McNeil Island Habitat Restoration Project Feasibility Report

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List of Acronyms

BERK	*BERK consulting firm*
DOC	*Washington Department of Corrections*
DOE	*Washington Department of Ecology*
DNR	*Washington Department of Natural Resources*
DSHS	*Washington Department of Social and Health Services*
MHHW	*Mean Higher High Water*
MOU	*Memorandum of Understanding*
T-sheet	*Topographic sheet of US Coast Survey in late 1800's*
USGS Quad map	*United States Geological Survey 7.5-minute quadrangle topographic map*
WDFW	*Washington Department of Fish and Wildlife*

Introduction

Project overview

McNeil Island offers a unique opportunity to protect and restore natural habitat in a large setting within Puget Sound. Much of the shoreline of the island is in a natural state, retaining high quality habitat due to limited access by the public. However, development related to the historic use of the island for a federal penitentiary resulted in some locations being highly impacted and relict structures or debris along shorelines. The Washington Department of Fish and Wildlife (WDFW) and the Washington Department of Natural Resources (DNR) desire to collaborate on habitat restoration at impacted sites to return as much of the island to natural conditions as possible. WDFW worked with DNR to survey the shoreline of McNeil Island for potential beach cleanup sites and to collect information on four potential habitat restoration sites for further assessment. This report will present the results of the shoreline survey and preliminary feasibility analysis for the four potential sites.

McNeil Island setting

Physical

McNeil Island is located in South Puget Sound approximately 7 miles SW of Tacoma and 15 miles NE of Olympia. The island covers over 4400 acres, with approximately 12 miles of shoreline (Figure 1).

Figure 1: McNeil Island vicinity map

Puget Sound was formed by repeated advance and retreat of glaciers carving deep troughs and filling the lowland with glacial deposits, along with shaping due to tectonic forces. Although the last glacial retreat was between 13-16,000 years ago, Puget Sound beaches are relatively recently formed. As sea level stabilized approximately 5-6,000 years ago, the tides, winds, waves and gravity worked the weak glacial sediments and shoreline bluffs to form the shoreline landforms and beaches seen today. The shorelines of Puget Sound continue to be subject to erosion due to the geologic history of the region and the high tidal range, despite low wave energy due to limited fetch in many locations (Finlayson 2006).

The shoreline is relatively undisturbed, with the exception of high intensity shoreline modifications near the penitentiary. Approximately 25% of the shoreline is identified as feeder bluff (Washington Department of Ecology, DOE Digital Coastal Atlas), while remaining areas are moderate to low bank vegetated shorelines. While much of the shoreline is bluffs, the remainder of the island is low relief, rising to the highest elevation of 320 feet near Hyde Point. The island watersheds are small and there are few flowing streams. Most of the streams were modified by dams, elevated culverts or standpipes to impound water to supply the prison and agriculture or as a source of water for firefighting. Pump stations were added to some impoundments (Till and Caudill 2003) to improve water delivery to the island residents.

Biological

Much of the high quality habitat at McNeil Island has been retained due to limited access and that development activities are concentrated in only a few locations. Marine shorelines are relatively undisturbed along most of the island and include a diversity of high quality habitats such as bluff-backed beaches, barrier spits, and estuarine wetlands. Eelgrass and kelp are found in marine waters offshore. Developed areas along the shoreline are infrequent (approximately 8-9% of shoreline) but highly impacted at these select sites, while the remainder of the island supports overhanging mature vegetation along undisturbed beaches. The riparian areas are limited in width by the road along the shoreline in places, but the amount of intact marine riparian habitat along the McNeil Island shoreline is unusual to find in South Puget Sound.

The uplands are forested with mature conifers, although logging has removed old-growth forest in the past. Forests are interspersed with cleared areas for current or former agricultural activities which require maintenance for removal of invasive species when not in production. WDFW wildlife area plans recommend investigation of management activities for the forested portions of the island to improve wildlife habitat, as the stands are even-aged (WDFW 2006). Wetlands are also found on the island, providing additional habitat diversity for wildlife. WDFW noted most of McNeil Island as a priority habitat as a "biodiversity area and corridor".

The importance of McNeil Island and associated Gertrude and Pitt Islands for wildlife led to special protections for the site. Gertrude Island hosts the largest harbor seal rookery (*Phoca vitulina*) in Puget Sound, as well as important bird nesting habitat (great blue herons, alcids and bald eagles). Access to and around Gertrude Island is tightly controlled to avoid impact to wildlife resources. The main island also supports bald eagles and heron rookeries. At least 80 bird species were documented on McNeil Island by the U.S. Fish and Wildlife Service in 1979 (BERK 2012). Other observed mammals include black-tailed deer, coyote, river otter, muskrat, mink and raccoon (BERK 2012).

Marine shorelines are important habitats for forage fish, juvenile salmonids, shellfish and shorebirds. Forage fish, such as surf smelt (*Hypomesus pretiosus*) and Pacific sand lance (*Ammodytes hexapterus*), spawn along upper beaches on the island northwest of Milewa Creek and near the barge landing site (Figure 2). The upper beach habitat is often impacted by development such that much former forage fish spawning habitat is no longer available in Puget Sound. Several species of juvenile salmonids are present in the shallow waters along the shoreline in late winter through early summer. The shallow protected waters of the nearshore provide abundant food source and refuge from predation during early life history of salmon, allowing the fish to grow big quickly and improving survival. During sampling of several McNeil Island sites by the Nisqually Tribe for the Nisqually Reach Aquatic Reserve, twenty species of fish were collected in the nearshore in 2012 (BERK 2012).

Figure 2: McNeil Island forage fish spawning sites

Land Management

McNeil Island is the site of a federal penitentiary, later operated by the state, which was in use from 1875 to 2011. The entire island has been federally owned since 1940, and was transferred to state ownership in 1984 (BERK 2012). Approximately 70% of McNeil Island, along with Gertrude and Pitt Islands, was transferred to WDFW for wildlife management in 1984 under a quitclaim transfer deed with U.S. Bureau of Prisons. The transfer included 3119 acres of tidelands and uplands that became part of the WDFW South Puget Sound Wildlife Area and 1326 acres in 24 parcels of various size to the Washington State Department of Corrections (DOC) for the penitentiary complex, vocational annex and farmland (Till and Caudill 2003). While the penitentiary closed in 2011, a special commitment center remains open and is operated by the Washington Department of Social and Health Services (DSHS). WDFW ownership may include some of the McNeil Island tidelands associated with the previous private lands purchased by the federal government, although the Washington Department of Natural Resources owns and manages most of the tidelands as state-owned aquatic lands of the island (BERK 2012). Land ownership of McNeil Island is shown in Figure 3.

Land use modifications on McNeil Island are associated with the penitentiary operation and include the facility itself, the "perimeter road" around the island shoreline, Butterworth dam and reservoir, approximately 50 houses for staff, and facilities for ferry operations (BERK 2012). The perimeter road, identified on maps as the "Coastal Road", is a gravel paved road that provides visual access to the shoreline for security purposes along much of the road, as well as transportation needs (Eric Heinitz, DOC, personal communication). The residences have been boarded up and utilities disconnected since the penitentiary closed.

The transfer included provisions indicating that McNeil, Gertrude and Pitt Islands be managed as a sanctuary for the unmolested feeding and breeding of wildlife and will be unavailable to the public (BERK 2012). Additional provisions on the transfer within the WDFW Puget Sound Wildlife Area are excerpted from BERK 2012 and included in Appendix A. In addition to wildlife protection restrictions, specific references to archaeological and cultural resource assessment protocol are included in these provisions and may be pertinent to future restoration design work. In 1984, the Washington Department of Game (later WDFW), Department of Corrections and the federal government entered into a Memorandum of Understanding (MOU) regarding management of McNeil Island lands. The MOU grants DOC authority to patrol all beach areas for security and allows DOC to maintain a 100 yard safety buffer zone into the water around the island (BERK 2012). Since that time, DSHS has assumed responsibility for the perimeter security patrol, although land management responsibilities remain with DOC (BERK 2012).

WDFW manages the McNeil Island unit of the South Puget Sound Wildlife Area for wildlife protection. While recreational use and public access is generally a goal for WDFW wildlife area management, the McNeil unit is closed to the public, affording good protection for wildlife resources. Weed control and some agricultural activities (leased) are the major management activities at the site (WDFW 2006).

WDFW assessed fish passage for the South Sound Wildlife Area streams (Till and Caudill 2003). In the McNeil unit, several fish passage barriers and water diversions were documented, with barriers primarily related to water storage facilities. Most of the streams were short run and had limited habitat gain for fish barrier remediation. Milewa Creek was initially identified for barrier correction, although concerns about archaeological and cultural resources led to prioritization of Luhr Creek instead. Fish passage barrier correction and stream improvement was completed at Luhr Creek in spring 2015. Bodley/Bradley Creek and Floyds Cove were also assessed. An excerpt from the Till and Caudill 2006

study summarizing fish passage findings is included as Tables 1 and 2. More detailed information is included in the individual project descriptions.

In 2011, DNR established the Nisqually Reach Aquatic Reserve including the Nisqually delta, Anderson Island and the southern portion of McNeil Island (Figure 4). The aquatic reserve program was developed to conserve high quality native ecosystems for environmental, research and educational purposes. The management plan identifies protection and restoration of the functions and natural processes of nearshore ecosystems as key goals (Nisqually Reach Aquatic Reserve Management Plan 2011).

Feasibility report

For this report, WDFW worked with DNR to perform a boat survey of the entire shoreline of McNeil Island to identify and assess potential shoreline habitat restoration projects to remove marine debris and modify or remove shoreline armoring where possible. The results of the survey are presented in the following section.

In addition, WDFW staff assessed four potential habitat restoration sites to determine feasibility. The sites are:

- Milewa Creek
- Bodley Creek (Bradley Creek)
- Floyds Cove
- Barge Landing fill

For each of the sites, existing information was compiled and reviewed, along with collection of additional survey information and biological assessment. We investigated a range of options from full restoration to no action, noting that the limited access to the island for staff and for construction materials and equipment, along with security concerns related to the perimeter road would complicate and greatly increase costs on most of the options over a similar project on the mainland.

In addition, the options were developed without full knowledge of potential concerns related to cultural resources. DNR will perform this assessment as the projects develop. McNeil Island has a rich cultural history such that protection of cultural resources may have a big role in eventual project development.

The results of this assessment will provide conceptual options to bring forward for further discussion with land managers at McNeil Island. While we have attempted to include logistical and security concerns within the option development, additional discussion is needed to fully evaluate the habitat restoration options with land managers.

