EXHIBIT 9.I: Stream Crossing/Baywatch Connection Technical Justification

September 16, 2026 Job No. 2090-004-022

Mr. Joshua M. Ranes
City of Poulsbo Engineering Department
200 NE Moe St
Poulsbo, WA 98370

RE: Technical Justification for Vertical Roadway Geometry Failures at Stream C Crossing (Pinnacle at Liberty Bay Preliminary Plat and Planned Residential Development) P-06-20-25-03

PURPOSE

The purpose of this letter is to provide City staff with a technical evaluation of the geometric and regulatory constraints associated with a proposed roadway crossing of Stream C (Barrantes Creek) extending from Baywatch Court NE. This narrative serves as a technical companion to the enclosed Engineering Exhibit (Figure 2), which maps the dimensional conflicts of this crossing.

ALTERNATE ROAD ALIGNMENT ANALYSIS

An analysis was conducted to determine whether an alternative roadway alignment could be provided along the west side of the project. Based on the existing parcel layout, built infrastructure, and adjacent critical areas, there are no available alternative access corridors to the property. The proposed location is the only viable access point to the project site.

Alternative Road Locations

As shown in Figure 1 – Alternative Access Locations Analysis, the west side of the project site is constrained by existing physical conditions.

Southern Boundary (SR 305 Frontage): Direct vehicular access to the south is not permitted due to state highway access control regulations along State Route 305.
Southwestern Boundary (Existing Infrastructure): The presence of an established detention pond creates an unbuildable constraint along the southwestern corner of the property.
Western Boundary (Built Environment): The western property line is bordered by an existing residential plat, leaving no practical opportunity to establish a new public right-of-way.
Sole road location: The existing Right-of-Way (ROW) stub at Baywatch Ct NE is the single point of connection. Because the stream channel runs parallel to this western boundary, any road extending from the ROW stub must cross the stream even before entering the project parcel.

Alignment Optimization at Existing ROW Stub

Because a stream crossing is necessary at the existing ROW stub, the alignment review focused on minimizing the vertical conflict at the crossing.

Intersection Angle Limit: City of Poulsbo Street Standards Section 2, Item 12 prohibits public streets from intersecting at angles of less than 60 degrees. To start the new road at the highest practical elevation, the proposed alignment uses this minimum 60-degree angle. Rather than connecting perpendicular to Baywatch Ct NE, the angled intersection moves the connection farther uphill. This provides more vertical room as the road extends into the ravine and helps maximize clearance over the stream.

Superelevated Road: The road cross-slope is intentionally superelevated (instead of a typical crown layout) to lift the north side of the roadway profile as high as possible, representing in effort to clear the crossing structure.

GEOMETRIC ANALYSIS OF CITY AND FIRE STANDARDS

Design Factors

The following criteria were used to evaluate the feasibility of a potential stream crossing road profile given the optimized road alignment.

Crossing Clearance Standard: Per the City's finding that Stream C is fish-bearing, the crossing must comply with WAC 220-660-190 and WDFW 2013 Guidelines. Because the stream channel is located within a confined ravine, the standard recommended clearance of 3.0 feet above the ordinary high-water mark (OHWM)/top of bank was assumed as the minimum required vertical clearance to the bottom of the crossing structure to safely accommodate debris and sediment transport.

Additionally, it is assumed that the crossing structure will be placed parallel to the longitudinal slope of the stream to maintain approximately 3 feet of freeboard across the full width of the channel. In other words, the top of the culvert is assumed to be sloped to minimize the overall crossing culvert height above the channel.

Maximum Grade: Per City of Poulsbo Construction Standards and Fire Standards, the maximum allowable grade for a road within the City is 12%.

Intersection Landing per King County Road Standard Figure 2-013. This City adopted King County figure establishes the geometric profile tolerances for intersection landings, requiring a flat approach zone extending 20 feet for residential streets from the major road's right-of-way line. Within this defined landing zone, the vertical profile is controlled to a 1-foot maximum variation from the finished grade to eliminate abrupt transitions before vehicles enter the primary travel way.

