Day Slough Fish Passage Project
Preliminary Design Report

Skagit Fisheries Enhancement Group
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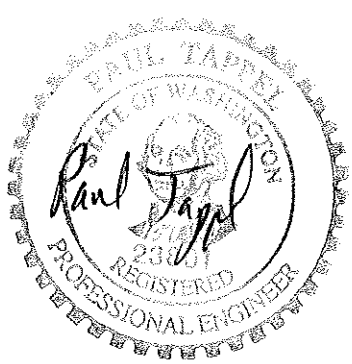
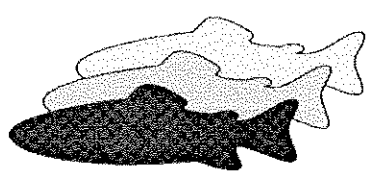


December 2015



Fisheries Engineers, Inc.
Brier, WA

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Preliminary Design Drawings (bound separately)

1. Site Preparation & Water Control
2. Final Project Site Plan
3. Bridge and Slough Sections
4. Slough Profile at Centerline

1. Introduction and Background

Day Slough is a productive side-channel of the Skagit River near Lyman, Washington (Figure 1). All resident and anadromous fish in the Skagit River would be expected to use this slough time-to-time; this would include all six native salmon species (chum, coho, king, pink, sockeye, and steelhead).

At an existing road crossing over Day Slough, there are three steel culverts between 30"-diameter and 60"-diameter; these culverts are undersized and present a barrier to upstream fish movement. Fish blockage at this road crossing limits use of this slough by the entire fish community, with an adverse impact to aquatic and fisheries production. This Preliminary Design Report describes the following project for replacement of the fish barrier culverts (Figure 1):

- ✓ Replace the fish barrier culverts with a 50'-span x 12'-wide weathering steel bridge set on pre-cast concrete footings.

- ✓ Excavate the slough to pass water under the bridge with semi-natural cross-section dimensions for conveyance of high flows, large wood and bedload.

The proposed bridge would increase the existing open area for Day Slough by more than 8 times (29 ft^2 vs 236 ft^2) and would provide excellent fish passage conditions at all river flows, including peak floods. The project would be considered a cost-effective fisheries improvement in Washington. A bridge (compared with existing pipes) would also substantially improve flood flow conveyance, wood transport during peak flows, and bedload movement. Construction for the fish passage project is scheduled to be completed during summer 2016.

This report is intended for review by the Skagit Fisheries Enhancement Group (project sponsor), Washington Department of Fish and Wildlife (WDFW), Skagit Land Trust, Tony + Hilda Becarra (landowners), and other people or agencies interested in this project. Report text, combined with four preliminary design drawings (bound separately) and the construction cost estimate, should provide a comprehensive understanding of the proposed fish passage project.

