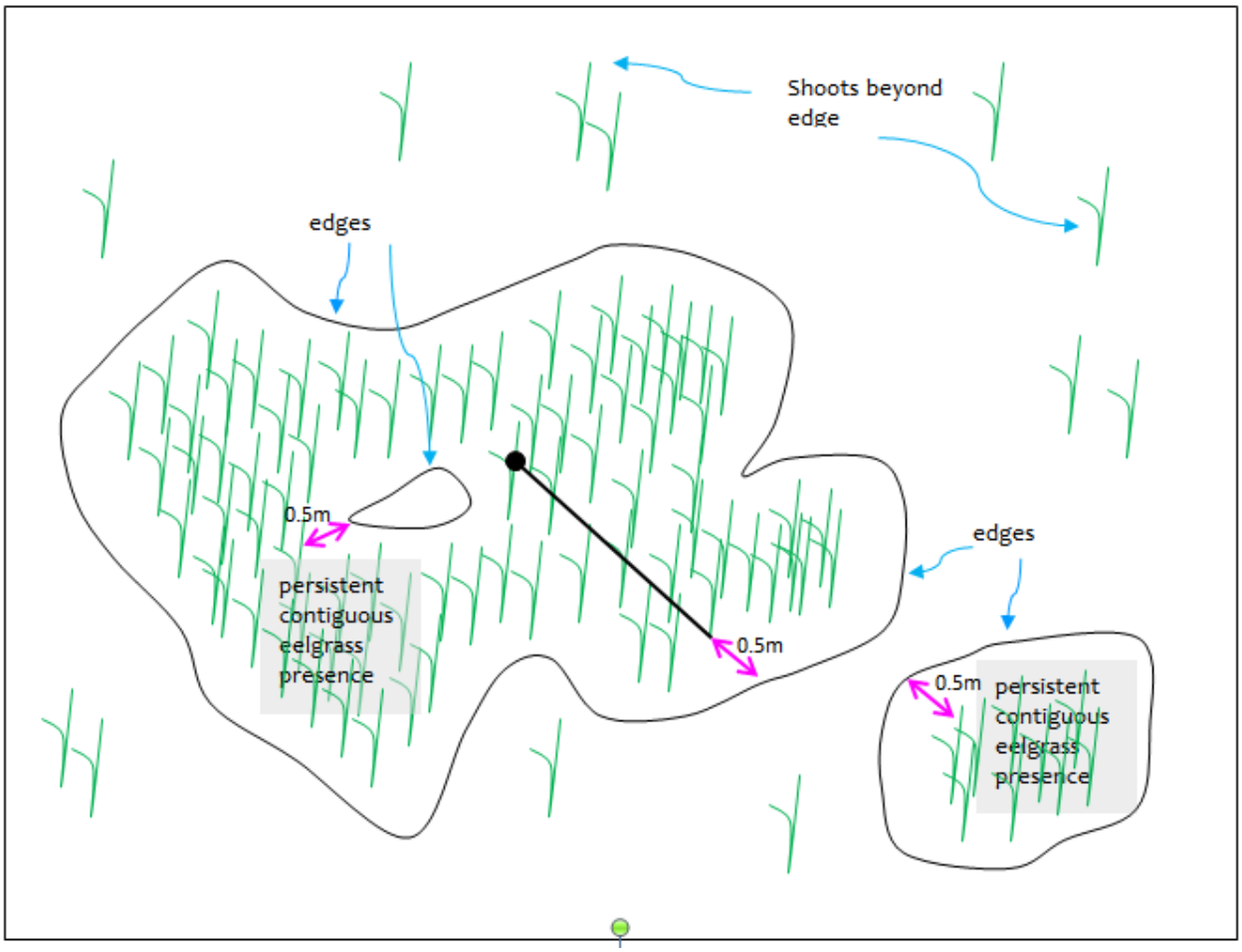
Proposed criteria

The proposed criteria for identifying the minimum eelgrass presence needed to delineate a vegetated edge with demonstrated ecological function are listed in Table 11. The criteria are based on information derived from review of the scientific literature and examination of available field data (from Puget Sound sites). Note that these criteria emerged from the limited data and information available regarding ecological function of *Zostera marina* characteristics and dynamics and are meant to provide an operational definition. Future sampling and further analysis may indicate that an adaptation or refinement of these criteria is necessary. In particular, field data from the estuaries of Washington's outer coast may provide scientific support for establishing separate criteria for those estuaries.

