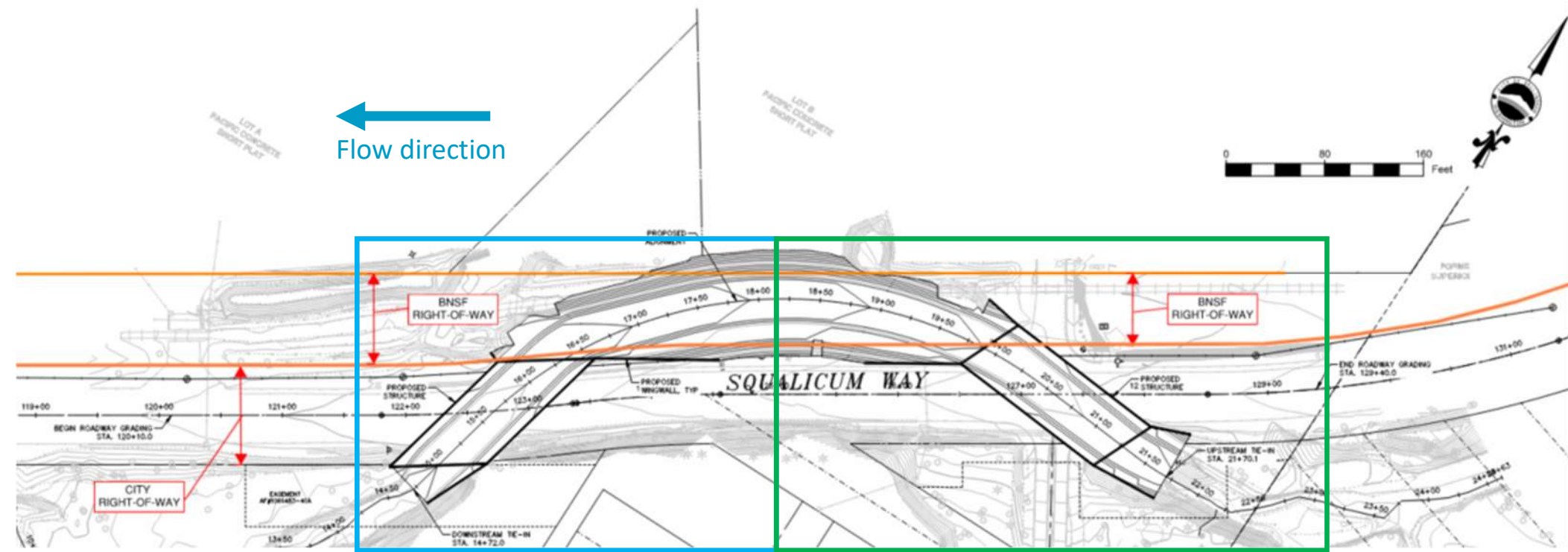


Proposed Alternative 1b - Overview

Osborn
Consulting



Replace existing barriers with fish passable structures, realign and restore channel between structures.