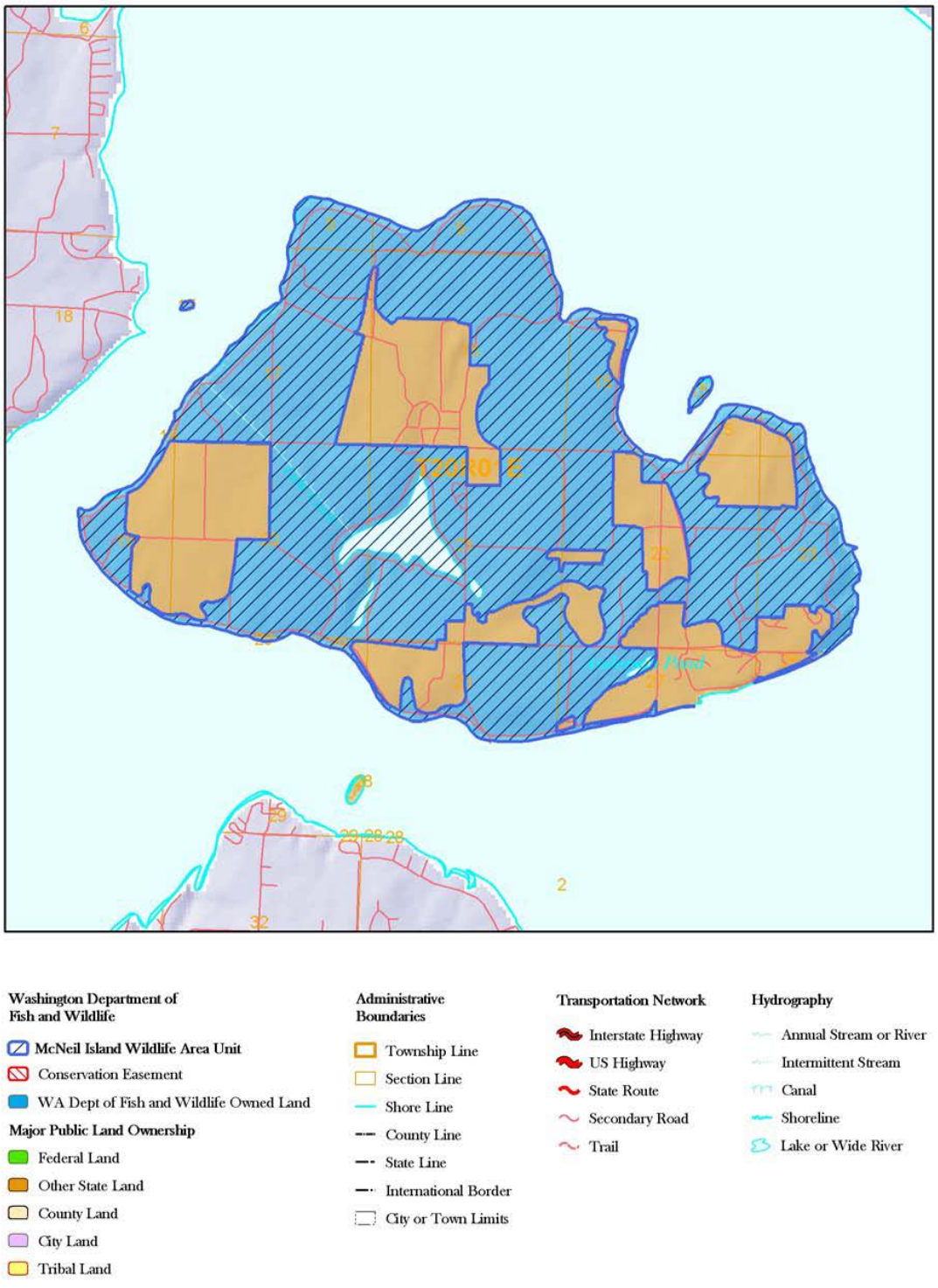


Figure 3: McNeil Island land ownership as shown in the WDFW South Puget Sound Wildlife Area Management Plan (from WDFW 2006)

Table 1: Fish Passage Barrier Identification from Till and Caudill (2003)

Site ID	Stream	Tributary to	Expected Species Utilization[1]	Feature Type	% Pass-able	Additional Barriers		Habitat Gain			Priority Index (PI)
						Up-stream	Down-stream	Survey Length (m)	Spawning (m^2)	Rearing (m^2)	
McNeil Island Unit											
981751	Luhr Cr	Puget Sound	CH/SCT	Culvert	0	1	0	351	25	1,956	8.39
981735	Eden Cr	Puget Sound	RT	Dam/PD	0	1	0	1,300	0	39,386	6.31
981737	Eden Cr	Puget Sound	RT	Dam	0	0	1	765	0	29,558	5.87
981757	Bradley Cr	Puget Sound	SCT	Dam/PD	0	0	0	115	0	5,479	5.17
981753	Floyd Cove	Puget Sound	SCT	Dam/PD	0	0	0	70	0	4,408	4.90
981770	Milewa Cr	Puget Sound	SCT	Dam	0	0	0	150	0	4,236	4.85
981750	Luhr Cr	Puget Sound	SCT	Dam/PD	0	0	1	216	0	1,775	3.90

Species Codes: CH - Chum, CO - Coho, SH - Steelhead, SCT – Searun Cutthroat, RT - Resident trout, DB - Dolly Varden/Bull trout, RB - Rainbow trout.
PD – Pump Diversion

Table 2: Fish Passage Diversion Identification from Till and Caudill (2003)

Site ID	Stream	Tributary to	Ownership Type	Diversion Type	Compliant Screen?	Flow (gpm)	Screening Priority Index (SPI)
McNeil Island Unit							
981767	Butterworth Res.	Eden Cr	WDFW	Pump Diversion	No	UD [1]	UD [1]
981735	Eden Cr	Puget Sound	WDFW	Pump Diversion	No	UD [1]	UD [1]
981750	Luhr Cr	Puget Sound	WDFW	Pump Diversion	No	UD [1]	UD [1]
981753	Floyd Cove	Puget Sound	WDFW	Pump Diversion	No	UD [1]	UD [1]
981757	Bradley Cr	Puget Sound	WDFW	Pump Diversion	No	UD [1]	UD [1]

1. UD – Undetermined. Flow and SPI could not be determined because pump information was not available and intakes are offshore.

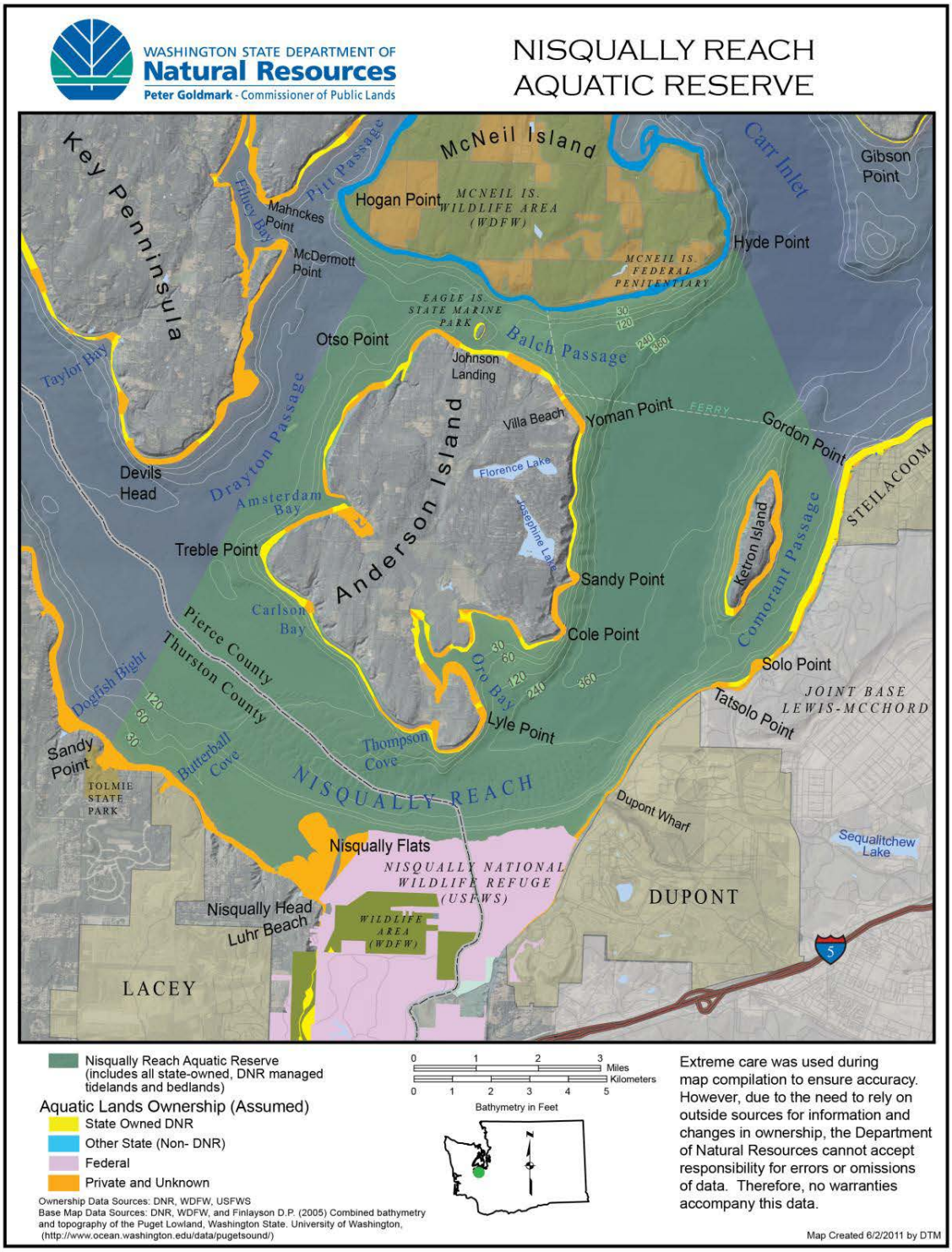


Figure 4: Map of the Nisqually Reach Aquatic Reserve (from DNR 2011)

Island Boat Survey

Methods:

We quantified the shoreline modifications on McNeil Island by documenting shoreline characteristics and potential project opportunities using visual techniques with a small survey component. On February 12, 2015, the island was circumnavigated by boat travelling as close to shore as possible and shoreline modifications were photographed, described, physically measured (height, length), and the location identified with GPS waypoints. At sites with formal structures (e.g. bulkheads, groins) the top and toe of the structure were surveyed with respect to the tide in order to assess the level of tidal interaction. The four restoration sites were measured by terrestrial survey while the other structures elevations were measured with survey grade level equipment. This data was entered into a field form for office review. Photographs of the shoreline survey sites are compiled in Appendix B. A plan view map of the location of the individual site waypoints is displayed on Figure 5 and the full size figure in Appendix G.

The field data was then used to sketch the various sites. The sketches were used to measure the area of tidal interaction. Site photos/aerials and notes from data forms were used to assess the debris material, the presence of freshwater input, the condition of the feeder bluff, the risk to existing infrastructure, the slope of the beach, beach material, the condition of the riparian, the difficulty of access, level of tidal encroachment, impact to drift cells, and an approximate cost category. Based on the physical location of the sites the potential impacts or benefits to fish and wildlife species were assessed. After review of site characteristics and resources, each site was given a value/score by WDFW staff for each of these values for use in prioritizing the correction of the various shoreline modifications. Table 3 is a summary of the shoreline site description and evaluation.

Results:

In general, the sites we observed fell into a few categories: 1) assorted debris on the beach, 2) drainage structures, and 3) structures for protection of infrastructure. The sites observed on the northern portion of the island (Floyds Cove to Baldwin Point) were the three potential estuary type restoration sites, Floyds Cove, Bodley Creek and Milewa Creek. Infrastructure protection type sites were near the prison site (sites 17-19), near Still Harbor (sites 7-13), and at Luhr Creek (site 2). Two of the drainage type sites were located on the southeastern corner of the island (one potentially part of an abandoned landfill, BERK 2012), and one site on the main island across from Gertrude Island. The remainder of the sites is debris on the beach that is sporadically spread along the island's shoreline.