Fire Truck Considerations: Poulsbo E-One Pumper (Length: 30 feet, Width: 8.33 feet, Ground Clearance: 1.1 feet)

Fire Access Standards: Maximum Grade: 12%, Maximum Approach: 6%

Crossing Structure and Structural Cover: For this evaluation, we assumed a 12-foot-wide, low-profile bottomless arch culvert. The span allows the concrete footings to remain entirely outside the active channel and ordinary high water mark (OHWM), while clearing the stream banks and accommodating the channel's natural skew. A structural plate arch was selected because its low-profile shape reduces the depth needed between the stream and the roadway.

To support standard AASHTO HL-93 highway loading, the arch requires a minimum of 1.5 to 2.0 feet of structural cover and pavement above its crown. Keeping this cover to the minimum required depth helps maintain the lowest practical driving-surface elevation, which is necessary to stay within the 6.0% maximum approach grade for emergency fire apparatus.

Roadside Geometry. The road section used for the analysis is based on a Collector classification. This includes two 11-foot lanes, curb & gutter, parking, and sidewalk on both sides all within a 50-foot ROW. City staff have supported the idea of a reduced ROW to make the stream crossing more feasible. At a minimum, the section requires one sidewalk, curb and gutter, and two 11-foot travel lanes.

Guardrail and Wall Clearances: The vertical drop to the stream requires both a retaining wall and a guardrail. Approximately 6 feet of horizontal clearance is needed between the back of the sidewalk and the face of the retaining wall to accommodate the wall, guardrail, and the required 2- to 3-foot deflection zone for a W-beam guardrail system.

RESULTING ANALYSIS

This analysis demonstrates that a code-compliant roadway crossing over Stream C is likely a physical impossibility as depicted in the enclosed Figure 2.

To satisfy the fire engine's physical front bumper overhang constraints and limit the approach grade change to the max allowed of 6.0%, a minimum sag vertical curve length of 25.7 feet is necessary (K=1.31). The vertical curve has been placed such that it stays within the City's intersection landing criteria per the City's vertical curve criteria memo dated April 29, 2014.

While this profile prevents the emergency vehicle from bottoming out on paper, it triggers other physical and legal conflicts:

Inadequate Stream Clearance: As shown on the North Side of Road Profile on Figure 2, the incoming roadway profile along the north is forced down so low by the intersection landing constraints that the pavement surface sits almost on the top of the arch culvert.

Property Line & Retaining Wall Conflicts: The constrained topography necessitates an 8-to 10-foot retaining wall on the north side of the road. There is inadequate space (only 3 feet) to construct this retaining wall between the road and the neighbor's property line along parcel 5146-000-001-003. Constructing this wall would require grading encroachments and a temporary construction easement from the adjacent neighbor, which cannot be obtained. Furthermore, the required wall alignment conflicts with an existing gas main and other utilities in the adjacent utility easement.

Critical Area Disturbance: A roadway crossing in this location would still require a significant disturbance within the stream buffer. Even if vertical retaining walls were used to narrow the road footprint, the bridge or culvert, wall foundations, guardrail, and utility easements would all need room. In practical terms, a crossing that meets City and fire access standards would extend all the way through the protected 150-foot stream buffer and would impact the stream corridor.

CONCLUSION

As demonstrated by the attached exhibits, there is no apparent solution that satisfies the crossing clearances while also meeting City standards for road grade and emergency vehicle access. Incorporating the required retaining walls, guard rails, and dry utility easements further expands the disturbance footprint, causing direct conflicts with existing utilities and neighboring property lines that cannot be mitigated.

It has been determined that a roadway crossing at this location is technically and legally infeasible and will not be proposed as part of the Pinnacle at Liberty Bay development.