Conceptual Alternatives Analysis Matrix

Summary of Project	<p align="center">The City of Bellingham is planning to replace two fish passage barriers on the main stem of Squalicum Creek with fish passable structures. The two barriers are located beneath Squalicum Way and have been identified by the Washington Department of Fish and Wildlife (WDFW) as crossing IDs 811121 and 991105.</p>		
Alternatives	<p align="center">Alternative 1</p> <p>Remove and replace the existing barriers with fish passable structures, including limited channel regrades as needed to tie into the existing Squalicum Creek channel alignment and install the proposed fish-passable structures. The existing channel between the two crossings will be maintained in its current condition to the extent feasible.</p> <p>WDFW ID 991105 (upstream crossing) Remove and replace the existing WDFW ID 991105 structure along Squalicum Way with an 81-foot wide (measured along roadway centerline), 53-foot span (measured perpendicular to flow), 130-foot long structure that provides 3-foot of freeboard above the 100-year water surface elevation. The roadway profile of Squalicum Way in the vicinity of the crossing will be raised by 7 feet to meet freeboard requirements above the 100-year water surface elevation and City road design requirements.</p> <p>Regrade approximately 200-feet of Squalicum Creek stream channel, including 130 feet through the proposed structure and approximately 35-feet upstream and downstream to connect the existing upstream and downstream reaches. The proposed channel slope is 1.3%, with a channel cross-section representative of the existing conditions observed on-site. The alternative will include channel and floodplain restoration, including placement of large woody material (LWM) and other channel habitat features to mimic the existing conditions. The proposed structure was realigned to better tie into the existing stream alignment and to reduce bend scour.</p> <p>WDFW ID 811121 (downstream crossing) Remove and replace the existing WDFW ID 811121 structure along Squalicum Way with a 75-foot wide (measured along roadway centerline), 53-foot span (measured perpendicular to flow), 105-foot long structure that provides 3-feet of freeboard above the 100-year water surface elevation. The roadway profile of Squalicum Way in the vicinity of the crossing will be raised by 5 feet to meet freeboard requirements above the 100-year water surface elevation and City road design requirements.</p> <p>Regrade approximately 205-feet of Squalicum Creek stream channel, including 105 feet through the proposed structure and approximately 70-feet upstream and 30-feet downstream of the proposed structure to connect the existing upstream and downstream reaches. The proposed channel slope is 1.5% with a channel cross-section representative of the existing conditions observed on-site. The alternative will include limited channel and floodplain restoration including placement of LWM and other channel habitat features to mimic the existing conditions. The proposed stream is also realigned to better tie into the existing stream alignment upstream of the culvert providing a larger bend radii than the existing conditions prior to the culvert inlet.</p>	<p align="center">Alternative 1b</p> <p>Remove and replace the existing barriers with fish passable structures, regrade and restore approximately 356-feet of Squalicum Creek between the two barriers.</p> <p>WDFW ID 991105 (upstream crossing) Remove and replace the existing WDFW ID 991105 structure along Squalicum Way with an 88-foot wide (measured along roadway centerline), 53-foot span (measured perpendicular to flow), 136-foot long structure that provides 3-feet of freeboard above the 100-year water surface elevation. The roadway profile of Squalicum Way in the vicinity of the crossing will be raised by 4 feet to meet freeboard requirements above the 100-year water surface elevation and City road design requirements.</p> <p>WDFW ID 811121 (downstream crossing) Remove and replace the existing WDFW ID 811121 structure along Squalicum Way with an 83-foot wide (measured along roadway centerline), 53-foot span (measured perpendicular to flow), 122-foot long structure that provides 3-feet of freeboard above the 100-year water surface elevation. The roadway profile of Squalicum Way in the vicinity of the crossing will be raised by 5 feet to meet freeboard requirements above the 100-year water surface elevation and City road design requirements.</p> <p>Squalicum Creek Regrade Regrade approximately 700-feet of Squalicum Creek stream channel through both proposed structures including approximately 43-feet upstream of the proposed upstream crossing and approximately 20-feet downstream of the proposed downstream crossing to connect the existing upstream and downstream reaches at a continuous 1.0% slope using a channel cross-section representative of the existing conditions observed on-site. The alternative will include channel and floodplain restoration with placement of LWM and other channel habitat features to mimic the natural condition. The proposed stream alignment aligns flow reminiscent of the historical Squalicum Creek alignment. The proposed alignment provides a buffer between the existing riparian habitat in Willows Spring and the proposed stream channel.</p>	<p align="center">No-action Alternative</p> <p>Take No-action, leaving the existing fish passage barriers at WDFW ID 991105 and 811121 in place.</p>
Advantages	<ul style="list-style-type: none"> •Smaller disturbance footprint compared to Alternative 1b. •Lower earthwork volumes compared to Alternative 1b. •Provides fish passage by removing both existing barriers. •Less impact to existing vegetation compared to Alternative 1b. •Less construction impact and likely shorter construction duration compared to Alternative 1b. •Less complicated stream bypass and dewatering compared to Alternative 1b. •Less flood impact than No-action alternative. 	<ul style="list-style-type: none"> •Realigns Squalicum Creek to a more natural alignment, similar to historical conditions. •Provides restoration and habitat benefit to the channel between the two crossings. •Provides fish passage by removing both existing barriers. •Less roadway impacts compared to Alternative 1. •No channel constriction downstream of crossing ID 991105, an improvement compared to Alternative 1. •No backwater effects through proposed structures, an improvement compared to Alternative 1. •More hydraulic capacity within Squalicum Creek compared to Alternative 1 and No-action alternative . •Smaller flood inundation limit and impacts to surrounding properties and infrastructure compared to Alternative 1 and No-action alternative. •Provides buffer between Squalicum Way and Squalicum Creek, unlike the No-action alternative and Alternative 1. 	<p>No construction impacts to the Squalicum Creek corridor.</p>
Disadvantages	<ul style="list-style-type: none"> •Existing Squalicum Creek stream channel between the proposed crossings is maintained in a confined plane-bed configuration providing little habitat benefit to the system compared to Alternative 1b. • Less natural stream alignment compared to Alternative 1b. •Requires additional roadway raise to meet freeboard requirements compared to Alternative 1b. •Maintaining the existing channel between the proposed crossings constricts flow downstream of WDFW ID 99105. <ul style="list-style-type: none"> •Generates a backwater effect at the proposed upstream structure. •Potential for greater scour risk compared to Alternative 1b. •Potential for greater velocities compared to Alternative 1b. •Less hydraulic capacity within Squalicum Creek compared to Alternative 1b. •Larger flood inundation limits impacting surrounding infrastructure and property compared to Alternative 1b. •Does not provide a buffer to Squalicum Way, unlike Alternative 1b. 	<ul style="list-style-type: none"> •Larger disturbance limits compared to Alternative 1 and No-action alternative. •Larger earthwork volumes compared to Alternative 1 and No-action alternative. •Larger impact to existing vegetation compared to Alternative 1 and No-action alternative. •Larger construction impact, potential for longer construction duration compared to Alternative 1 and No-action alternative. •Potential for a more complicated stream bypass and dewatering compared to Alternative 1 and No-action alternative. •Potential need for bank armoring to protect Willows Spring. •Greater impact to BNSF property compared to No-action alternative and Alternative 1. 	<p>Existing fish passage barriers are left in place.</p>
Recommendation	RECOMMENDATION		