Marina Relocation Alternatives Analysis

UPDATED DRAFT

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Executive Summary

The Port of Silverdale has planned overwater, non-motorized user upgrades to the Silverdale Waterfront Marina, including a new float for non-motorized recreational craft use, an extension to the end walkway finger pier, and new 80-foot aluminum gangways to the new non-motorized float and the existing wooden floats. This study evaluates these upgrades against four alternatives to relocate the marina into deeper water in an attempt to save on future dredging. The scoring procedure used in this report indicates Alternative 2b as the slightly preferred alternative. Alternative 2b consists of moving the existing wood floats to deeper water, while constructing the new non-motorized float to span the new gap between the fixed pier and relocated floats. This not only reduces dredging, but it presents the opportunity for additional savings beyond dredging, by eliminating the need for one new gangway, several new piles, and a new section of wood float. Since a construction crew and pile driving rig will be needed anyways to construct the overwater upgrades, Alternative 1, there can be cost savings by moving the marina during the same project. Concrete floats were also evaluated but would present a very significant upfront construction cost and effort. A next step is also to gather input from local non-motorized user groups regarding the differences in functionality between different alternatives.

Introduction

The Port of Silverdale is planning several upgrades to the Silverdale waterfront marina in Old Town Silverdale, which were outlined in the report “Overwater Facility Upgrades Concept Design Report” by Art Anderson Associates dated July 31, 2020 (Reference [A]). The planned upgrades are a new float for non-motorized recreational craft use, an extension to the end walkway finger pier, and new 80-foot aluminum gangways to the new non-motorized float and the existing wooden floats.

The Port conducts dredging around the marina footprint and boat ramp periodically to remove built-up sediment and ensure adequate underwater clearance for boats at low tides. According to Marine Surveys and Assessments (Reference [B]), about 21,000 cubic yards of sediment was dredged around 1993, 3,950 cubic yards was dredged around 2005, and 17,165 cubic yards is proposed to be dredged in plans developed in 2018.

The wooden floats in the marina were designed in 1986 by Marina Ventures in Baltimore, MD. The floats consist of wood decking over timber structural cross members, attached to filled polyethylene floatation tubs. The Port indicated they are considering replacing the wooden cross-members of the floats.

The purpose of this report is to evaluate several alternatives to adjust the location of the marina floats. The impetus for the investigation is the idea that moving the floats into deeper water will eliminate or greatly reduce the dredging required. Potential relocation has impacts on the planned design of the finger float extension and non-motorized float upgrades to the marina, as well as any repairs to the existing timber floats.

Basis of Design

Codes and Standards

2010 Department of Justice *ADA Standards for Accessible Design*
ASCE/SEI 7-16 *Minimum Design Loads for Buildings and Other Structures*
Shore Protection Manual, SPM 2002, U.S. Army Coastal Engineering Research

Water Levels

Tide	Elevation (ft, MLLW)
Highest Estimated Tide	15.2
Mean Higher High Water	11.7
Mean Tide Level	6.8
NAVD88	2.5
Mean Lower Low Water	0.0
Lowest Estimated Tide	-5.0

Wind Generated Waves

Fetch (SSW)	2.5 mi.
Wave Generating Wind Speed	52 mph (50-year return)
Wave Generating Wind Duration	0.7 hour
Significant Wave Height	3.6 ft.
Wave Period	3.2 sec.

The prevailing wind direction is from the south-southwest, and secondarily from the northeast. The fetch that corresponds with the south-southwest winds is roughly 2.5 miles.