Table 11. Criteria for eelgrass bed edge and beyond.

Terms	Criteria	Bed edge or beyond?	Rationale
Persistent Bed Edge	Begin at a point within the interior of the bed (where ≥ 3 shoots/0.25m^2 within 1 m of adjacent shoots); move along any radial transect. Find the last shoot that is within 1 m of an adjacent shoot along that transect. Continue 0.5 m beyond this shoot: This is the bed edge. Both exterior and interior edges of bed can exist (Figure 6).	Bed edge	• Vegetated areas as small as 0.24 m^2 demonstrated different ecological function from unvegetated substrate. • 3 shoots per 0.25 was the minimum density necessary for an eelgrass patch to persist from one season to the next in Puget Sound. • Observed average rhizome lengths ranged from 0.3 to 0.7 m, and rhizome growth rates of approximately 0.3 m per year have been documented. Observed average shoot lengths ranged from 0.5 to 0.9 m. • Two adjacent shoots would require a minimum distance of 1.0 m to accommodate above- and below-ground parts of the plant. • A distance of 0.5 m beyond the last shoot is needed to accommodate the below-ground rhizome of an edge shoot.
Shoots or Patches	Single shoot or patches < 3 shoots/0.25m that are > 1 m from adjacent shoot	Beyond	• The ecological function of patches below this size and density has not been documented. • Patches below this size and density have been documented as ephemeral.
Ephemeral Shoots and Patches	Shoots or patches that may disappear then reappear from one season or year to the next	Beyond	• The ecological function of shoots and patches with limited temporal consistency has not been documented. • Ephemeral shoots and patches cannot feasibly be monitored for before-after effects analysis.

Figure 6. Schematic depicting two distinct, intact, contiguous eelgrass areas. Edges are 0.5 m beyond the last shoot found within 1 m of an adjacent shoot.



Conservation approaches

The ephemeral nature of eelgrass, particularly the edges of eelgrass presence, has been documented in the scientific literature and by data from Puget Sound and Willapa Bay. It has also been anecdotally observed in the field by shellfish growers and scientists. SeagrassNet protocol acknowledges it by requiring measurement from a fixed transect to the edge and to the furthest shoot. Eelgrass at the edge is less persistent than eelgrass near the center of a contiguous area. This migratory characteristic of eelgrass makes it a challenge to specify protocols for detecting changes effected by a specific activity. It is also a problem for those making management decisions, such as at what distances from the eelgrass it might be appropriate to encourage use and access of the tidelands, while still protecting sustainable eelgrass functions. Table 12 presents some metrics from published literature and the recent data analysis that may be relevant in determining these distances.

Table 12. Metrics relevant for developing buffers.

Relevant ecological attribute	Eelgrass Metric	Value
Potential Migration Zone	Expansion (+) or contraction (-) distance	Maximum documented annual bed expansion of +4 m, and contraction of -5 m (Washington DNR un-published data for two different sites) sampled over 4 year period).
Seed Dispersal	Seed dispersal distance	5 m (Ruckelshaus, 1996)
Genetic Diversity	Distance at which plants can be genetically distinguished	4 m (Ruckelshaus, 1994)

Recommendations

The revised goal described in the introduction of this memo was to determine the criteria for defining an eelgrass bed edge. The definition ". . . must allow for repeatable delineation of the beds, so that any impacts from activities authorized by Washington DNR in marine tidelands can be avoided or minimized with the application of appropriate conservation measures." There was consensus early on among the workshop participants that the purpose of this effort was to apply scientific evidence to distinguish between an intact, persistent, and functioning eelgrass area and spare individual blades of eelgrass, ephemeral eelgrass areas, or potential eelgrass habitat. A comprehensive review of scientific literature and analysis of available data led to the following recommendations:

- Apply the proposed criteria listed in Table 11 to delineate an edge around eelgrass presence. This distinguishes between contiguous eelgrass presence and sparse shoots of eelgrass that may be present at a site, but are not within a contiguous area.

- Consider the values provided in Table 12 as the uncertainty distance around an intact, persistent eelgrass area. It is only through siting activities within this expansion, contraction, and seed dispersal distance that positive or negative changes to eelgrass can be effectively monitored for adaptive management.

