PND ENGINEERS, INC.

MEMORANDUM

To:	Christina Schoenfelder, Whatcom County Public Works	Date:	May 13, 2015
From:	John Olson, PND Engineers, Inc.	Project No:	154032.01
Subject:	Lummi Ferry System – Analysis of Terminal Modifications to Accommodate the M/V HIYU Ferry		

Whatcom County has requested that PND Engineers conduct a feasibility and cost analysis of possible terminal modifications to the Lummi Island Ferry System that would be required to accommodate a different vessel than the one currently serving the route. Following is a summary of our analysis and opinion of probable cost to make the required modifications.

INTRODUCTION

The County has become aware of a surplus vessel from the Washington State Ferries fleet, which may be available to replace the vessel currently serving the Lummi Island Ferry System. The potential replacement vessel is the M/V HIYU (HIYU), which is larger in length, beam, draft and displaced volume (weight) than the existing vessel, the M/V WHATCOM CHIEF (CHIEF). The relevant specifications for each vessel are presented further into this report as part of a comparison study.

Earlier this year, the County commissioned a Terminal Compatibility Study, which explored the extent of terminal modifications that would be required to accommodate the HIYU. The study also considered how the CHIEF would lay in a berth that was modified to serve the HIYU. The scope of the study appeared to be limited to geometric configuration and layout of the dolphins and wingwalls. The study did not appear to consider the increased vessel length and berthing energy due to vessel mass, which can have a significant effect on the dolphin and wingwall structures.

This report will consider the additional constraints of vessel mass, length, draft and beam and the costs associated with all recommended modifications to the berthing facilities. Anticipated modifications will include:

1) Demolition of existing dolphins and wingwalls at both terminals
2) New style dolphin design, accounting for larger berthing forces
3) Relocation of dolphins to provide adequate slip width for landing and load/unload as well as sufficient offset distance from end of ramp for half point moorage
4) New style wingwall design, accounting for larger berthing forces
5) Reorientation of wingwall berthing face to fit new vessel profile
6) Foundation type must account for varied soil conditions and overburden depth at each terminal (i.e. rock anchors in shallow bedrock, bearing plates or tension pile tips in deep overburden, etc.)
7) New, relocated south breakwater at island terminal
8) Dredging to accommodate deeper vessel draft

VESSEL COMPARISON

The following Table 1 summarizes the principal characteristics of each vessel considered as part of this study. The terminals have been designed, constructed and repaired or upgraded to accommodate the characteristics of the existing vessel, CHIEF. Each of these characteristics needs to be considered when evaluating the suitability of the terminal facilities to accommodate a new vessel.

	Existing	Proposed
Vessel Name	M/V WHATCOM CHIEF	M/V HIYU
Length	99'-10"	162'-0"
Beam	44'-1"	63'-1"
Draft	9'-1"	11'-3"
Displacement	192 long tons	621 long tons
Passenger Capacity	100 max	200 max
Vehicle Capacity	20 autos	34 autos
Speed	10 knots	10 knots

Table 1. Vessel Comparison

TERMINOLOGY

For the purposes of this report the following terminology will be used to describe the various structures that are subject to modification. The wingwalls are the fender structures sitting immediately to each side of the ramps. The main function of the wingwalls is to provide a fender surface for the vessel to push forward against when loading and unloading. Each terminal has a different configuration and layout for the dolphins, but we will assume that any new dolphin arrangement will consist of a total of four dolphins at each terminal. The outermost dolphins we will call approach dolphins, used to help guide the vessel into the slip. The inner dolphins, between the wingwalls and approach dolphins, we will call breasting dolphins. The breasting dolphins will be the structures that the vessels lays against when berthed in the slip.

ANTICIPATED MODIFICATIONS REQUIRED

In order to modify the terminals at Gooseberry Point and Lummi Island to accommodate the HIYU, a number of significant structural changes are anticipated. Factors to be considered include vessel length, beam, displacement tonnage (weight) and vessel under keel draft. Following is a brief discussion of the principal characteristics and how they affect the modification of the terminal elements.

Length

The location, placement and spacing of the dolphins at each terminal are determined, in part, on the length of the vessel. Generally, when the vessel is at berth, the breasting dolphins should be located slightly past the midpoint of the vessel, for balance. The new dolphins at the Gooseberry Point terminal were constructed with this goal in mind (for the CHIEF). The additional length of the HIYU versus the CHIEF suggests that the location of the breasting dolphins should be moved offshore approximately 30 feet in order to meet this criteria. The breasting dolphins on the North side of the Lummi Island terminal appear to provide the spacing required of this criteria for the HIYU, however later in this report we will illustrate other shortcomings with the placement of the existing dolphins for the HIYU. The spacing to

the furthest offshore dolphin on the South side of the berth could work for a breasting dolphin, although other limitations will control the possible use of this dolphin for the HIYU, as shown later in the report.