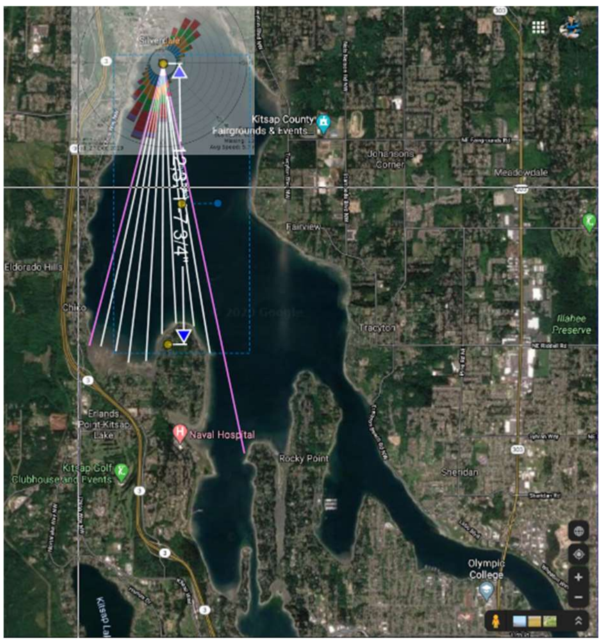

Figure 1: Fetch and wind rose

A site bathymetric survey was provided by Coastal Geologic Services in 2017 (Reference [D]), as well as the maintenance dredging plan. A snapshot of the dredge plan area is shown in Figure 3.

Alternatives

Five alternatives will be described and evaluated.

Table 1: Alternative Summary Comparison Matrix

	Floats	Location	Effect on Planned Overwater Upgrades	Effect on Dredging
Alternative 1	Reuse existing wood frame floats	Existing floats remain in same location	No change to previous concept	No reduction in required dredging
Alternative 2a	Reuse existing wood frame floats	Shift floats out to deeper water, extend out with new section of wood float	Rotate new non-motorized float location to deeper water, finger extension no longer needed	Eliminate or greatly reduce required dredging around floating docks footprint
Alternative 2b	Reuse existing wood frame floats	Shift floats out to deeper water, extend out with new non-motorized float	New non-motorized float location moved to between fixed pier and relocated main marina floats, finger extension no longer needed	Eliminate or greatly reduce required dredging around floating docks footprint
Alternative 3a	Replace existing wood frame floats with concrete floats	Relocate new floats to deeper water, same footprint as 2a	Rotate new non-motorized float location to deeper water, finger extension no longer needed	Eliminate or greatly reduce required dredging around floating docks footprint
Alternative 3b	Replace existing wood frame floats with concrete floats	Relocate new floats to deeper water, same footprint as 2b	New non-motorized float location moved to between fixed pier and new relocated concrete marina floats, finger extension no longer needed	Eliminate or greatly reduce required dredging around floating docks footprint

Alternative 1 – Original Marina Upgrades Concept

Alternative 1 serves as a baseline option, to carry on with planned overwater upgrades without moving the existing wooden floats. Specifically, a new non-motorized use float will be installed on the north side of the existing dock as shown in Figure 2, and about 46,300 square feet will be dredged in this vicinity, as shown in Figure 3.

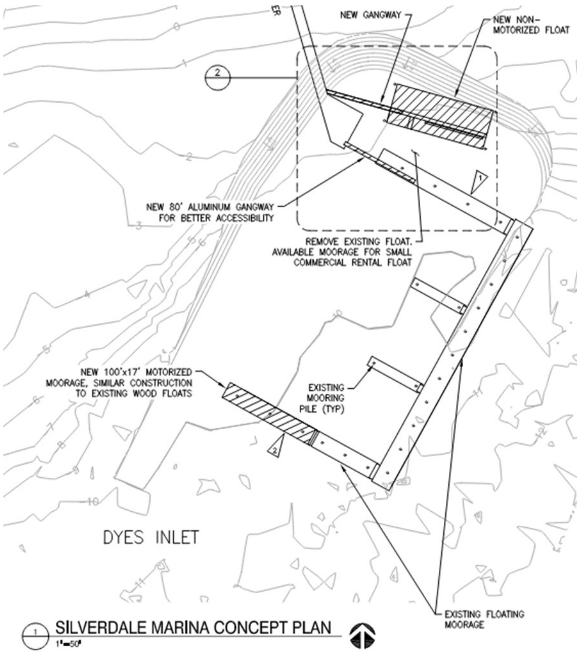

Figure 2: Alternative 1 - previously developed overwater upgrades, no moving of existing dock