We have prioritized the sites described above into three categories.

- The first category is those sites that have a high benefit to cost ratio with little risk to infrastructure (sites 1, 3 and 19). Correcting these sites will be fast, cost effective, and have a good environmental benefit.
- The second category is the sites that have a high benefit with moderate costs, and their removal would require protection to prevent risk to infrastructure (sites 7, 8, 9, and 10). These sites are situated in the area around the Still Harbor ferry landing.
- The third category is those sites that have a small benefit, moderate to high cost, and access limitations but simple implementation make them worth doing (sites are 11, 14, and 15).

The remaining sites are either too costly, pose too much of an infrastructure threat, or have negligible environmental benefit.

Construction Implementation:

Half of the sites identified during the boat survey are debris, or remnant structures that pose a minimal risk to any infrastructure (sites 1, 3, 7, 8, 9, 11, 13, 14, 19, 20, 21, and 24). These sites will require little, if any, replacement or new bank protection. The implementation of these sites would be best suited to barge access, demolition/removal, and disposal.

The other half of the sites include more existing infrastructure (sites 2, 4, 5, 6, 10, 12, 15, 16, 17, 18, 22, and 23). Due to the light use of the majority of McNeil Island, this infrastructure should be assessed for use/longevity in order to potentially reduce the need for replacement bank armor. Most of this second group of sites will require some light handed, preferably soft shore, type armor at least temporarily to protect the existing infrastructure in place (the coastal road in most cases). Some of the sites may not be feasible for full removal of shoreline armoring (e.g. at the penitentiary) but some debris removal may be possible to improve beach conditions. Coordination with DOC for these sites is necessary.

Discussion:

The information presented is based on mostly visual estimates of the type, quantity, physical setting, and biological setting of the sites visited. As such, we recommend using this information strictly for prioritization. The cost category specifically was based on very coarse estimates of the potential cost to remove and restore the various sites. Site 5 (Floyds Cove), Site 6 (Bodley Creek), and Site 12 (Milewa Creek) were surveyed and are discussed in depth in the following sections of this report, including cost estimates and conceptual drawings. In order to characterize these sites beyond prioritization they should be surveyed, fully quantified, estimated, and designed (grading, target elevations, finish surface treatment, soft-shore armor as necessary). The existing bulkheads, docks, and other infrastructure surrounding the active penitentiary site, Sites 16-18, were not assessed in whole due to their currently active status. The rest of the necessary information to complete the prioritization of these sites would be quick to assess upon a change in their active use.

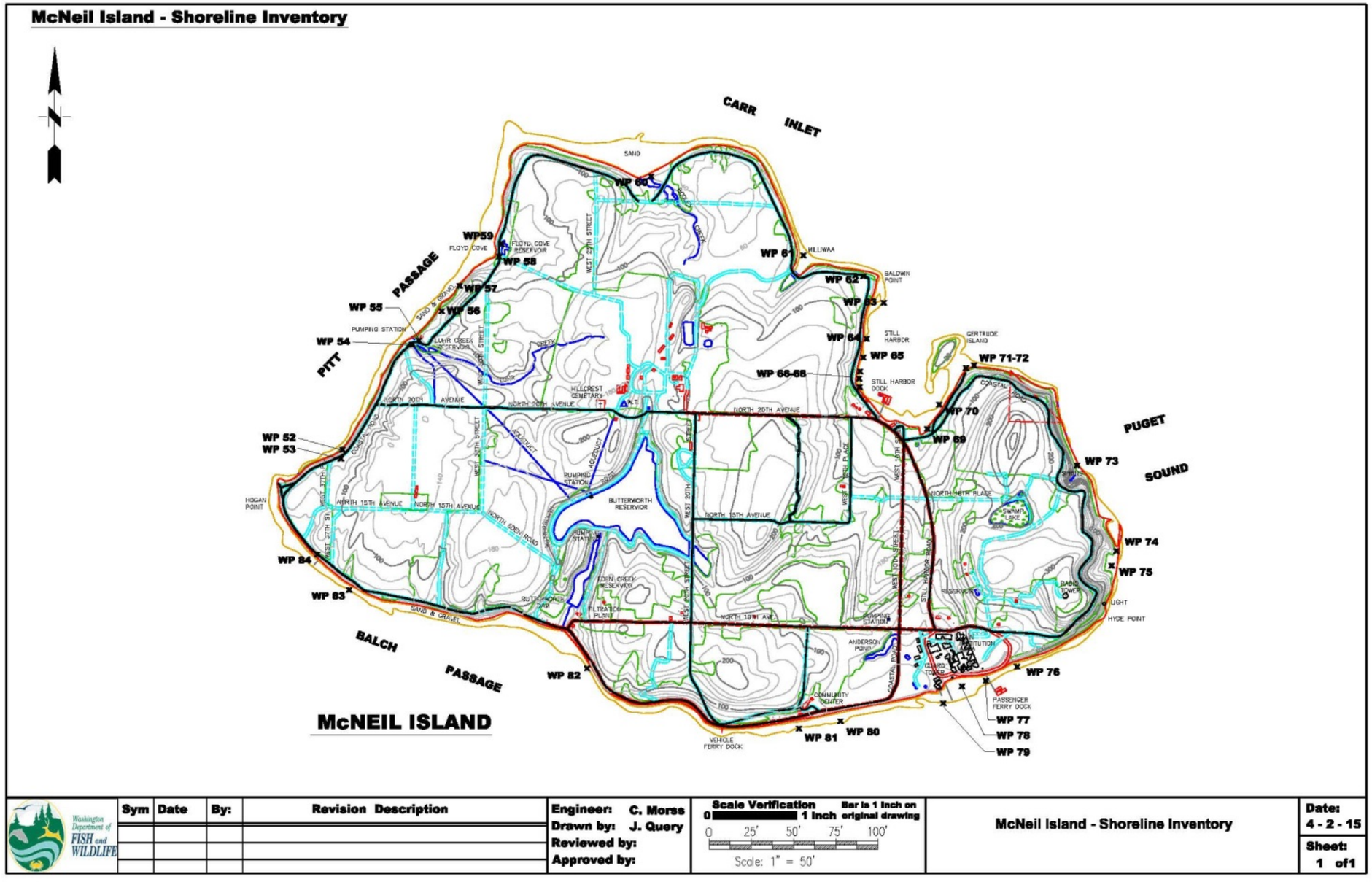


Figure 5: Shoreline Survey Waypoints

Table 3 Summary of Shoreline Survey

Site #	WP	Photo Ref	description	Tidal Interaction Area, ft^2	Debris Material	Freshwater Input?	Bluff Condition	Infrastructure risk (1-Low 4-High)	Beach Slope	Beach Material	Riparian Condition	Access Level	Intertidal Encroachment (1-Low 3-High)	Drift Impact	Forage Fish Spawning Habitat	Project Description and Potential Benefits	Cost Category
1	53	2610-2614	Beach Piles/Debris	0	BR + MTL + CONC	Yes	High/Intact	1	2-4%	CBL + SND + GRV	High/Healthy	3	3	2		removal of large non-native rocks along the shoreline will restore natural beach materials underneath	1
2	54	2643-2651	Luhr Creek Dam	518	CONC + RIPRAP	Yes	Low/Impaired	4	1-2%	SND + GRV	Low/Impaired	1	3	3		removal of shoreline armoring; potential risk to structure so some armoring may be needed; restoration of low bank shoreline	2
3	56	2657-2659	Rock Pile On Beach	0	RCK + PLG	No	High/Intact	1	LOW	SND	High/Healthy	2	3	1		in high quality shoreline area with bluff; part of slump onto beach; removal of non-native cobble & manmade debris and restoration of native beach material	1
4	57	2660-2662	Old Bulkhead	0	CONC	No	High/Intact	1	2%	SND + GRV	High/Impaired	3	2	2		in high quality shoreline area with bluff; removal of concrete, non-native rocks & manmade debris and restoration of native beach material	1
5	58	2667-2687	Floyd's Cove	259	CONC + RIPRAP + PLG + SUB + MTL	Yes	Low/Impaired	3	3-4%	SND + GRV	Low/Absent	1	2	3		removal of non-native materials used in shoreline armoring at Floyds Cove; rip rap, piling, submarine cable; restoration of native shoreline	2
6	60	2711-2714	Bodley Creek	150	EMB	Yes	Mod/Impaired	2	2%	GRV	Mod/Impaired	1	1	2		some manmade debris at site; restoration of sandspit and beach	2
7	63	2757-2759	Debris along road	0	CONC + BR	No	Mod/Impaired	2	LOW	CBL + SND + GRV	Low/Impaired	1	2	2		shoreline armoring along low bank with road close to shoulder; removal of manmade materials would improve shoreline condition but would likely need road relocation or some form of bank protection	1
8	64	2762-2766	Pilings	0	CONC + PLG	No	Mod/Impaired	2	HIGH	CBL + GRV	Mod/Impaired	1	2	2		non-functional piling shoreline armoring; removal of manmade materials would improve shoreline condition but would likely need road relocation or bank protection	1
9	66	2769-2771	Boat Launch - Still Harbor	0	CONC + PLG	No	Low/Impaired	2	HIGH	SND	Mod/Impaired	1	2	3		remnant concrete debris and concrete boat ramp; removal of concrete would restore shoreline and beach; boat ramp appears lightly used, if at all	2
10	68	2772-2779	Still Harbor Ferry Dock	1800	SUB	No	Low/Impaired	3	LOW	SND + GRV	Mod/Impaired	1	2	3		low bank shoreline is armored with extensive submarine cable, several rows high in places; removal of submarine cable would likely require some sort of bank protection for road along shoreline	3
11	69	2790-2799+2804-2805	Pocket Estuary	0	PLG + CONC	Yes	Low/Impaired	2	LOW	SND + GRV	High/Healthy	2	2	2		semi-impounded and filled pocket estuary with moderate amount of manmade debris; investigate history of site to determine fill removal or partial removal potential to restore shoreline	1
12	61	2758	Milewa Creek	1201	CONC + RIPRAP + PLG + SUB	Yes	High/Impaired	3	4-5%	GRV	Mod/Impaired	1	2	3	surf smelt to the northwest	shoreline armoring of rip rap, concrete and submarine cables along with undersized culvert; removal of shoreline armoring would improve shoreline conditions but may need some bank protection if road remains in place; removal of concrete groin will allow littoral drift in area with documented surf smelt spawning	2-3
13	70-72	2814-2818+2830-2831	Flume and Diffuser	0	CONC	Yes	High/Impaired	2	LOW	SND + GRV + BLD	High/Healthy	3	3	3		flume in riparian area and pipe into intertidal; removal would improve shoreline and riparian condition; uncertain if still in use for stormwater runoff	2
14	73	??	Old Dock Site	0	PLG	YES	Low/Intact	1	LOW	SND + GRV	High/Healthy	3	2	2	sandlance	pilings and some remnant decking from former dock; removal would restore intertidal beach and shoreline; not functional; within documented sandlance spawning habitat	1
15	74	2835-2844	Power Station	0	PLG	No	Low/Intact	4	HIGH	SND + GRV	High/Impaired	1	2	2		manmade debris at sandspit and pocket estuary site; high quality habitat would be improved by removal of manmade materials associated with the former power station to the greatest extent possible	2
16	76-77	2847-2848	Pen. Wall and Docks	note 1	EB + PLG	No	Low/Impaired	4			Low/Absent	1	3	3		high intensity shoreline armoring associated with the penitentiary; most of rip rap will need to remain due to infrastructure	3
17	77-78	2849-2852	Pen. Wall	note 1	RIPRAP	No	Low/Impaired	4			Low/Absent	1	3	3		high intensity shoreline armoring associated with the penitentiary; most of rip rap will need to remain due to infrastructure	3
18	78-79	2853-2859	Marine Railway	note 1	CONC + SUB + PLG	No	Low/Impaired	4			Low/Absent	1	3	3		high intensity shoreline armoring associated with the penitentiary; submarine cable may be able to be removed without risk to infrastructure; some of dock structure appears abandoned; some of armoring next to dock appears non-functional and may be able to be removed without risk to infrastructure	3
19	80	2862-2870	Beach Dump	0	CONC + SUB + CBL + SUB	No	High/Intact	2	LOW	SND + GRV	High/Impaired	2	3	2		manmade debris along shoreline in piles; appears to be trash dump; removal of the material will improve beach condition and remove potential toxins from engine parts and machinery	1
20	81	2871	Beach Debris	0	CONC + SUB	No	High/Intact	2	HIGH	SND	Mod/Impaired	3	2	2		concrete sections along shoreline as armoring; removal would restore shoreline to natural condition	2
21		2874-2883	Barge Landing	389	CONC + PLG + EB	No	Mod/Impaired	2	LOW	SND + GRV	High/Impaired	1	2	2	surf smelt and sandlance	former barge landing site with concrete ecology blocks and manmade materials around edge; documented surf smelt and sandlance spawning site; removal would expose new spawning habitat and decrease impacts on existing spawning habitat	2
22	82	2885	Outfall 1	28	EB	Yes	High/Impaired	3	HIGH	SND + CBL + BLD	High/Healthy	3	1	1		wall of ecology blocks surrounding outfall; removal of ecology blocks would improve bank and may allow increased material to reach the beach; some form of armoring may be needed to protect the outfall, if it is still functional	2
23	83	2890-2892	Outfall 2	0	EB	Yes	High/Impaired	2	HIGH	GRV+CBL	Mod/Impaired	3	1	1		wall of ecology blocks surrounding outfall; removal of ecology blocks would improve bank and may allow increased material to reach the beach; some form of armoring may be needed to protect the outfall, if it is still functional	2
24	84	2893-2901	Conc. Columns	0	CONC	No	Mod/Impaired	2	HIGH	GRV + CBL	Mod/Impaired	3	2	1		concrete piling laid horizontally on the beach as informal shoreline armoring; removal of piling would restore the shoreline conditions	2