Next steps

It was suggested that further examination of the available data might be used to develop some indices of bed characteristics from different areas of the state. Various seagrass attributes (such as shoot density, plant architecture, and colonization rates) have been shown to have a strong relationship to the physical setting of an area (Frederiksen et al., 2004; Robbins & Bell, 1994; Turner et al., 1999). Monitoring interannual variability in shoot density and the edge location in different areas would provide information on how to determine best site uses that do not conflict with sustainable ecological function of eelgrass habitat.

If the intent is to develop the most effective operational definition possible, it will be useful to design initial baseline and adaptive management sampling to evaluate the practicability of the bed criteria and some of the eelgrass metrics listed in Table 2. Data relevant to longshore dynamics of *Zostera marina* are limited (Frederiksen et al., 2004); therefore, Washington DNR's adaptive management monitoring should include baseline sampling designed to explore interannual edge migration in both the cross and longshore.

These proposed edge criteria, delineation methods, and conservation approaches are the outcome of a series of technical workgroup discussions. This information can serve as a starting point for future policy deliberations on developing effective conservation measures that will allow for management of resources, while encouraging sustainable uses on state-owned aquatic lands.

References

Anchor Environmental (2004) Taylor Ave Dock Year-0 post-construction eelgrass survey Prepared for City of Bellingham Parks and Recreation Department

ATSI (2010) Biological Evaluation Shannon Point Marine Center Seawater Pumping System Prepared for Western WA University January, 27, 2010

Bell, S.S., R.A. Brooks, B.D. Robbins, M.S. Fonseca, and M.O. Hall (2001). Faunal response to fragmentation in seagrass habitats: implications for seagrass conservation. *Biological Conservation* 100:115-123.

Blackmon, D., T. Wyllie-Echeverria, and D.J. Shafer (2006). The role of seagrasses and kelps in marine fish support. Wetlands Regulatory Assistance Program ERDC TNWRAP-06-1. February 2006.

Boese, B.L., K.E. Alayan, E.F. Gooch and B.D. Robbins (2003) Desiccation index: a measure of damage caused by adverse aerial exposure on intertidal eelgrass *(Zostera marina)* in an Oregon (USA) estuary. *Aquatic Botany*, 76:329-337

City of Bellingham (2005) Post Point Lagoon Monitoring Project, City of Bellingham Department of Public Works Project Summary

Cox, P.A., R.H. Laushman, and M.H. Ruckelshaus (1992). Surface and submarine pollination in the seagrass *Zostera marina L. Bot. J. Linn. Soc.* 109:281-291

de Cock, A.W.A.M. (1980). Flowering, pollination and fruiting in *Zostera marina L. Aquat. Bot.* 9:202-220.

Duarte, C.M., R. Martinez and C. Barron (2002). Biomass, production and rhizome growth near the northern limit of seagrass *(Zostera marina)* distribution. *Aqua. Bot.* 72:183-189.

Evans, N.T. and Leschen, A.S. (2010). Technical Guidelines for the Delineation, Restoration, and Monitoring of Eelgrass (Zostera marina) in Massachusetts Coastal Waters Massachusetts Division of Marine Fisheries Technical Report TR-43 October, 2010, 9 pps.

Fonseca, M.S. and S.S. Bell (1998). Influence of physical setting on seagrass landscapes near Beaufort, North Carolina, U.S.A. *Mar. Eco. Prog Ser*, 171:109-121.

Fonseca. M.S. and J.A. Cahalan (1992) A preliminary evaluation of wave attenuation by four species of seagrass. *Est. Coast and Shelf Sci.*, 35:565-576

Fonseca,M.S. , W.J. Kenworthy, D.R. Colby, K.A. Rittmaster, and G.W. Thayer (1990). Comparisons of fauna among natural and transplanted eelgrass *Zostera marina* meadows: criteria for mitigation. *Mar. Eco. Prog. Ser.* 65:251-264

Fonseca, M.S., J.W. Kenworthy, and G.W. Thayer (1998). Guidelines for the Conservation and Restoration of Seagrasses in the United States and Adjacent Waters. NOAA Coastal Ocean Program Decision Analysis Series No. 12. NOAA Coastal Ocean Office, Silver Spring,MD. 222 pps.