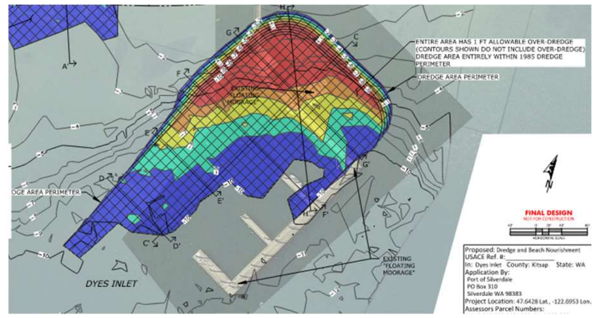

Figure 3: Planned dredge area, from Reference C, 11,000 cubic yards, 46,300 square feet

Alternative 2 – Relocate Wood Floats

Alternative 2 consists of two layout options, a and b, for relocating the existing wood floats to deeper water. Relocation would involve pulling out the existing steel piles, towing the existing wood floats to the new location, and then using the floats as a template for redriving the steel piles. It is assumed that most or all the piles can be reused if in good condition.

The purpose for moving the floats is so they are in deeper water and can greatly reduce or eliminate the need for dredging this area. The existing dredge plans also include dredging around the concrete boat launch area, so even if the need for dredging around the floating moorage is eliminated, some dredging is still required at the boat launch. To optimize the move, the new location should be in sufficiently deep water to significantly reduce dredging. By examining the existing bathymetry, the floats must be both rotated and translated outward. Since they are translated outward, a new float structure is needed to span the gap between the fixed pier and the new float location.

Figure 4: Alternative 2a and 3a - marina relocation with extended walkway

Alternative 2a proposes a 150-foot extended main walkway of similar construction to the existing main walkway. The new non-motorized float will still have its own access gangway, but it will also need to be rotated into deeper water that does not rely on the dredged bathymetry. Therefore, two new gangway seats off the fixed pier are required.

Figure 5: Alternatives 2b and 3b - marina relocation with non-motorized float as extension

Alternative 2b proposes that the new non-motorized float be placed between the fixed pier and relocated main walkway floats. This means there would be a single access to all floating facilities, and only one new gangway seat would be needed.

Alternative 3 -Relocate Floats, Replace with Concrete

While going through the exercise of examining relocation options, the Port wanted to also consider the pros and cons of replacing the existing timber floats with concrete. The existing floats are 35 years old, and while they are still in fair condition from visual observation, they are due for some cross member replacement, and are likely to see increased maintenance required in the coming years.

Alternative 3a and 3b use the same location footprint as described in Alternative 2a and 2b, except with concrete floats. The main walkway would be 17 feet wide to match the width of the replaced wood floats. Finger floats would be narrower. The main walkway would likely have an overall height in the range of 5 to 6 feet. Assuming an 18-inch freeboard, the draft would be in the range of 3.5-4.5 feet. The floats would consist of concrete pontoons rigidly connected with post-tensioning strands.

Evaluation Criteria

The alternatives are each compared in terms of the following evaluation criteria:

First Cost and Implementation Impacts

1. Construction Costs

This criteria compares the construction costs relating to moving and/or constructing new marina floats.

2. Constructability

A measure of the complexity of construction and the impact on the schedule of the planned overwater upgrades

3. Permitting Impact

Ease of obtaining permits for work and cost and schedule impacts of permits and mitigation

Lifecycle Impacts

1. Estimated Lifecycle

The estimated useful lifespan of the system before full replacement.

2. Maintenance Costs

The estimated reoccurring maintenance costs to prolong the life of the system.

3. Dredging Impact

The anticipated reduction in required dredging

Functionality

1. Motorized user experience

The ability of the marina layout to maintain or increase the user experience for motorized craft users.

2. Non-motorized user experience

The ability of the marina layout to maintain or increase the user experience for non-motorized craft users.

3. Ability of floats to function as a breakwater

The ability of the marina floats to function as a breakwater by reducing transmitted wave height.

Alternative Scoring

First Cost and Implementation Impacts

Figure 6 contains a comparison of construction costs of some of the key project elements between alternatives. The purpose of the costs listed are to give a relative comparison between some of the construction items that would vary between alternatives to assign a qualitative cost score to judge each alternative.