Table 3 Notes:

1.) The existing bulkheads and docks at the Penitentiary were not measured due to their currently permanent/active status

Debris Materials:	BR - Bricks	
	MTL - Metal (iron/steel)	
	CONC - Concrete	
	RCK - Angular, oversized rock	
	RIPRAP - Large Rock Structure	
	PLG - Log Piling	
	SUB - Submarine Netting	
	EMB - Earthen Embankment	
	EB - Ecology Blocks	
	CBL - Insulated Cables/Wires	
Bluff Condition:	Remaining Capacity	Quality
	High - Significant Volume Available	Intact - Bluff is Not Impeded From Feeding Material
	Mod - Bluff Volume Partially Fed Out	Impaired - Bluff Has Been Held Back/Limited
	Low - Very Little Bluff Volume Available	
Infrastructure Risk:	1 - No Risk to Active Infrastructure or No Infrastructure Present	
	2 - Risk to Inactive Infrastructure	
	2 - Moderate Risk to Active Infrastructure	
	3 - High Risk to Active Infrastructure	
Intertidal Encroachment:	1 - No, or minimal tidal encroachment	
	2 - Partial Tidal Encroachment/Protuberance	
	3 - Entire Site Extends Into Intertidal Zone	
Beach Materials:	CBL - Cobbles 4-8"	
	BLDR - Boulders >8"	
	GRV - Gravel 3/4" - 4"	
	SND - Sands	
	FN - Fines, Clays, Silts, Mud…	
Riparian Condition:	Quantity	Quality
	low - <25% Cover	Healthy - Native Plants - Combined Trees/Brush
	Mod - 25-50% Cover	Impaired - Combined Native + Invasive - Grasses + Underbrush
	High - >75% Cover	Debilitated - Invasive - No Brush or Trees
Access Level:	1 - Simple Road Approach	
	2 - Difficult Road Approach, Boat Access	
	3 - No Road Approach, Boat Access Only	
	4 - No Access by Road or Boat	
Drift Impact:	1 - No Potential/Observed Drift Impact	
	2 - No Observed Drift Impact	
	3 - Observed Drift Impact	
Cost Category:	1 - Low Cost	
	2 - Moderate Cost	
	3 - High Cost	

Potential Habitat Restoration Projects

Methods

In the early stages of this project, WDFW and DNR identified four potential habitat restoration projects:

- Floyds Cove Dam
- Bodley Creek Dam
- Milewa Creek Dam and
- Barge Landing Fill/Debris Removal

These sites were visited during the shoreline boat survey in order to include them in the prioritization of the shoreline modifications around the entire island. Due to the simplicity, and lack of infrastructure at the Barge Landing site, no additional field data was collected for this site. Further data collection at the remaining sites included review of existing information on historic uses and natural resources, topographic survey, aquatic vertebrate sampling, and depth sounding on the ponded areas. The topographic survey was developed into maps of each site and options were developed using the historic mapping of the sites, estimates of historic levels of tidal inundation, current levels of tidal inundation, restoration benefit, and maintenance of current functional use. Three options were developed for each site in addition to analyzing a "No Action" option. Generally, the options include two full restoration options and one partial restoration option, which are discussed in greater depth in the following narrative for each site.

General Construction and Permitting Considerations for all projects:

The most glaring constraint on McNeil Island projects is the fact that it is an island. Any supplies, including construction materials and heavy equipment, will be required to use the island vehicle barge or passenger ferry, sourced from the island, or brought in by independent barge. While it is likely that early developments on the island involved barged in supplies, this practice is not common, and has not been done under the current management of the island. Permitting and approvals for barge landings may be difficult.

Construction involving activities in-water or near water are often limited to short windows due to avoidance of impacts to natural resources. In particular, it will be important to avoid disturbance around Gertrude Island and Still Harbor at key times. Shoreline activities are also restricted by tides for certain types of work. With these construction timing limitations already in place, the limitations of timing related to ferries for construction crews, which must leave the island daily, makes construction logistics challenging.

Additionally, the penitentiary was constructed on the island between 1854 and 1877 (see historical maps, Appendix F) and was one of the last functioning island prisons in the US. This means that a lot of the old infrastructure on the island is historic and will be historically/culturally relevant. Archaeological and cultural limitations may be very restrictive.

Results:

Milewa Creek Dam

Milewa Creek is located on the northern shore of McNeil Island, approximately 1 mile northwest of the Still Harbor Ferry landing by way of the Coastal Road. The estuary is oriented to the northeast and is

well protected by the shorelines extending northeast on either side. The Milewa Creek estuary was originally crossed with a 300' long bridge (date unknown, see 1965 drawings below). Upstream of the bridge barges were stored/loaded. At some point before 1965 the bridge either failed, or was removed and plans construct the road were developed to allow access across the estuary once more. The Milewa Creek site is identified on the shoreline modification Figure 5 as Waypoint # 61. The Milewa Creek portion of the *1877-1878 Coast Survey of the Puget Sound from Pt. Defiance to Ketron Island* (T-Sheet) is displayed below in Figure 6. Additionally, the topo and proposed improvement drawings are included in Figure 7 and 8. 11" X 17" copies of these drawings have been included in Appendix G for better clarity.