Fonseca, M.S., and M.A.R. Koehl (2006). Flow in seagrass canopies: the influence of patch width. Estuar. *Coast Shelf Sci* 67:1-9

Frederiksen, M. D. Krause-Jensen, M. Holmer, J. S. Laursen (2004) Spatial and temporal variation in eelgrass *(Zostera marina)* landscapes: influence of physical setting. *Aquatic Botany*, 78:147-165

Frost, M.T., A.A. Rowden, and M.L. Attrill (1999). Effect of habitat fragmentation on the macroinvertebrate infaunal communities associated with the seagrass *Zostera marina L. Aquatic Conservation: Marine and Freshwater Ecosystems*, 9:255-263.

Geomatrix (2007) Golden Tides Marina Mitigation and Monitoring Plan Prepared for GRE Golden Tides LLC

Geomatrix (2008) Draft Biological Evaluation Golden Tides Marina Breakwater Replacement and Maintenance Dredging Project 2008 Prepared for GRE Golden Tides LLC

Grette Associates (2005) Northwest Aggregates: Maury Island Gravel Dock 2005 Annual Eelgrass Survey Report, December 19, 2005, Prepared for Northwest Aggregates by Grette Associates LLC, 30 pps

Grette Associates (2008) Northwest Aggregates: Maury Island Gravel Dock 2008 Annual Eelgrass Survey Report,2008 Annual Eelgrass Survey Report, September 19, 2008, Prepared for Northwest Aggregates by Grette Associates LLC, 31 pps

Greve, T.M., D. Krause-Jensen, M.B. Rasmussen, and P.B. Christensen (2005). Means of rapid eelgrass *(Zostera marina L.)* recolonisation in former dieback areas. *Aqua. Bot.*, 82:143-156.

Hirst, J. A. and M.J. Attrill (2008). Small is beautiful: An inverted view of habitat fragmentation in seagrass beds. *Est Coast & Shelf Sci.*, 78:811-818

Hovel, K.A., M.S. Fonseca, D. Myer, W. Kenworthy, and P. Whitfield (2002). Effects of seagrass landscape structure, structural complexity and hydrodynamic regime on macrofaunal densities in North Carolina seagrass beds. *Marine Ecology Progress Series*, 243:11-24.

Kendrick, G.A., C.M. Duarte, and N. Marbà (2005). Clonality in seagrasses, emergent properties and seagrass landscapes. *Mar Ecol-Prog Ser.*, 290:291

Koch, E.W. (2001). Beyond light: physical, geological, and geochemical parameters as possible submersed aquatic vegetation habitat requirements. *Estuaries*, 24:1:1-17

Mateo, M. A., J. Cebrian, K. Dunton, T. Mutchler (2006). Carbon flux in seagrass ecosystems, In: Larkum WDA, R.J. Orth and C.M. Duarte (eds) Seagrasses: Biology, Ecology and Conservation Springer, Dordrecht, The Netherlands, p 159-192.

Marbà, N., and C.M. Duarte (1995). Coupling of seagrass *(Cymodocea nodosa)* patch dynamics to subaqueous dune migration. *Jour. of Ecol.*83:381-389,

Marbà, N., and C.M. Duarte (1998). Rhizome elongation and seagrass clonal growth. *Mar. Ecol. Prog. Ser.* 174 269-280.

MARBIPP (2006) Marine biodiversity patterns and processes, research programme 2001-2006. Available on http://www.marbipp.tmbl.gu.se

McKenzie, L.J., S.J. Campbell, and C.A. Roder (2003). Seagrass-Watch: Manual for Mapping and Monitoring Seagrass Resources by Community (citizen) volunteers. 2nd Edition (QFS, NFC, Cairns) 100 pp

Moore, K.A., R.J. Orth and J.F. Nowak (1993). Environmental regulation of seed germination in *Zostera marina L.* (eelgrass) in Chesapeake Bay: effects of light, oxygen and sediment burial. *Aqua. Bot.* 45:79-91.

Olesen, B. and J. Sand-Jensen (1994). Patch dynamics of eelgrass *Zostera marina. Mar. Ecol. Prog Ser.* 106:147-156.

Orth, R.J., T.J.B. Carruthers, W.C. Dennison, C.M. Duarte, J.W. Fourqurean, K.L. Heck Jr., A.R. Hughes, G.A. Hendrick, W.J. Kenworthy, S. Olyarnik, F.T. Short, M. Waycott and S.L. Williams (2006). A global crisis for seagrass ecosystems. *Bioscience*, 56:987-996.