A few points that distinguish different alternatives are discussed in this paragraph. Alternative 1 does not require any removal or relocation of floats or piles. While this provides some savings, the cost of pulling piles and moving the floats is fairly minor compared to overall project costs incurred for the overwater upgrades. Alternative 2b offers savings compared to alternative 1 and 2a in that it will only require one new gangway, it will require fewer new steel piles, and it is assumed that a new wood float extension will not be required. The cost of new concrete floats for alternative 3 is a significant up-front cost, as expected.

A cost score for each alternative will be assigned in the following section. The cost and dredge savings categories will be assigned a weighting double that of the rest of the categories. An important note is that this section only looks at up-front cost and does not consider the cost of replacing the existing wood floats, which would happen much nearer in the future than if new concrete floats were constructed now.

ITEMS	QUANTITY		FIRST COST OF CONSTRUCTION					
DESCRIPTION OF WORK	#	UNIT	Unit $	Alt #1	Alt #2a	Alt #2b	Alt #3a	Alt #3b
Mobilization	1	LS	Varies	$30,000	$50,000	$50,000	$80,000	$80,000
Remove exst steel piles	22	EA	$3,000	-	$66,000	$66,000	$66,000	$66,000
Relocate exst wood floats	1	LS	$10,000	-	$10,000	$10,000	-	-
Remove exst wood floats	Varies	LS	$140,000	-	-	-	$140,000	$140,000
New concrete floats	Varies	SF	$250	-	-	-	$2,811,500	$2,324,000
New steel piles	Varies	EA	$10,200	$71,400	$81,600	$40,800	$81,600	$40,800
Redrive exst steel piles	22	EA	$4,000	-	$88,000	$88,000	$88,000	$88,000
Nonmotorized float	1	LS	$210,000	$210,000	$210,000	$210,000	$210,000	$210,000
New section of wood float	Varies	SF	$113	$192,270	$220,545	-	-	-
Aluminum gangway	Varies	LF	$482	$77,120	$77,120	$38,560	$77,120	$38,560
Electrical Upgrades	1	LS	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
Fire Protection Upgrades	1	LS	$20,000	$20,000	$20,000	$20,000	$20,000	$20,000
Misc Hardware (Cleats, railings, etc)	1	LS	$5,000	$5,000	$5,000	$5,000	$5,000	$5,000
Demobilization	1	LS	Varies	$20,000	$35,000	$35,000	$50,000	$50,000
DIRECT LABOR/ MATERIAL ITEM SUBTOTAL				**$775,790**	**$1,013,265**	**$713,360**	**$3,779,220**	**$3,212,360**
GENERAL CONDITIONS ITEMS	QUANTITY							
Description of Item	#	UNIT	UNIT($)					
Project Manager/Field Supervision Cost	10%	LS		$77,579	$101,327	$71,336	$377,922	$321,236
SUBTOTAL				**$77,579**	**$101,327**	**$71,336**	**$377,922**	**$321,236**
CONTRACTOR'S OVERHEAD	15%			$128,005	$167,189	$117,704	$623,571	$530,039
CONTRACTOR'S PROFIT	10%			$85,337	$111,459	$78,470	$415,714	$353,360
BONDS/ INSURANCE	3%			$25,601	$33,438	$23,541	$124,714	$106,008
SUBTOTAL				**$238,943**	**$312,086**	**$219,715**	**$1,164,000**	**$989,407**
LABOR & MATERIALS SUBTOTAL				**$1,092,312**	**$1,426,677**	**$1,004,411**	**$5,321,142**	**$4,523,003**
BREMERTON SALES TAX	9%			$98,308.11	$128,400.94	$90,396.98	$478,902.76	$407,070.26
DESIGN/ ENGINEERING FEE*	Varies			$87,385	$114,134	$80,353	$798,171	$678,450
DESIGN CONTINGENCY	10%			$109,231	$142,668	$100,441	$532,114	$452,300
MITIGATION CONTINGENCY	Varies			$314,400	$603,200	$457,600	$603,200	$457,600
CONSTRUCTION EST CONTINGENCY	15%			$163,847	$214,002	$150,662	$798,171	$678,450
ESCALATION TO 2022	1%			$10,923	$14,267	$10,044	$53,211	$45,230
SUBTOTAL				**$784,094**	**$1,216,671**	**$889,497**	**$3,263,771**	**$2,719,101**
* Note: permitting costs are not included in this design fee estimate. 15% for concrete options, 8% for others								
GRAND TOTAL				**$1,880,000**	**$2,640,000**	**$1,890,000**	**$8,580,000**	**$7,240,000**