Respectfully,

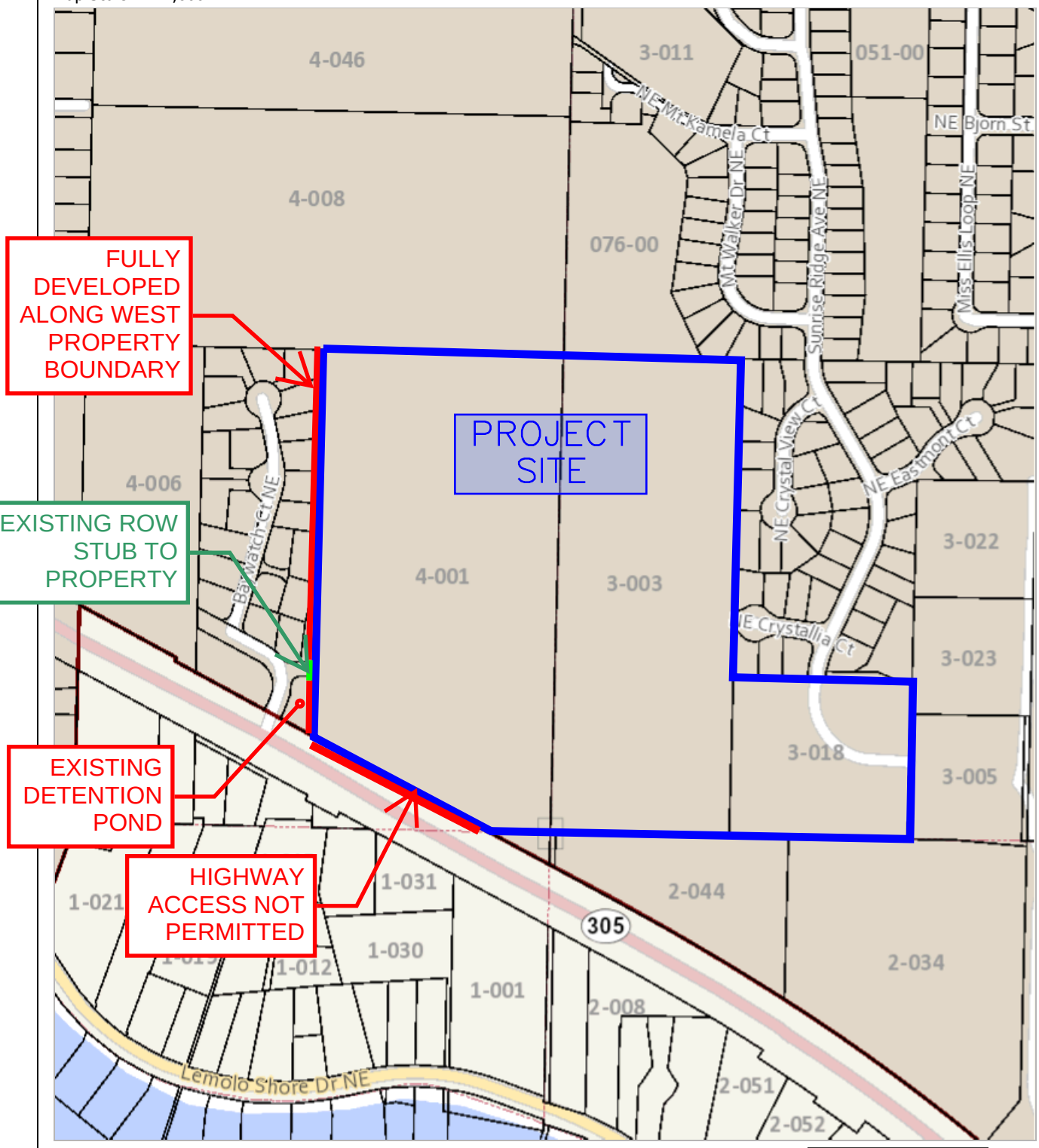
ESM CONSULTING ENGINEERS, LLC

BRANDON LOUCKS, P.E.
Project Manager

Encl. Figure 1, Figure 2
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Map Scale: 1 : 4,800