Another consideration is the desire to potentially use the CHIEF, in addition to the HIYU, at the reconfigured slip. Since the new breasting dolphins will be located further seaward than before, the gap between wingwall and breasting dolphin may exceed the optimal spacing for moorage of the CHIEF, possibly requiring another dolphin to each side of the slip. A moorage analysis would be needed to confirm acceptable vessel angles at the ramp for loading and unloading. It should also be noted that the design of new dolphins for use by the HIYU would be larger and have greater stiffness (to account for the larger vessel weight) than those being used by the CHIEF. This should be taken into consideration when evaluating the option of using the CHIEF and the HIYU at the same facility.

In addition, the existing breakwater at the Lummi Island terminal which provides protection from the predominately southern storm events extends approximately 115 feet from the ramp. The CHIEF can shelter behind the breakwater during severe storm events and overnight moorage. The longer HIYU would be exposed to more of the storm energy unless the wave barrier was extended.

Beam

The Terminal Compatibility Study from April 6, 2015 does a good job of illustrating how vessel beam affects the placement of the dolphins. The HIYU has a beam (width) 19 feet greater than the CHIEF. The current configuration of the dolphins at both terminals is too narrow to accommodate the HIYU. The mooring dolphins would need to be moved further off centerline of slip and the approach dolphins would probably need to be moved further still to provide a comfortable approach opening.

Additionally, widening the slip by moving the dolphins further off centerline might necessitate relocation and/or modification of the existing breakwaters on either side of the Lummi Island terminal.

Draft

The dimension from waterline to under keel is called the draft. The draft of the HIYU is about 2 feet deeper than the CHIEF, so dredging or implementation of operational limits (no berthing at extreme low tides) may be required in order to accommodate the HIYU. Dredging at the terminal ramp could have an effect on the tower foundations and wingwall structures, especially at the Lummi terminal, where shallow bedrock is present (which already limits the amount of overburden available to support pile foundations).

Displacement Tonnage

Displacement tonnage represents the weight of water displaced by the vessel hull when the vessel is fully loaded and fueled (and therefore the weight of the vessel and all contents). This figure is critical in the design of dolphins and wingwalls as the weight of the vessel is directly related to the energy and force required to slow and stop it from moving. The HIYU has a displacement greater than three times that of the CHIEF. The current dolphins and wingwalls are designed to accommodate the CHIEF, so a new dolphin and wingwall design will need to be implemented for the HIYU. Although it is possible that some of the existing construction materials may be suitable for use in the new design, coordination of these efforts (design applicability and contractor means and methods) might cost more than the realistic value gained.

OPINION OF PROBABLE COSTS

The costs associated with making modifications to the terminals in order to accommodate substitution of the motor vessel WHATCOM CHIEF with the HIYU are presented here as a rough order of magnitude estimate for planning purposes. Costs are presented in Table 2, below, with high/low range for each item. The average estimated cost is approximately $9.4 million with a plus/minus of about 20 percent. If additional dolphins are needed to accommodate both the HIYU and the CHIEF, this cost would increase to approximately $11 million plus or minus 20 percent.

Further analysis should be conducted to refine the presented estimates.

	ROM Cost Range			
Item	Low			High
Mobilization/Demobilization (~10% of Subtotal)	$ 450,000	to	$	690,000
Demolition and Disposal	$ 150,000	to	$	300,000
New Gooseberry Pt. Dolphins (4 total)	$ 800,000	to	$	1,200,000
New Lummi Island Dolphins (4 total)	$ 1,000,000	to	$	1,400,000
New Gooseberry Pt. Wingwalls	$ 600,000	to	$	1,000,000
New Lummi Island Wingwalls	$ 800,000	to	$	1,200,000
New Relocated and Extended Breakwater	$ 1,000,000	to	$	1,500,000
Dredging and Disposal	$ 60,000	to	$	100,000
Tower Support at Lummi Island	$ 100,000	to	$	200,000
Subtotal	$ 4,960,000	to	$	7,590,000
Construction Contingency (~20%)	$ 992,000	to	$	1,518,000
WSST (8.5%)	$ 506,000	to	$	774,000
Construction Subtotal	$ 6,458,000	to	$	9,882,000
Engineering/Permitting/Etc. (~15%)	$ 969,000	to	$	1,482,000
PROJECT BUDGET	**$ 7,427,000**	to	**$**	**11,364,000**

Table 2. ROM Cost Estimate