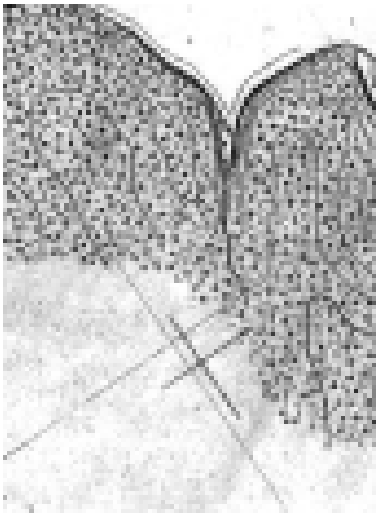


Figure 6: Topographic Sheet of Milewa Creek 1877-78

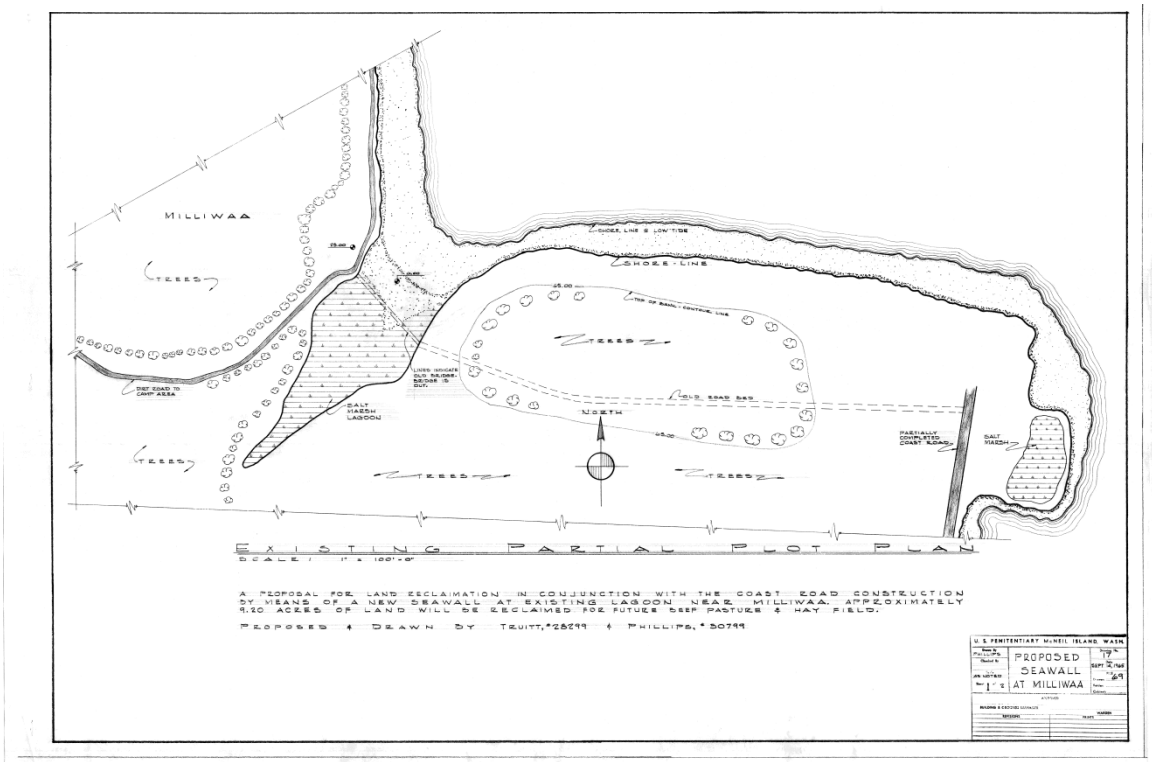


Figure 7: Existing Conditions at Milewa Creek in 1965

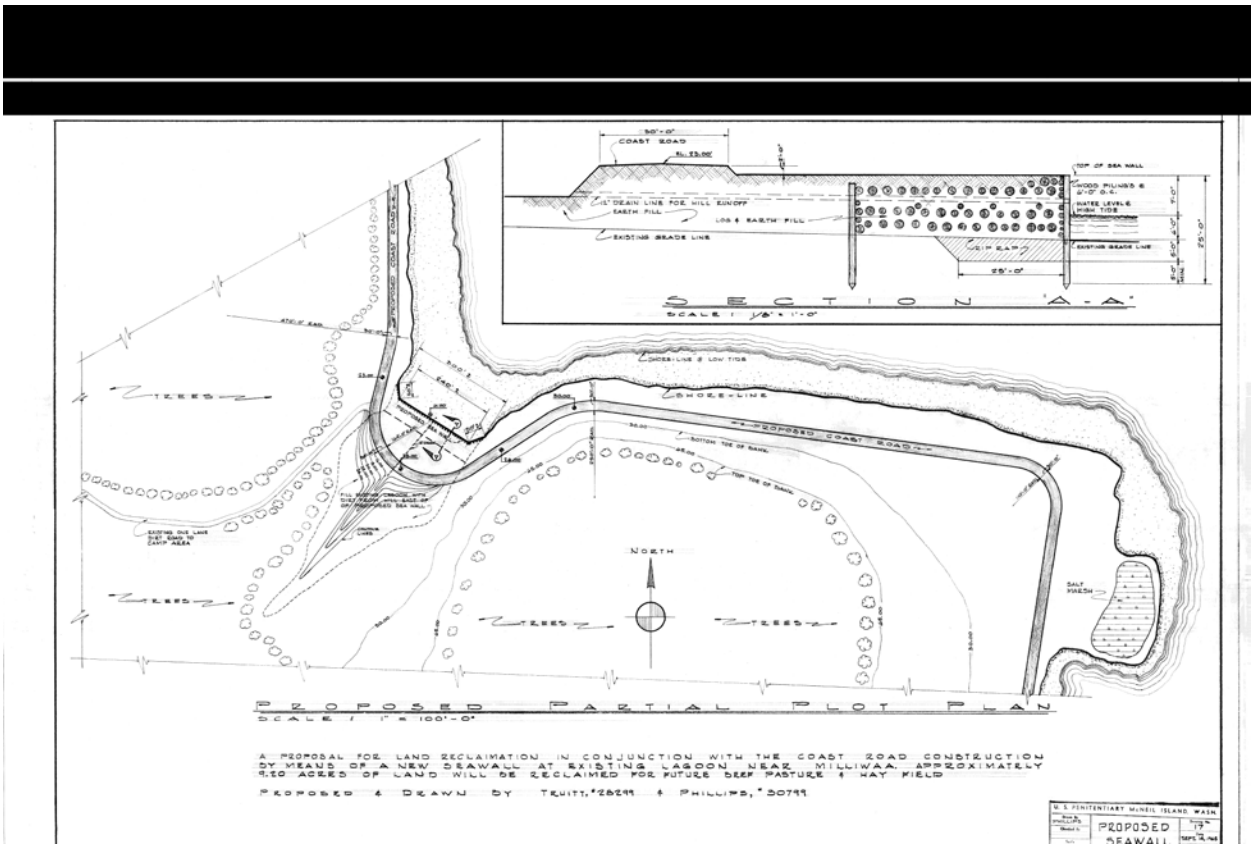


Figure 8: Proposed Project at Milewa Creek in 1965

Photographs of Milewa Creek

Aerial Photo of Milewa Creek Site

Debris over Culvert Outlet

Impounded Pond and Debris

Milewa Creek Site Shoreline and Groin

The road at Milewa Creek acts as a dam and the perched culvert reduces tidal inundation of the Milewa Creek Estuary, impacting approximately 2.5 acres of marsh. The existing road embankment was constructed after 1965 and replaced a 300 foot long bridge that was originally constructed at an unknown date. Due to the debris placed at the culvert outlet, and the pond elevations at the time of survey this culvert was not visible and was not surveyed or documented. Some tidal exchange may be taking place with this culvert or it could be completed buried and non-functional. A second 18" metal culvert directly above was surveyed and is described in the drawings below. This culvert is well above Mean Higher High Water (MHHW) and likely serves as an overflow during high flows. Additionally, a 2 foot wide by 180 foot long concrete groin extends from the existing culvert outlet location into the intertidal zone. The groin follows the slope of the beach, but the beach to the north is 3 feet above the beach on the south side of the groin. The footing for this groin is approximately 1 foot below the beach on its south side. The groin extends to +6.6 MLLW at the north, and +3.6 MLLW south. The current seawall/embankment is armored with a combination of concrete debris and submarine netting around the culvert. The orientation and condition of the culvert was difficult to observe due to overhanging banks and heavy vegetation. Within the impounded pond there are remnants of 2 barges and other concrete and construction type debris.

Milewa Creek is a small stream that may support sea-run cutthroat if fish passage was restored, but is unlikely to support other salmon species due to lack of spawning or freshwater rearing habitat. The estuarine habitat would support juvenile salmonids during outmigration if fish passage was restored, as well as other estuarine fish and wildlife species. The culvert at Milewa was identified as a complete fish passage barrier (site 981770 WDFW) in 2003 (Till and Caudill 2003). Habitat restoration at this site was considered at that time but postponed due to concerns about possible archaeological and cultural resource issues.

Restoration Options – The options listed below are all included on the feasibility level conceptual design drawing on Figure 9, with full size drawings in Appendix G. The cost estimates include the cost of design, contract administration, permitting, planning (geotechnical evaluation, wetlands, cultural resource assessment, etc.), construction cost, and contingencies (estimated at 30% of construction costs), but should be used with discretion. Archaeological and cultural resource assessment costs have been estimated; however the limitations, requirements, or potential isolation of sites as a result have not been accounted for.

Objectives for the Milewa Creek site include

- restoration of fish passage to Milewa Creek
- restoration of full tidal influence without attenuation
- removal of marine debris on the shoreline, including the concrete groin

Restoration of fish passage and tidal influence will allow juvenile salmonids to use the estuarine habitat for rearing during outmigration, as well as other estuarine species. Forage fish spawn to the west of the site such that restoring natural beach processes by removal of the concrete groin and shoreline armoring may improve overall beach sediment composition and transport in the vicinity.

Option 1 – Full Restoration

Description: Completely remove the existing road embankment and provide a full spanning bridge, approximately 300 feet long, with sloped banks and appropriate slope treatment. In addition, remove debris (e.g. barges, tires} from the impounded pond and the concrete groin on the shoreline. Fill will be removed to the existing beach elevations and the estuary allowed to re-grade naturally.

- This alternative would restore the entire tidal prism as well as the full extent of tidal processes. We estimate that tidal waters would extend at MHHW to the upper end of the current impounded area, providing excellent rearing for juvenile salmonids and habitat for estuarine fish and wildlife. Removal of submarine cables would uncover the upper beach material and restore natural beach processes.

- This option is the highest cost, range $4-$6 Million, with comparable ecological benefits to Option 2, described below.

- Access to this site, once on the island, is not exceptionally difficult, at least in relation to the other sites on McNeil Island. There are three potential road approaches, and the beach is well suited to shoreline access. High slopes and somewhat tight construction spacing could pose construction issues, specifically with a long span type structure which would presumably require a crane for placement. The largest potential construction difficulty would be disposal of the spoils generated by removing the existing embankment. The embankment was likely constructed from on-island sources (see 1965 proposed sea wall drawing notes) and disposal to other on-island sites would alleviate this type of concern. The narrow bay and minimal amount of freshwater input would allow relatively easy isolation of the site for construction activities. Beach debris removal could be achieved with careful monitoring of the tides (i.e. let equipment demolish materials and bring in barge with high tide, load and ship out.)

Option 2 – Full Restoration

Description: Completely remove the existing road embankment and relocate the road crossing to the Milewa Creek estuary upstream of the current location approximately 450 feet. This crossing would be a narrower span bridge in the range of 100 - 120 feet. This option would involve the construction of approximately 1,000 feet of gravel road to match the existing gravel approaches.

- This option would restore the entire tidal prism and the majority of tidal processes.

- The estimated cost is in the range of $2.5-$4 Million. In general the driver of cost is the volume of materials needing disposal. An on-island waste site could decrease the cost of this option by approximately $1 Million.

- See the previous option for the discussion on access. The limitations on equipment mobility and structure placement are less of a concern with this option as the structure to be placed is much shorter, and it is being placed where the slopes are much shorter and shallower.

Option 3 – Partial Restoration

Description: Remove a portion of the existing embankment and span with a 100' span bridge to allow the tide to pass freely into the Milewa Creek estuary at velocities low enough to allow fish passage and allow a gradual transition of habitat from saltwater to freshwater.

- This alternative would restore the entire range of tidal influence and a portion of the tidal processes. Sediment transport, woody material recruitment and transport and marsh development would be impacted by the smaller crossing.

- The cost of this option is estimated in the range of $1-$1.5 Million.

- The construction considerations are essentially the same as the previous option, with somewhat steeper and higher slopes. A significant decrease in the volume of excavation and road reconstruction drive the reduced cost of this option.

No Action

This alternative is presented to describe the current impacts of the existing impoundment and the potential long term impacts. Continued impoundment will prevent the delivery of sediment and organic matter to the nearshore environment and potentially cause degradation of beach habitat and physical elevations.

- Portions of the other options described above can be incorporated to this option. Specifically, debris in the pond and the concrete groin could be removed, along with potential removal of the bank armor and replacement with more ecological techniques such as soft bank protection.

- Costs for removal of debris and re-placement of soft-shore armor are in the range of $100,000-$160,000.