Printed: Sunday. Jul 19, 2026

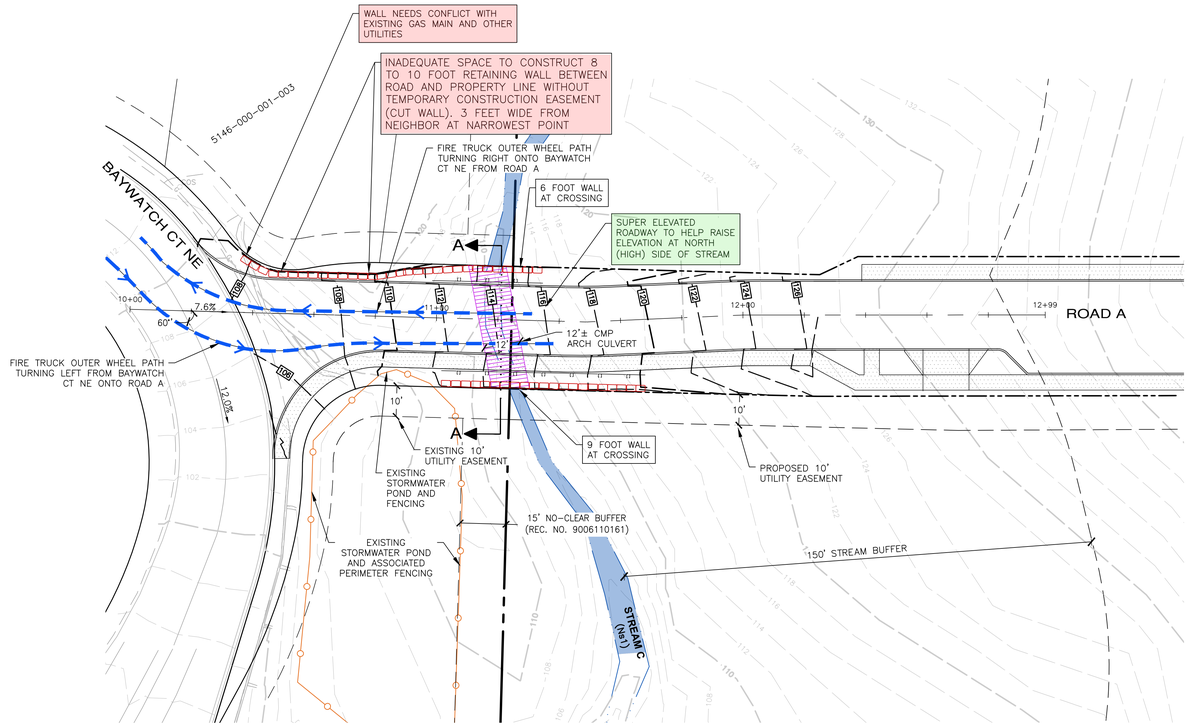


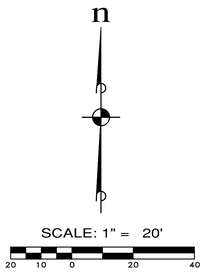
** This map is not a substitute for field survey **

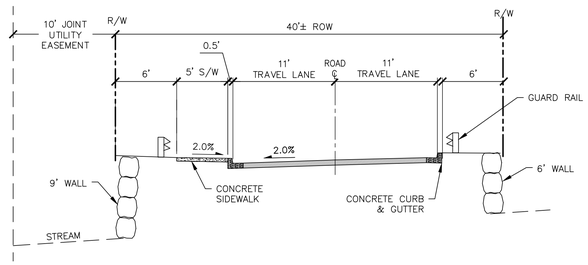
500 ft

FIGURE 1 - Alternative Access Locations Analysis

A PORTION OF THE SE 1/4 OF SEC 23, TWP 26 N, RGE 1 E, W.M.