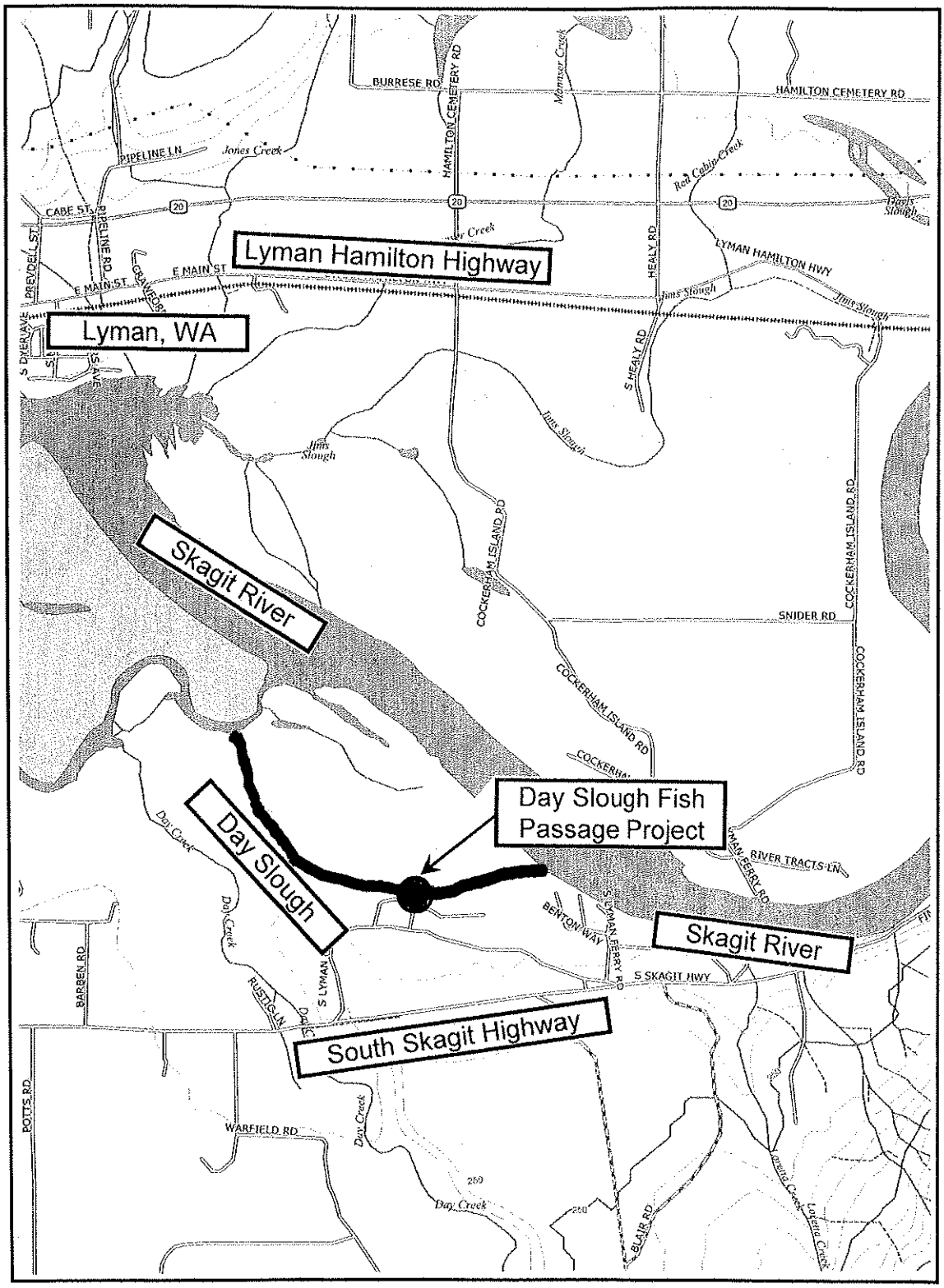

Figure 1. Project location for Day Slough Fish Passage Project about 2 miles southeast of Lyman, Washington, in Skagit County. SE ¼ Section 21, T35N, R6E. Map scale: 1" = 2,000' +/-. Source: Delorme 2013.

2. Design Criteria

Design of fish passage projects requires an interdisciplinary application of fish passage criteria, civil and structural engineering criteria, requirements for permits, and common sense. It is impractical to list all criteria used for project designs; however, some of the most important criteria are listed below for each category:

Fish Passage Criteria

- Design and construction of a bridge (vs. culvert) is the preferred water crossing structure for fish bearing streams (Washington Administrative Code 220-110-070, WDFW 2013).
- Bridge design would allow a slough channel under the bridge with dimensions and channel elevations similar to adjacent slough sections.

Engineering Criteria

- Bridge superstructure and foundations would be designed for HS-20 live load. This live load design criterion would be the same as typical county requirements for bridges.
- Bridge width = 12' between wood curbs would allow ample room for all vehicles, and would accommodate future minor changes (if any) to existing road alignment.
- Bridge length (50'-span) would be sufficient to avoid any constriction of the slough channel, even during floods.
- All elements of bridge design would conform to standard civil and structural engineering practices.