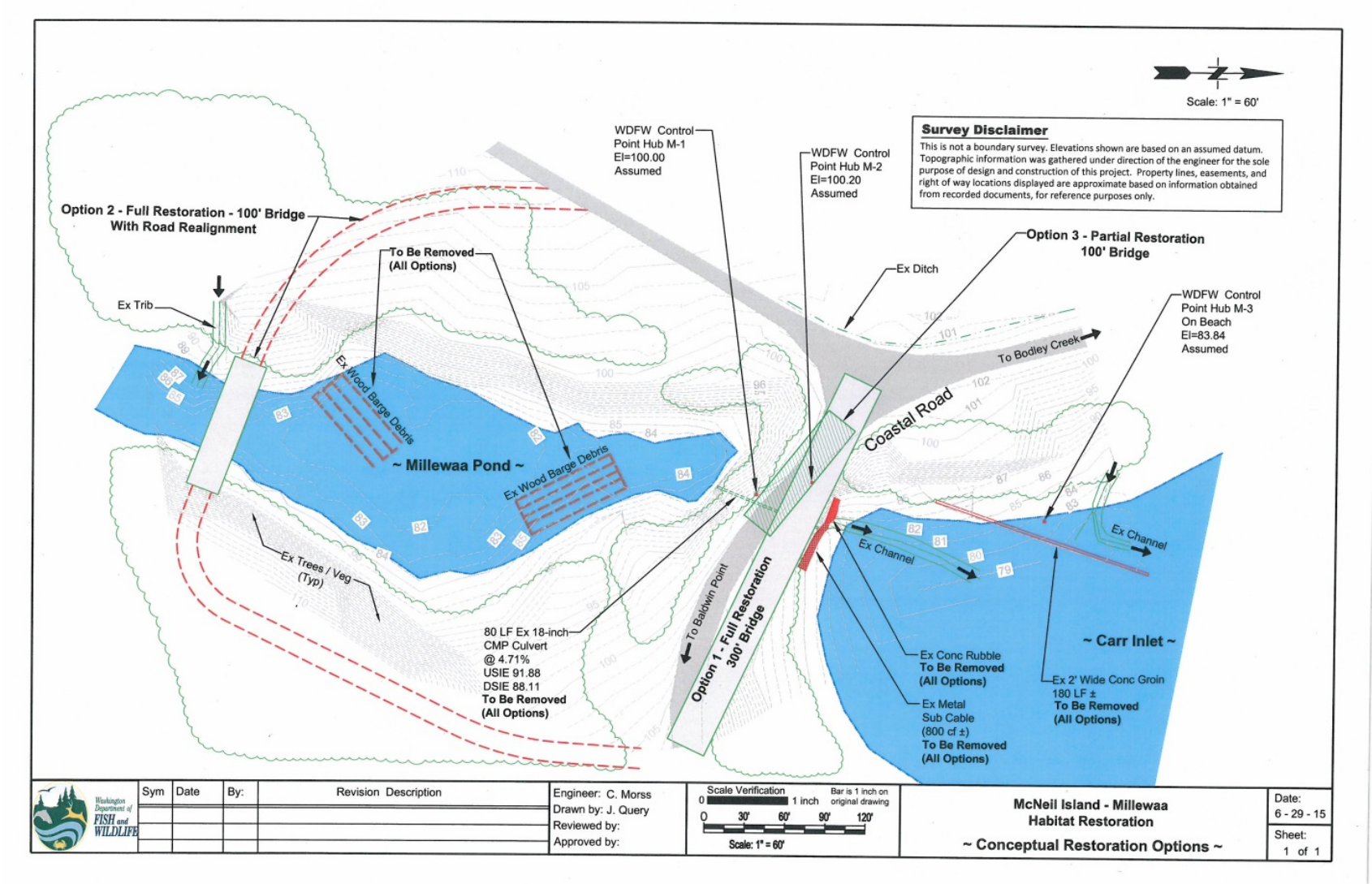


Figure 9: Conceptual design options for Milewa Creek habitat restoration

Bodley (Bradley) Creek Dam

Bodley Creek is located on the northern shore of McNeil Island approximately ¾ mile east of Samego Point, the Northwesterly corner of the island, by way of the Coastal Road. The marsh is oriented slightly west of north with moderate protection by wide adjacent shorelines to the east and west. The existing embankment that forms the upstream freshwater pond was constructed to impound freshwater that would be piped into Butterworth Reservoir. Butterworth Reservoir is the primary source of freshwater on the island, and water from it was used for irrigation, cattle and domestic supply throughout the penitentiary. The pumps at the Bodley Creek pond are still active and may still supply freshwater to Butterworth. The Bodley Creek site is identified on the shoreline modification (Figure 5) as Waypoint # 60. The Bodley Creek portion of the T-Sheet for this region is shown in Figure 10. Drawings were not available for the construction at Bodley Creek. However, pre-development mapping is shown in an excerpt from the 1959 USGS Quad Map "McNeil Island" in Figure 11. An 11" X 17" copy of the entire McNeil Island Quad Map 1959 is located in the Appendix F for better clarity and context. At some point in the past, Bodley Creek was mapped as "Bradley" Creek and may appear as either in maps.

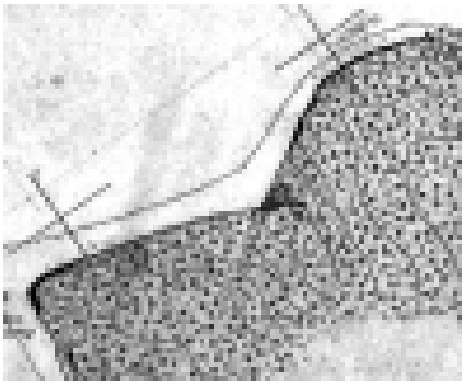


Figure 10: Enlargement of T-sheet for Bodley Creek 1877-78

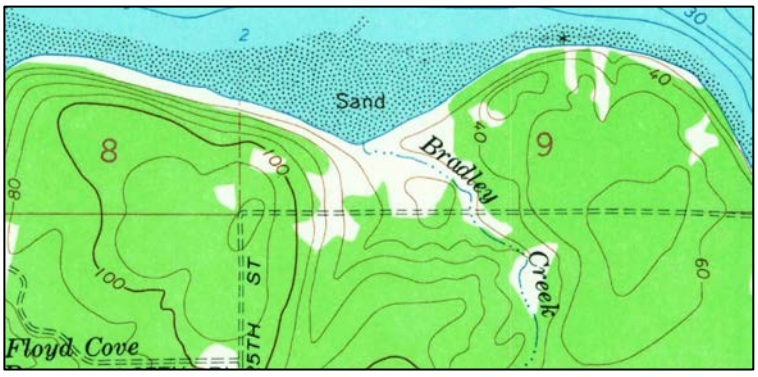


Figure 11: USGS Quad Map excerpt from 1959 of Bodley Creek (mis-spelled)

Aerial Photo of Bodley Creek Site.

Outlet of Culvert Drain.

Ponded Creek and Control Structure

Tidal channel at outlet

The bisection of the Bodley Creek marsh with the Coastal Road culvert lies high in the tidal prism. The blocked tidal prism is estimated to have historically been approximately 17,000 ft^3, with an estimated historical tidal marsh area of approximately 0.4 acres. Landward of the culvert, the Bodley Creek would have historically supported additional tidally influenced marsh and transition to freshwater marsh. The Coastal Road embankment blocks an estimated 100' wide opening at MHHW. The pond elevation is controlled through the use of a corrugated metal standpipe which drains into a 36" diameter dual wall plastic pipe culvert. Prior to the development of the Coastal Road, there was a gravel drive that crossed Bodley Creek approximately 600 feet upstream of the current crossing. The vegetation was too thick at the time of survey to observe, but there is likely a second blocked crossing structure at this location. Downstream of the culvert crossing, Bodley Creek and associated tidal marsh are in good condition. There is a row of pilings in the upper marsh, and a sign warning against beach access, but much of the habitat appears intact. There is a minimal amount of armor placed around the existing culvert outlet, which appears to be functioning well.

Restoration Options – The options listed below are all included on the feasibility level conceptual design drawing on Figure 12, with a full size drawing Appendix G. The cost estimates include the cost of design, contract administration, permitting, planning (geotechnical investigation, wetlands, cultural assessment, etc.), construction cost, and contingencies (estimated at 30% of construction costs), but should be used with discretion. Archaeological and cultural resource assessment costs have been estimated, however the limitations, requirements, or potential isolation of sites as a result have not been accounted for.

The impounded reservoir is used by amphibians for breeding and rearing (see Appendix D). The habitat restoration options would impact habitat currently used by amphibians which cannot tolerate saline waters. Typically, habitat restoration project designs seek to restore natural processes to impacted habitat, e.g. remove structures that impound streams, as it is the most sustainable approach and produces high habitat diversity for wildlife use. For Bodley Creek, the transition zone created by restoration of full tidal influence to allow the gradual transition from saltwater habitats to freshwater stream and wetland habitat is relatively small as it is high in the tidal prism. Only extreme tides would influence a restored Bodley Creek. The removal of the standpipe will greatly reduce freshwater wetlands, particularly open water wetlands, but is the natural condition of the stream. Impacts to existing amphibian use are difficult to balance with restoration of natural processes at this site. A technical memo of the findings from the amphibian survey at Bodley Creek, Floyds Cove and Milewa Creek is in Appendix D.

Option 1 – Full Restoration

Description: Completely remove the road embankment and provide a full spanning bridge, approximately 100 feet long, estimated by matching upstream MHHW elevations with downstream MHHW elevations. Pull the existing pilings out of the upper marsh, remove the pump house, and pump diversion. The impoundment will be eliminated in this option and Bodley Creek will re-establish as a small stream within a wetland complex. Some replanting and invasive plant control may be needed, as reed canarygrass is abundant at the site.

- This option will restore the entire tidal prism to pre-developed conditions and will restore all tidal/estuarine processes at the crossing.

- This option is the highest cost, range $700,000-$1 Million, with comparable ecological benefits to Option 2, described below.

- The access to the Bodley Creek site, once on the island, is good comparatively with McNeil Island sites. There is access from the Coastal Road from both sides; however the long shallow gradient beach has dunes that greatly restrict shoreline access and sensitive marsh vegetation is well established. Due to the location of the road crossing in the tidal prism and small freshwater input worksite, flow isolation should be straightforward. The abundance of accessible area surrounding the site makes spoils disposal near the site a feasible option. A structure in this size range would likely need a crane to place structural elements, which would almost certainly need to be barged in at a different location and trucked/driven to the site.

Option 2 – Partial Restoration

Description: Remove a portion of the existing embankment and construct a culvert within tidal influence sized to pass combined tidal exchange and freshwater flows, approximately 14’ span structure about 80 feet long. Remove the pilings, abandoned road crossing, pump house and pump diversion.

- This alternative would restore full tidal influence and a portion of the tidal processes. The constriction at the culvert crossing would impede transport of sediment and large woody debris, but restore tidal influence without tidal asymmetry.

- The cost of this option is estimated in the range of $500,000-$800,000.

- Access and construction considerations are similar to those above. This structure, being in the tidal range, would likely require concrete construction, which would likely require a crane or heavy excavator. Cast in place construction for that type of structure would greatly reduce the construction issues.

- In the event that the freshwater diversion cannot be removed due to a need for continued use, a setback dike could be placed and the existing structure maintained to allow continued diversion at the required rate.

Option 3 – Full Restoration

Description: Completely remove the existing road embankment and replace the assumed crossing of Bodley Creek upstream of the marsh area. Additionally, remove the existing pilings, pump house, pump diversion and allow natural regrading of the marsh area. This crossing would be entirely outside of the intertidal zone and could be achieved with the use of a culvert designed using Stream Simulation methods estimated to be the range of a 10 ft span. This option would also require the re-construction of approximately 650 lineal feet of the abandoned gravel road, and the new construction of approximately 650 feet of new gravel road.

- This option is would restore all tidal exchange and processes, as well as relocating the road back from the shoreline. The impoundment will be eliminated in this option and Bodley Creek will re-establish as a small stream within a wetland complex. Some replanting and invasive plant control may be needed, as reed canarygrass is abundant at the site.

- The estimated cost is in the range of $350,000-$500,000.

- See the previous option for the discussion on access. The biggest potential access benefit to this type of option would be the potential to avoid the need for equipment larger than an excavator. Being entirely freshwater, a metal structure (aluminum or steel) could be utilized, which would greatly reduce the construction cost and access issues. The majority of the cost for this option is excavation and gravel road construction. Potentially, a portion of the existing traveled road surface could be recycled to reduce costs. Additionally, as discussed above, an on island (and near site) waste site would greatly reduce costs.

- This option would need discussion with DOC to evaluate the road relocation. Visual sightlines to the shoreline are a design consideration for the road.