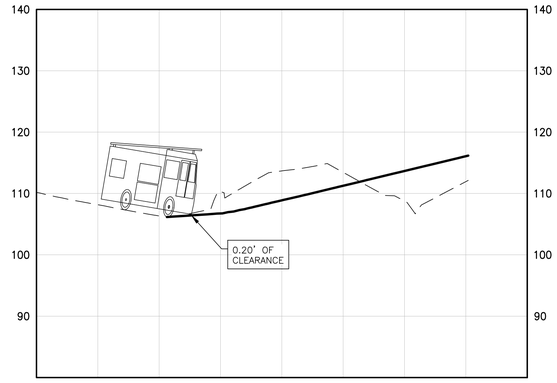




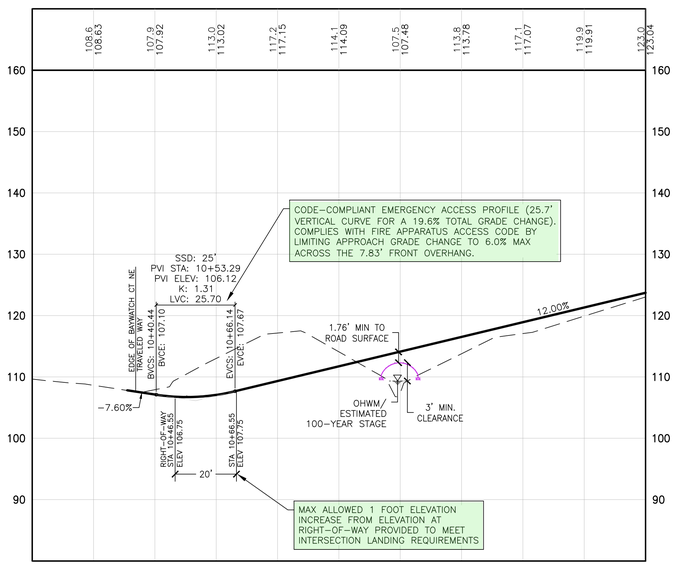
A-A ROAD SECTION AT STREAM
MODIFIED COLLECTOR
SCALE: 1"=6'

POULSBO EONE PUMPER

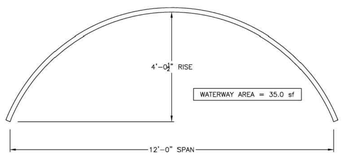
OVERALL LENGTH:	30 FEET
OVERALL WIDTH:	8.33 FEET
OVERALL BODY HEIGHT:	7.5 FEET
MIN GROUND CLEARANCE:	1.1 FEET



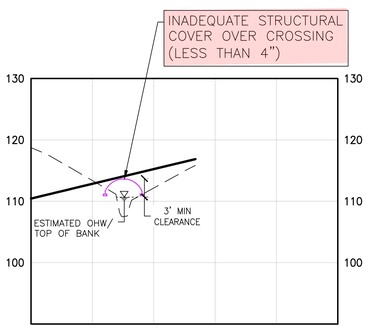
FIRE TRUCK OUTER WHEEL PATH TURNING LEFT FROM BAYWATCH CT NE ONTO ROAD A
SCALE: 1"=20' HORIZ. 1"=10' VERT.



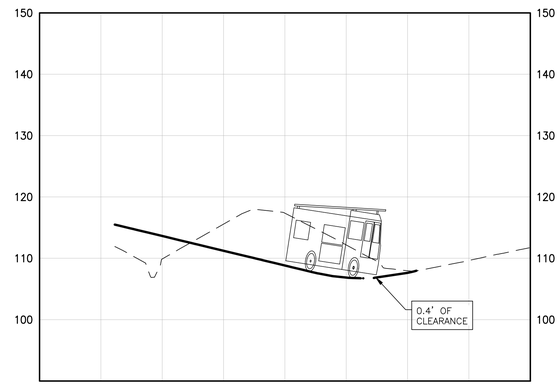
ROAD A
SCALE: 1"=20' HORIZ. 1"=10' VERT.



ESTIMATED CULVERT DIMENSIONS
SCALE: NTS



NORTH SIDE OF ROAD
SCALE: 1"=20' HORIZ. 1"=10' VERT.



FIRE TRUCK OUTER WHEEL PATH TURNING RIGHT ONTO BAYWATCH CT NE FROM ROAD A
SCALE: 1"=20' HORIZ. 1"=10' VERT.

REVISIONS		
NO.	DESCRIPTION/DATE	BY

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PINNACLE AT LIBERTY BAY SUBDIVISION

STREAM C & ROAD A CROSSING FEASIBILITY EXHIBIT

CITY OF POULSBO WASHINGTON

JOB NO.	2090-004-022
DWG. NAME	EN-35
DESIGNED BY:	
DRAWN BY:	DCL
CHECKED BY:	
DATE:	09/03/2026

EN-35

1 OF 1 SHEETS

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