Requirements for Permits

- Clearing of riparian vegetation along Day Slough would be minimized, and as many on-site trees as practical would be protected during construction of the bridge.
- Construction work would be isolated from flowing water to minimize turbidity. Standing water at the work site, which would be expected to become turbid, would be pumped to an upland area for discharge, with infiltration of water into the ground.
- Project design would directly and indirectly incorporate normal requirements associated with a project of this type based on WDFW and Tribal review.

3. Slough Site and Hydraulic Data

Site Survey

A site survey was completed in December 2015 by the design engineer, with on-site assistance from Skagit Land Trust (Hal Lee). The survey collected information on site topography and features using a Total Station survey instrument (Leica TC800), including: alignment, dimensions, and grade for the existing road; existing culvert dimensions and elevations; tree locations, sizes and types near the project site; slough characteristics; channel elevations and gradient; and water conditions (width, depth, etc.) at the time of the survey. Survey data were used to draw a detailed base map of the project location to serve as a background for the project site plan (overhead view). The survey covered an area of about ¼-acre surrounding the road crossing, including a 100'-length of Day Slough.

Hydraulic Data

High flows of the Skagit River commonly overtop the existing road, and the bridge is designed to be submerged during high river flows. The sandy slough bed and banks, gradual meanders, existing vegetation, and local observations all indicate relatively mild hydraulic conditions during slough submergence; mild hydraulic conditions would be typical for similar sloughs and backwaters of the Skagit River.

4. Preliminary Design for Slough Channel

Design of the slough for passage under the proposed bridge was based on site observations:

- Day Slough sections near the road crossing were measured for cross-section dimensions, with a U-shaped channel about 20' to 30' wide being a generic composite. A channel with dimensions similar to this composite channel is proposed to be excavated for the bridge to connect with upstream and downstream slough sections (see drawings).
- It was assumed that the existing culverts were placed on native slough materials (vs. over-excavated, then backfilled with imported soils). Hence, straight-forward excavation of the U-shaped channel at the road crossing should penetrate into native slough materials.

5. Preliminary Design for Weathering Steel Bridge

A 50'-span x 12'-wide pre-fabricated weathering steel beam bridge (e.g. manufactured by Big R, TrueNorth, or RTI) placed on pre-cast concrete footings, would be a suitable new structure for fish passage and flood flow conveyance (Drawing 2). Short-term road closure (4 to 6 days) would be required for heavy equipment mobilization, excavation for rock slopes, placement of footings, excavation of the new slough channel, bridge module delivery and placement, and other

necessary work. As shown on Drawing 2, the new bridge would be set at the existing road crossing.

A 50'-span steel bridge was selected so the bridge could be placed on pre-cast concrete footings "set back" from the slough edges, with 1.5:1 armor rock slopes extending to the concrete footings (Drawings 3 and 4). Reinforced concrete strip footings for the bridge would be pre-cast in halves for each side of the bridge, with four footing sections required for bridge construction.

The bridge superstructure will be slightly higher elevation than the existing road surface (Drawing 3), and it is expected that Day Slough will overtop and completely submerge the bridge during high river flows and floods. Steel beams would be shorter than a conventionally designed steel bridge, with a few more beams therefore required. Instead of bridge guardrails, short wood curbs would border each side of the bridge. Short steel beams, and short wood curbs (Drawing 3), would present a minimum structural cross-section for interception of floating wood debris.

Bridge beams and other structural members would be weathering steel (ASTM A588), which is a specific steel alloy for corrosion resistance. Each steel beam (6 beams assumed) would be placed on and welded to weathering steel bearing plates anchored to the reinforced concrete footings. One side of the bridge would rest on slotted bearing plates to allow for thermal expansion and contraction of bridge beams.

The bridge deck (driving surface) would be gravel and sand placed over corrugated galvanized steel bent plate panels, which would be welded to the weathering steel superstructure. The final driving surface would have a shallow crown to shed water, and the bridge would be sloped about 1' down from south to north (Drawing 3). Deck slope should minimize ice formation during freezing weather. Short wood curbs would border each side of the bridge. The top two feet of roadfill materials would be held in place at the steel beam ends with reinforced concrete backwalls tucked under a steel angle at each bridge end.