No Action

This alternative is presented to describe the current impacts of the existing impoundment and the potential long term impacts. This site is high enough in the tidal prism that it does not appear to have degraded the tidal processes and transitional habitat greatly. The small quantity of freshwater flow would likely not deliver a large quantity of sediment to the nearshore and the organic contribution would likely be deposited similarly to its existing arrangement. However, the road impoundment and infrastructure will need continued maintenance to retain current conditions.

- The existing pilings, the abandoned road, and the crossing associated with the abandoned road should be removed regardless of the selected option. Cost of removing these features is in the range of $10,000-$25,000.

Each of the above options could be modified to include the construction of a setback dike to preserve the ability to impound a portion of flows for continued diversion to the Butterworth Reservoir. This would maintain the existing culvert in addition to the selected option. The additional cost for this type of option would be in the range of $30,000-$50,000.

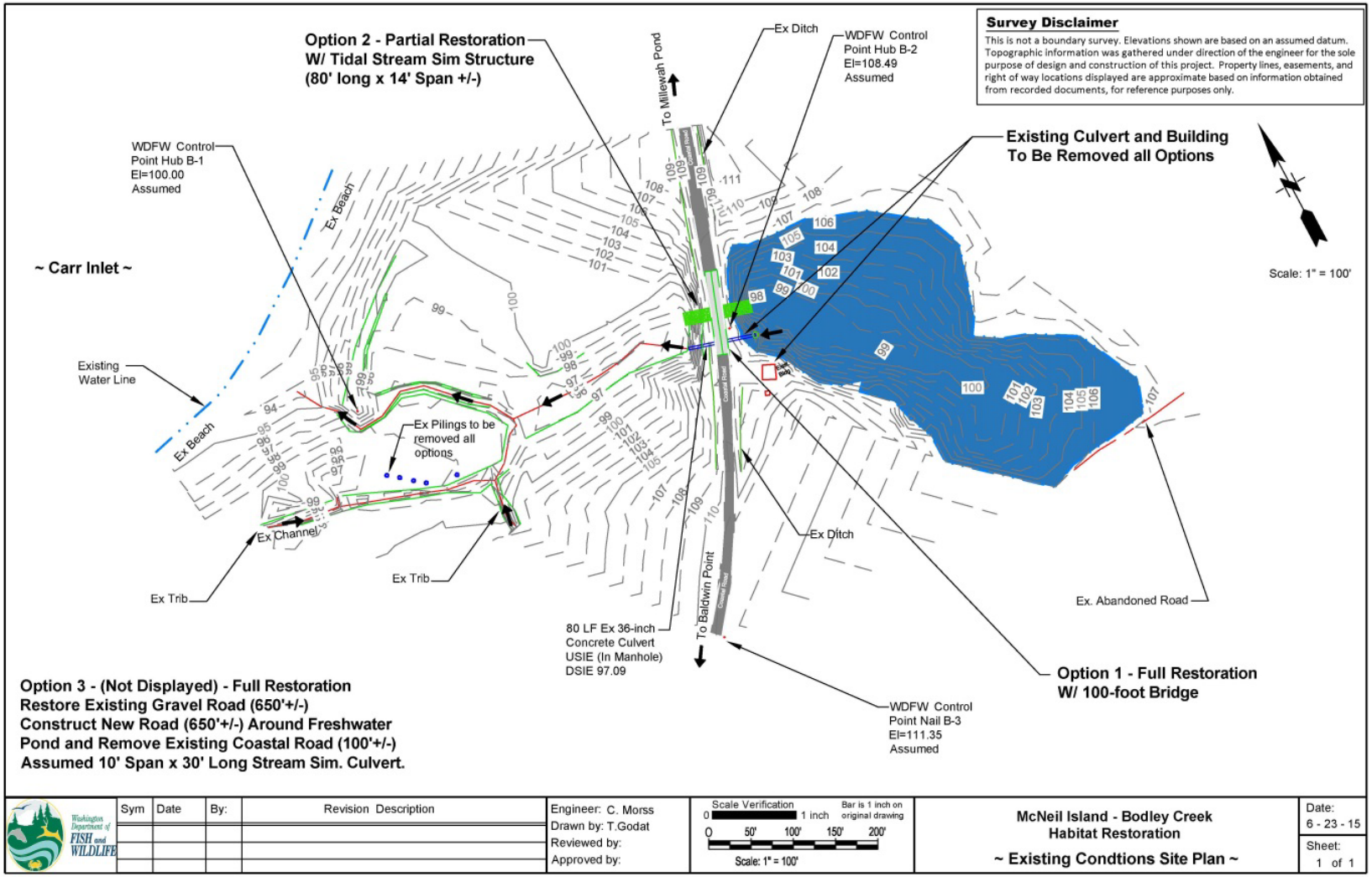


Figure 12: Conceptual designs for Bodley Creek

Floyds Cove

Floyds Cove is located on the westerly coast of McNeil Island along Pitt Passage, almost due east of Pitt Island. The site is accessed by the Coastal Road from the North and South, and lies approximately ½ mile south of Samego Point. The cove is oriented just north of due west. Pre-development Floyds Cove was an open estuary with a barrier beach extending to the south from the northern shoreline (Figure 13). The embankment that impounds the existing pond was constructed to help provide freshwater to Butterworth Reservoir, similar to the Bodley Creek site. There is an existing pump house and diversion that are inoperable currently. Additionally, the shoreline is heavily armored with a combination of riprap, piling, and submarine cable bulkheads. A gravel access road intersects the Coastal Road at the existing pump house that runs to the east and accesses the middle area of the island. Floyds Cove is identified on the Shoreline Modifications Figure 5 as Waypoints 58 and 59. An enlarged portion of the T-Sheet for this area is included below in Figure 13 and the close up of Floyds Cove on the USGS 1959 Quad Map of this area is Figure 14.

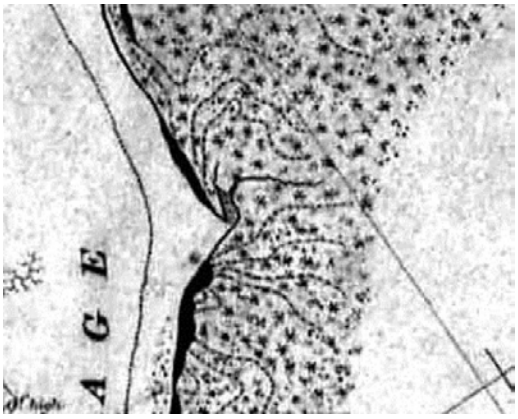


Figure 13: Floyds Cove from T-sheet 1877=78

The road embankment and perched culvert along Floyds Cove has blocked the tidal inundation of approximately 0.5 acres at MHHW. The existing pond bottom is assumed to have aggraded significantly since the embankment was constructed. Field crew indicated that the substrate was covered in about a foot of loose fine sediment over more solid substrate throughout much of the pond. The existing culvert is a 24" concrete pipe culvert that is perched above the beach and has one or more sections that separated. The pump house and diversion are not in operation at this time and may be a fire suppression water source, rather than a freshwater source.

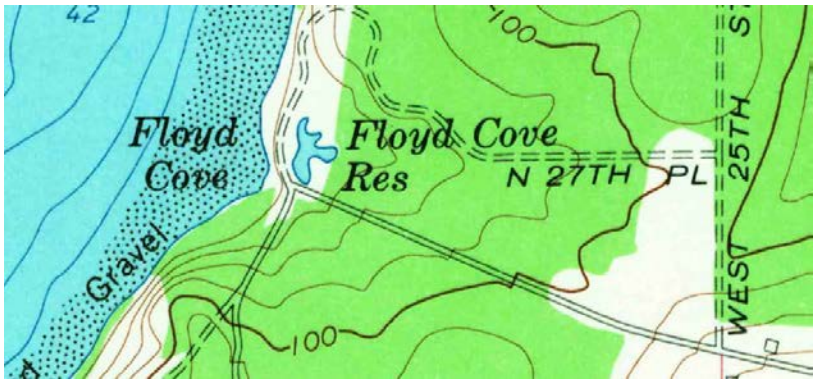


Figure 14: Floyds Cove from USGS Quad map 1959

The culvert was assessed as a complete barrier for fish passage due to the outfall drop of 0.2 to 2.5 meters at high tide (Till and Caudill 2003, WDFW 981753). Four small streams flow into the impoundment but are limited for potential fish use due to small stream length (less than 200 meters) and low flows (Till and Caudill 2003).

Aerial Photo of Floyds Cove Site from DOE shoreline photos (2000)

Floyds Cove Embankment from Boat Survey

Shoreline armoring along embankment at Floyds Cove

Restoration Options

The options listed below are all included on the feasibility level conceptual design drawing on Figure 15, with full size drawing in Appendix G. Cost estimates include the cost of design, contract administration, permitting, planning (geotechnical investigation, wetlands, cultural resources assessment, etc.), construction cost, and contingencies (estimated at 30% of construction costs), but should be used with discretion. Archaeological and cultural resource assessment costs have been estimated, however the limitations, requirements, or potential isolation of sites as a result have not been accounted for. The impounded reservoir is used by amphibians for breeding and rearing (see Appendix D). The habitat restoration options would impact habitat currently used by amphibians which cannot tolerate saline waters. See Appendix D for evaluation of habitats and amphibian use related to the proposed projects.

Restoration objectives for Floyds Cove focus on re-establishing natural processes at the site. The impounded area is high in the tidal prism such that tidal influence is only inhibited at highest tides. However, the impoundment of the area with a perched culvert creates an artificial condition of open water wetlands at a site of former high salt marsh and transitional marsh habitat, resulting in an abrupt transition from saltwater habitat to freshwater habitat. In addition, sediment dynamics along the shoreline and input and transport of large woody material is interrupted by the impoundment structures. Amphibians currently occupy the freshwater impoundment, such that the benefit of restoring the transitional marsh habitat and habitat connectivity with marine shoreline will need to be balanced with current wildlife use.

Option 1 – Full Restoration

Description: Completely remove the road embankment that closed off the historic opening of estimated at approximately 160 feet and replace with a bridge. Remove the existing pump house, and freshwater diversion. Remove the existing culvert drain and allow the cove to re-establish a natural substrate. Remove the existing bank armor and reduce road elevation to minimize the need for soft shore armor.

- This option will restore all tidal prism, tidal processes and the historic shoreform.
- This option is the most expensive cost at a range of $1.25 Million – $2 Million, while providing a slightly lesser benefit to Option 2 described below.
- Floyds Cove has good road access, from the north, south, and west. Shoreline access to the beach is good, however limited for construction access due to the high fill of the Coastal Road. There is currently no access from the beach to the uplands. The existing road and adjacent ponded areas do allow for manipulation of cranes and heavy equipment fairly freely. No overhead utilities limit site access. Site isolation should be easily achievable due to the existing location of the culvert high in the tidal range, and the low quantity of freshwater input.

Option 2 – Full Restoration

Description: Completely remove the portion of the Coastal Road that blocks the historic opening, and excavate down to historic barrier spit elevations on the remaining hardened embankment. Construct approximately 650 lineal feet of gravel road around the southerly side of the existing pond and install a water crossing structure designed using stream simulation techniques at the crossing location of the freshwater source to the cove. A culvert crossing designed using stream simulation methods is estimated at a 12 foot span. Remove the existing pump house, and freshwater diversion.