Figure 6: Alternative construction element cost comparisons

In terms of constructability, a drawback to Alternatives 2 and 3 is that the existing marina walkway and the new non-motorized float become co-dependent. In other words, the projects that relocate the marina and install the new non-motorized float would have to happen at the same time. This is because for alternatives 2b and 3b, the non-motorized float becomes part of the walkway to the transient moorage dock. For alternatives 2a and 3a, the non-motorized float is shifted slightly compared to alternative 1, so it also is in an area that is not dependent on dredging. This means any scheduling, funding, or permitting delays of one of the projects would also hold up the other. It is recommended they be packaged as a single project to optimize costs.

The construction of post-tensioned large concrete pontoons is a more complex process than wood floats of the style in the existing marina. Besides the cost, there are only several large graving dock facilities in the area capable of building these floats, which increases the potential costs and timeframe of the project.

Alternatives 2a and 3a are given a slightly lower permitting score, since they will have the most overwater coverage and the most new piles.

Lifecycle Impacts

The existing wood floats are about 35 years old, so the nominal remaining lifespan is likely 5-10 years. A new concrete floating marina would have a design lifespan of about 50 years. Maintenance should be expected to increase in the coming years for the existing wood floats. The Port regularly has to reattach or replace floatation tubs.

Historical dredge volumes are:

- 21,000 cubic yards in 1993
- 3,950 cubic yards in 2005
- 17,165 (moorage area) and 1,700 (boat ramp) cubic yards planned in coming years

Alternatives 2 and 3 are located such that no dredging would be required based on the existing, pre-dredge, bathymetry in the moorage area. The marina locations were selected so the moorage area and fairway lie outside the -10’ MLLW contour. Alternatives 2a and 3a also relocated the planned non-motorized float so that float is not dependent on dredging either.

The Port indicated the most recent planned dredging is anticipated to cost roughly $600,000. If the marina is relocated, dredging is still required around the boat ramp area. Also, assuming the planned upcoming dredging is executed regardless of this report, future dredging would not be required for about another 20 years. So, the cost savings of moving the marina would not be realized until then.

The current dollar value of future savings in dredging was estimated by using several assumptions. It was assumed that future dredging costs, in 2021 dollars, would be $600,000 in 20 years from now, and $600,000 40 years from now. This is based on information from Port of Silverdale commissioners, and the time between large dredge projects in the past. These future savings were converted to $500,000 in current dollars by assuming a net interest minus inflation rate of 3%.

Functionality

It is a prerequisite of all alternatives to maintain an equal level of user experience for motorized craft users. Since the focus of the planned overwater upgrades is not motorized craft use, it is not a current focus to enhance the motorized craft experience. Therefore, each alternative is neutral on the experience of motorized craft users. Alternatives 2 and 3 are given a slightly higher score than Alternative 1, because boat traffic will be in slightly deeper water.

Each alternative is expected to enhance the non-motorized user experience, since that is the objective of the planned overwater upgrades. Each alternative includes the same new non-motorized float, designed for crew shell and sailboat storage and launching. Alternatives 2a and 3a are likely the best option for non-motorized users. This is because they provide a separate new gangway access to the non-motorized float, apart from the main marina walkway. Alternatives 2a and 3a are also slightly better than Alternative 1 because the marina has moved out into deeper water, giving further space between activity of non-motorized and motorized users.

Wave transmission effectiveness is a function of float width and depth. Concrete floats would be more effective as a breakwater. The size of concrete floats proposed here are comparable to the dimensions planned for the future Port Orchard Marina replacement breakwater. Floats of this size would have a rough transmission coefficient of 0.65 for large waves, meaning wave height would be 65% of the original wave height. However, the existing wood floats are also 17 feet wide, and while not quite as deep or solid, they likely provide only a slightly higher wave transmission. The difference in breakwater effectiveness is thus relatively insignificant, especially since there is not a large marina inside to protect that relies on a dedicated breakwater.