Orth, R.J., J.R. Fishman, M.C. Harwell and S.R. Marion (2003). Seed-density effects on germination and initial seedling establishment in eelgrass *Zostera marina* in the Chesapeake Bay region. Mar. Ecol. Prog. Ser. 250:71-79

Orth, R. J., M. Luckenbach and K.A. Moore (1994). Seed dispersal in a marine mcarophyte: implications for colonization and restoration. *Ecology*, 75(7)1927-1939

Phillips, R.C. (1984). The ecology of eelgrass meadows in the Pacific Northwest: a community profile. U.S. Fish and Wildlife Service, FWS/OBS 84/24.

Robbins, B.D. and S.S. Bell (1994) Seagrass landscapes: A terrestrial approach to the marine subtidal environment. *Trends in Ecology and Evolution*, 9:301-304)

Ruckelshaus, M.H. (1994). Ecological and Genetic Factors Affecting Population Structure in the Marine Angiosperm *Zostera marina L.* Ph.D. Dissertation, University of Washington, Seattle, WA 206 pps.

Ruckelshaus, M.H. (1996). Estimation of genetic neighborhood parameters from pollen and seed dispersal in the marine angiosperm *Zostera marina. Evolution* 50(2):865-864

Short, F. T, L. J. McKenzi, R. G. Cole, K. P. Vidle,and J. L. Gaeckle (2006). SeagrassNet Manual forScientific Monitoring of Seagrass Habitat.Worldwide edition. Durham, New Hampshire:University of New Hampshire. 75. pps http://www.seagrassnet.org

Sintes, T., Marbà, N. Duarte, C.M., (2006) Modeling nonlinear seagrass clonal growth: Assessing the efficiency of space occupation across the seagrass flora. Estuaries and Coasts 29:72-80

Thom, R., J. Gaeckle, A. Borde, M. Anderson, M. Boyle, C. Durance, M. Kyte, P. Schlenger, J. Stutes, D. Weitkamp, S. Wyllie-Echeverria and S. Rumrill (2008). Eelgrass *(Zostera marina L.)* Restoration in the Pacific Northwest: Recommendations to improve project success. Pacific Northwest National Laboratory. PNWD-3970

Taylor Associates and Battelle Marine Sciences Laboratory (1998) Eelgrass Bed Survey and Proposed Dock Replacement

Turner, S.J., J.E. Hewitt, M.R. Wilkinson, D.J. Morrisey, S.F. Thrush, V.J. Cummings and G. Funnell (1999). Seagrass patches and landscapes: The influence of wind-wave dynamics and hierarchical arrangements of spatial structure on macrofaunal seagrass communities. *Estuaries*, 22:1016-1032.

Virnstein, R., W. Avery, and J.O.R. Johansson (1998). On defining the “edge’ of a seagrass bed. Proceedings from Tampa Bay Study Group Annual Workshop, S. Johns River Water Management District, Palatka, FL

Walker, D. W. Dennison, G. Edgar (1999). Status of Australian seagrass research and knowledge. In: Butler, A. and P. Jernakoff (eds) Seagrass in Australia CSIRO Publishing, Collingswood Victoria, p1-18

Wyllie-Echeverria, S. and R.M. Thom (1994). Managing seagrass systems in western North America: Resarch gaps and needs. Alaska Sea Grant College Program: Alaska Sea Grant report; no 94-01, 21 pps.

Wyllie-Echeverria, S., Wyllie-Echeverria, T., Cordell, J., Klinger, T., Skalski, J., Fresh, K., Stamey, M., and Young, C. (2002). "2001 Guemes Channel Marine Habitat Assessment Report," Prepared for the Port of Anacortes, Anacortes, WA. Project No. 049-01.

Yang, S. (2011) Ecosystem engineering by eelgrass *(Zostera marina)* leads to population feedbacks in certain environmental contexts PhD Dissertation, University of WA 69 pps

WASHINGTON STATE DEPARTMENT OF
Natural Resources
Peter Goldmark - Commissioner of Public Lands

Aquatic Resources Division
1111 Washington St. SE
Olympia, WA 98504-7027

www.dnr.wa.gov

Printed in the USA on recycled paper DNR is an equal opportunity employer BUG