- This option would allow full tidal influence, all tidal processes and would restore the tidal opening, as well as the functioning ephemeral barrier spit. This option has the highest ecological benefit of the three restoration options.
- The estimated cost is in the range of $900,000-$1.25 Million.
- See the previous option for the discussion on access and site isolation. The drivers of the cost for this option are the volume of excavation and the road construction. The crossing structure could be metal construction, or even multi-plate to reduce cost and construction equipment impacts. The majority of the cost for this and the previous option is the pure volume of material to be moved (over half of the estimated cost). A restoration option with a reduced opening size, or less barrier spit restoration could reduce costs significantly.

Option 3 – Partial Restoration

Description: Remove a portion of the Coastal Road embankment large enough to install a 30 foot culvert within the tidal range. The culvert would be sized to minimize impacts to fish passage and tidal processes through crossing. Remove existing bank armor and provide soft shore alternatives. Remove existing pump house, freshwater diversion, and existing pond drainage structure.

- This option will restore the tidal prism, and some tidal processes, without restoring the historic shoreline.

- The cost of this option is estimated in the range of $1-$1.5 Million

- The construction considerations are essentially the same as the previous option. The required excavation would be similar; however a concrete box structure would be needed for interaction with saltwater, which will likely require heavier equipment for placement. Compromising on the opening size (which greatly reduces project benefit) could help reduce the cost of this option.

No Action

This alternative is presented to describe the current impacts of the existing impoundment and the potential long term impacts. The pre-development shoreline similarly impeded the influx of sediment and organic matter to the nearshore; however the barrier spit feature was likely partially, or entirely, washed away during high flow events. The surrounding high banks and quantity of large wood would be prevented from contributing to the shoreline processes. A project to remove bank armoring materials (submarine cable, pilings, rip rap) would involve replacement with different shoreline armoring if the road was retained in its current location. Due to the high elevation of the existing marsh and toe of the existing embankment, bank armor modification without accompanying habitat restoration work may not be cost effective.

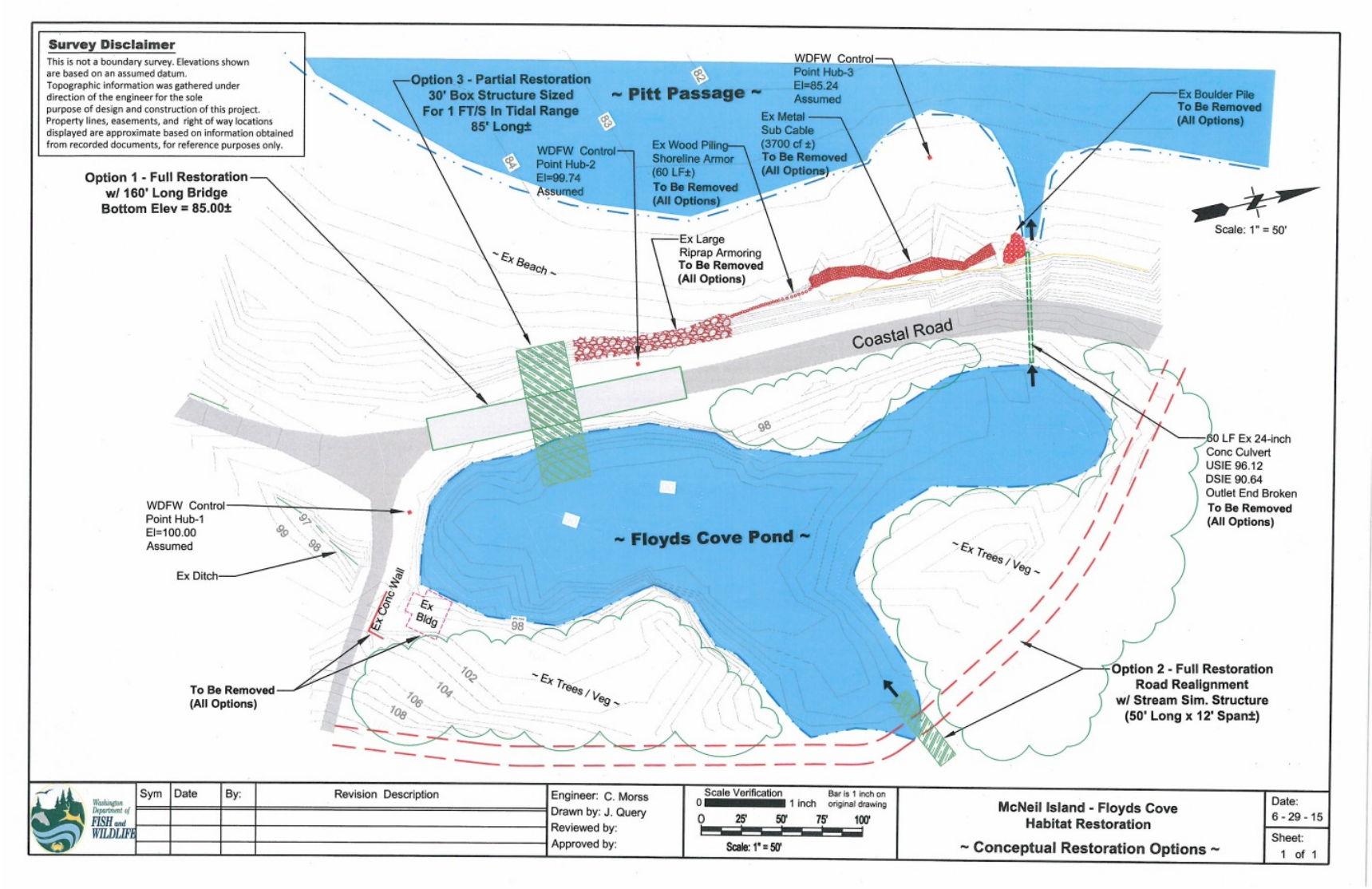


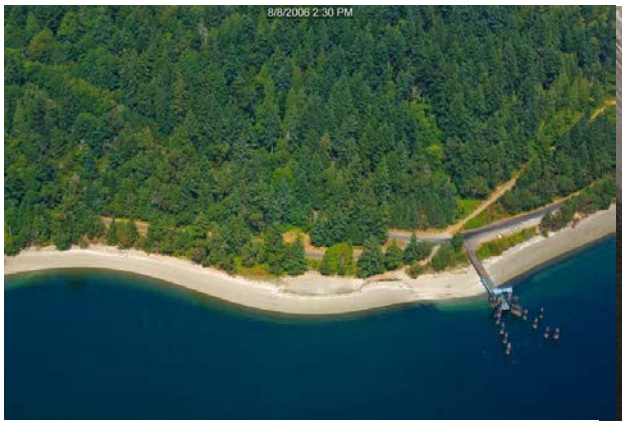
Figure 15: Conceptual designs for Options 1 - 3 for Floyds Cove

Barge Landing Site

The barge landing site is located adjacent to the vehicle barge landing, on the southernmost tip of McNeil Island. The site is oriented to the southwest facing Balch Passage and is within the Nisqually Reach Aquatic Reserve. The site is accessed by the Coastal Road approximately 300 feet west of the barge landing. The site currently has a staging yard surrounded by ecology blocks and layered with crushed gravel over the sand/pea gravel beach substrate. The staging yard also has several concrete voided slab bridge sections within the ecology block area. The history of the storage/staging area was not clear, although it is a relatively recent shoreline modification and does not appear to have a function at this time. The site was at one time an active small boat launch for island residents and still has a concrete ramp extending down to the shoreline.

This site was historically a sandy beach and does not stand out as a special feature in historical topographic maps or USGS Quad Maps. For this reason, these figures have been left out of this section. Aerial and ground level photographs are included. Cost estimates include the cost of design, contract administration, permitting, planning (geotechnical investigation, wetlands, cultural resource assessment, etc.), construction cost, and contingencies (estimated at 30%) and should be used with discretion.

Aerial Photo of Barge Landing and Site (DOE Oblique)



Aerial Photo of Barge Landing Site

Site Debris as observed from Shoreline Survey

Voided slabs and anchored rootwads at the site

The barge landing site is a documented forage fish spawning site for both surf smelt and Pacific sand lance and supports excellent quality spawning substrate along much of the beach in the vicinity, with the exception of the storage yard. The concrete structures and piling shoreline armoring cover the upper beach and remove this from potential use by forage fish and wildlife. The boat launch is covered with sand and natural debris, and is gated to prevent vehicle access. It is either lightly used or not in use at this time. The debris at the site is mostly concrete ecology blocks stacked variably 1-2 blocks deep and 1-2 blocks high forming a flat staging/parking area. Additional concrete debris on this parking area is 15 voided slab bridge sections. The ground surface of the staging/parking area is covered with crushed basalt quarry spalls. Adjacent to the staging/parking area is a series of log piles (50 +/-) forming a wall that the access road runs along. The toe of the log piling wall lies approximately 1.4 feet below MHHW while the toe of the block wall lies approximately 1.2 feet below MHHW. Large logs with rootwads have been placed and anchored around the concrete debris. The anchored rootwads are partial mitigation for construction work on the ramp in the past. Regulatory agencies will need to review any modifications of the mitigation to assure the function is retained (e.g. moving the rootwads to the upper beach as part of the project). Only two options are discussed below due to the simplicity of this site.

Option 1 – Full Restoration

Description: Remove all of the debris from the beach. Dispose of all concrete debris off site and remove the quarry spalls from the upper landing area. Expose existing beach material and regrade the beach to match the profile of the adjacent stretches of beach. Some backfilling of the beach after removal of crushed gravel and quarry spalls may be necessary to reach grade level. Remove the concrete boat launch and similarly regrade the beach. Pull all of the log pilings and dispose of at an approved landfill. Leave or reposition the logs with rootwads. The cost of this option is estimated at $20,000-$40,000

- Of the sites on McNeil Island, this site is the most easily accessible and workable. There is an existing access road from the Coastal Road down to the site, and the site is located adjacent to the Island Barge Landing. The beach is steep, which makes access from the water favorable. The site is high enough in the tidal range, and the project short duration, that a week of favorable tides would likely be enough to complete the project without the need of any tidal barriers. The largest variable at this site is the disposal of unnatural materials. The concrete, crushed rock and treated wood should be entirely removed from the beach and placed in an acceptable upland location, or removed from the island entirely.

No Action

This site covers potential forage fish spawning area. The walls and debris are preventing the small bluffs upslope from contributing sediment or organic materials to the beach. Portions of the above mentioned project could be implemented with this No Action option, particularly if the boat launch must remain.

Next Steps

This report was a first step to investigate potential habitat restoration projects along the marine shoreline of McNeil Island. The project evaluations were high level; additional investigation of cultural resources and a better understanding of current use of facilities and infrastructure are still needed to move proposals forward. As the project proposals are developed, opportunities to reduce costs on the projects may become evident.

We recommend that WDFW and DNR work together to review the options and opportunities of the feasibility report and identify options to review further with a stakeholder group to include DOC and DSHS staff, along with local tribes. Additional data collection, biological evaluation and engineering work are needed to develop conceptual designs for projects selected for additional work.

While particularly logistically challenging, the potential habitat restoration projects at McNeil Island, both large and small, are a good opportunity to enhance the marine shoreline environment in South Puget Sound. The habitat protection afforded by the limited access to McNeil Island improves the potential outcome of these projects. It is rare to find opportunity to preserve high quality shoreline habitat on the scale of McNeil Island. WDFW looks forward to a continued partnership with DNR to explore options for marine shoreline improvements at McNeil Island.

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