Cost Scoring Results

To compare the alternatives across all the evaluation criteria discussed in the previous section, a numerical score from 1 to 5 is assigned to each alternative for each criterion. Cost and dredging are weighted double, meaning scores for those categories are 2,4,6,8, or 10. A score of 1 means the alternative compares poorly to the others, while a score of 5 means the alternative scores greatly compared to the others. Table 2 contains the scoring results corresponding to the factors described in the previous section. Figure 7 below shows the alternative sketches again for quick reference while considering the scoring results table.

Table 2: Alternative Scoring Comparison

	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b
First Cost and Implementation					
Construction Cost*	8	6	8	2	2
Constructibility	5	2	2	1	1
Permitting Impact	3	2	3	2	3
Lifecycle					
Estimated Lifespan	2	2	2	4	4
Lifecycle Maintenance Costs	2	2	2	4	4
Dredging Impact*	4	8	8	8	8
Functionality					
Motorized user experience	3	4	4	4	4
Non-motorized user experience	4	5	3	5	3
Breakwater	3	3	3	4	4
Total	34	34	35	34	33
*2x weighted scores					

Figure 7: Quick reference alternatives: Alt 1 (left), Alt 2a/3a (middle), Alt 2b/3b (right)

Environmental Impact and Mitigation Comparison

The below table provides a comparison of quantities relevant to the environmental impact and required mitigation of each alternative. Marine Surveys and Assessments (Ref. [C]) prepared conservation calculators for each alternative to estimate mitigation points generated for each alternative. For this stage, points were included in the cost estimate assuming $800 per point purchased from Puget Sound Partnership. All alternatives were assumed ungrated for this estimate, however, grated surfaces should be considered during detailed design.

	Alt 1	Alt 2a	Alt 2b	Alt 3a	Alt 3b
# New 24” steel piles	7	8	4	8	4
# Relocated existing 24” steel piles	0	22	22	22	22
Area (SF) of new non-motorized float	4,000	4,000	4,000	4,000	4,000
Area (SF) of new wood marina float	1,700	1,950	0	0	0
Area (SF) of new concrete marina float	0	0	0	1,950	0
Area (SF) of existing wood float replaced with concrete floats	0	0	0	9,116	9,116
Net Mitigation Points ($800/point)	-393	-754	-572	-754	-572

Conclusion

The scoring procedure used in this report indicates Alternative 2b as the slightly preferred alternative. It appears that the savings to be gained from reduced dredging resulting from moving the marina are worth considering. From that point, Alternative 2b presents the opportunity for additional savings beyond dredging, by eliminating the need for one new gangway, several new piles, and a new section of wood float. Since a construction crew and pile driving rig will be needed anyways to construct the overwater upgrades, Alternative 1, there can be cost savings by moving the marina during the same project. Concrete floats would present a very significant upfront construction cost and effort. However, the existing wood floats nearing the end of their lifespan is something that needs to be considered.

To better understand the dredging cost savings from moving the marina, the total cost breakdown from the dredging process should be examined. Since dredging will still be required around the boat ramp, the costs of permitting, environmental studies, generating dredge plans, and a smaller dredge material volume will still be realized even if the marina is moved. If those costs are a large portion of the total dredge cost, then the scoring results presented here may need to be revised. A next step is also to gather input from local non-motorized user groups regarding the differences between alternatives 2a and 2b.

References

[A] Art Anderson Associates *(2020) Overwater Facility Upgrades Concept Design Report*

[B] Marine Surveys and Assessments (2018, Rev 2019) *Port of Silverdale Dredging Biological Evaluation*

[C] Marine Surveys and Assessments (2021) *Puget Sound Nearshore Conservation Calculator* Outputs for Alternatives 1a, 1b, 2a, 2b, 3a, 3b

[D] Coastal Geologic Services (2018) *Port of Silverdale Maintenance Dredging Plan – 2018*

Appendix 1: Alternative Sketches

Alternative 1

Alternatives 2a/3a

Alternatives 2b/3b