6. Preliminary Design for Other Project Elements

Miscellaneous and relatively minor project elements are briefly described below. Final project design would incorporate additional details on all these project features for a comprehensive and complete project construction.

- The single tree to be removed for bridge construction (24"-dia. alder) would be placed across the slough just downstream of the new bridge (Drawing 2).
- Clearing of on-site brush would result in a small pile of clearing debris. The design assumes that a disposal site can be approved (by the landowner) within 500' of the bridge location. Clearing debris would be piled and mashed, then allowed to naturally decompose.

- Day Slough is expected to be isolated pools during construction. Where excavation would approach standing water, a 2"-dia. trashpump would be used to de-water isolated pools. Fish rescue would be accomplished by SFEG (see notes on Drawing 1).

- Bridge construction would generate an estimated 140 cubic yards of excess soils, and/or soils saturated and unsuitable for project backfill. A permanent upland storage site for these soils would need to be approved by the landowner near the project site.

- A new sand and gravel road matching the existing road alignment will be constructed to 40' beyond each bridge end (Drawings 2 and 3).

- Final project work would include grading all raw soils to blend with on-site topography, spreading erosion-control seeds, and mulching soil slopes with straw.

7. Construction Quantities and Cost Estimate

Project drawings and design notes, etc. were used to develop a list of construction items and material quantities, which cumulatively were used for estimation of the construction cost for the fish passage project. The quantity take-off and construction cost estimate for the fish passage project is summarized in Figure 3. The quantity take-off format (Bid Form) is similar to the information that would be provided to general contractors to bid the construction project. The estimated costs for unit prices listed on the Bid Form (Figure 3) are comparable to similar and recent project construction experience in Washington. Total estimated construction cost would be $110,000 for the project (Figure 3).

8. References

DeLorme. 2013. 3-D TopoQuads for Washington State. DeLorme, Yarmouth, Maine.

Washington Administrative Code 220-110-070. State of Washington Administrative Code for Water Crossing Structures, Olympia, Washington.

Washington Department of Fish and Wildlife. 2013. Water Crossing Design Guidelines. Published by WDFW, Olympia, Washington.

Figure 3 - Bid Form
Day Slough Fish Passage Project

Contractor:

Spec.	Item	Qty	Unit	Unit Cost	Total Cost
1-09	Mobilization	1	LS	$5,800	$5,800
1-50	Surveying	1	LS	200	200
2-01	Clearing and Grubbing	1	LS	1,500	1,500
2-02	Remove & Dispose Existing Culverts (3)	1	LS	400	400
2-09	Structure Excavation & Stockpile	360	CY	20	7,200
2-09	Backfill & Compaction (native soils)	220	CY	25	5,500
2-09	On-site Dispose Unsuitable & Excess Soils	140	CY	10	1,400
2-15	Water Control	1	LS	1,500	1,500
6-02	Pre-Cast Concrete Class 4000 for Footings	5.9	CY	1,800	10,620
6-02	Pre-Cast Concrete Class 4000 for Backwalls	1.0	CY	2,000	2,000
6-03	Steel Bridge Fabrication & Supply	1	LS	58,000	58,000
6-03	Steel Bridge Placement & Assembly	1	LS	4,000	4,000
8-30	Wood Curbs (4 x 12s, bolts, labor)	1	LS	900	900
8-40	Erosion Control Seed	4	LB	20	80
8-50	Straw Mulch	8	BALE	20	160
9-03	Pea Gravel	15	TN	40	600
9-13	Large Rock for Rock Slopes (18" to 36"-size)	45	TN	40	1,800
Construction Subtotal (without sales tax):					$101,660
Washington State Sales Tax (@ 8.5%):					$8,641
Total Construction Cost (rounded):					$110,000

CY = cubic yard
LB = pound
LS = lump sum
TN = ton