Memorandum

DATE: February 23, 2022

TO: Fish Barrier Removal Board

FROM: Stephanie Sullivan, City of Sammamish

PROJECT: 45015.004, George Davis Creek Fish Passage and Stream Restoration Project

REGARDING: Fish Barrier Removal Board Technical Review Team (TRT) Review – Comment Responses

GENERAL REMARKS:

This Fish Passage Barrier Removal design grant should meet the criteria in Manual 22, specifically "Stream Simulation Design Option: This geomorphic approach involves building an artificial stream channel inside the culvert, which provides passage for any fish migrating through the reach. This option is assumed to be satisfactory for adult and juvenile fish passage and tends to be used more frequently at sites where juvenile fish passage is required" and comply with WAC 220-660-~~200~~190.

Response: The reach of George Davis Creek affected by this project is characterized by:

- Medium channel width, between 10- and 15-foot Bankfull width (BFW),
- Steep channel slope, greater than 3-percent,
- Low to medium floodplain utilization ratio (FUR), less than 3.0,
- Moderately stable channel,
- Moderately debris-prone, and
- Some to many site constraints.

In accordance with Chapter 1 of the Washington Department of Fish and Wildlife (WDFW) Water Crossing Design Guidelines (WCDG), these stream conditions indicate that the 'stream simulation design option' is best suited.

The kokanee salmon residing in Lake Sammamish are intended to be the primary beneficiary of this project. Primary spawning and juvenile rearing habitat for all resident and anadromous fish species is expected to be located farther upstream in the pristine ravine section of the creek. Juvenile fish passage through the lower reach of George Davis Creek is transitional and expected to be very temporal and

focused on out-migration after emergence from redds. Out-migrating juvenile kokanee will only be utilizing the steep lower reach as a migration corridor to quickly escape into Lake Sammamish. The project as designed will be amenable to all adult kokanee fish species passage upstream, and the lower section will provide critical holding habitat for spawning adults enroute to spawn in the upper sections of the creek.

Additionally, as discussed throughout this comment response document, the design team for this George Davis Creek Fish Passage and Stream Restoration project is contending with several opposing existing site conditions and constraints. By providing fish passage, restoring sediment flow regime and reconnecting the upper basin, the proposed design approach is striving to balance many fluvial, geomorphic, and habitat processes in order to produce the greatest possible ecological uplift to the George Davis Creek ecosystem.

TRT RESPONSE:

TRT recognizes that "kokanee salmon residing in Lake Sammamish are intended to be the primary beneficiary of this project" but as previously mentioned to meet the criteria in Manual 22, specifically "Stream Simulation Design Option: This geomorphic approach involves building an artificial stream channel inside the culvert, which provides passage for any fish migrating through the reach. This option is assumed to be satisfactory for adult and juvenile fish passage and tends to be used more frequently at sites where juvenile fish passage is required" and comply with WAC 220-660-190 for water crossing structures.

Additional considerations will be needed to ensure the proposed designs accommodates fish passage for fish at all life stages to pass through all aspects of this project. TRT is concerned that the proposed streambed sediment is over coarsened which has the potential of becoming a depth barrier for some fish passage at low flows. Please explore alternatives mixes more suitable for low flow passage. Additionally, based on the potential scour described in the draft hydraulic report a potential exists for a 4-side box culvert to become perched creating a fish passage barrier that would not be eligible for FBRB funds to replace or repair, and therefore TRT recommends a 3-side structure to allow for natural process for fish passage of all species and all life stages.

OVERALL DESIGN COMMENTS:

1. To understand the design elements of these plans we would like you to describe the constraints which may make it challenging to meet this guidance.

Response: George Davis Creek originates in the hills east of Lake Sammamish and drains to the lake, crossing East Lake Sammamish Parkway (ELSP), King County's East Lake Sammamish Regional Trail (ELSRT), and East Lake Sammamish Shore Lane NE (ELSSL) before discharging into the lake.

Currently, the creek is split upstream of ELSP at river station 14+25, at the existing sedimentation basin. Typical flows are directed toward the lake through a long series of culverts that daylights George Davis Creek under a lakefront home approximately 100 feet east of the Lake Sammamish shore. When high flows occur, flows are diverted through a bypass that discharges to the lake approximately 500 feet to the north.

This project addresses fish passage and habitat deficiencies along two portions of George Davis Creek by creating a new channel between ELSSL and the stream mouth at Lake Sammamish and upstream of ELSP, including replacing the stream crossing under ELSP.

The primary constraints that make meeting stream simulation guidance challenging are (1) available corridor width, (2) steep channel gradients, (3) an adjacent permitted restoration project, and (4) existing utilities.

Constraint 1: The available corridor width, from the upstream (undeveloped) gully to Lake Sammamish is only 35 to 50 feet wide, which is narrow for a stream with 10-feet BFW, a proposed channel profile with an average profile between 6 and 7 percent, and channel grading that requires excavation depths between 6 and 12 feet from existing ground to the proposed stream thalweg. The widest portion is between ELSSL and the lake, where the City purchased a private property to realign and daylight the creek. The existing home on this property will be demolished and a new streambed will be installed in its place. The proposed stream grading uses 2:1 horizontal-to-vertical bank slopes to match existing grades on either side of the corridor, while minimizing the size of retaining walls.

TRT Response:

TRT has concerns that the channel design and crossing will constrict flows and induce scour, impacting spawning and incubation. The 2:1 bank slope may erode which potentially may result in the proposed bank stabilization rockery to fall into the stream. TRT recommends a maximum side slope of 3:1 and using natural features for stabilization. Please provide additional details on how these slopes will be stabilized to minimize the potential for slope erosion. See comment 10 as well.

TRT recognizes that the City took the extraordinary steps to purchase a lakefront property to realign and daylight George Davis Creek. One solution that was suggest in the March 16th meeting to address the stream confinement through this narrow property was purchasing an additional parcel. Does the City think this is a viable option?

Constraint 2: The channel gradient between the gully and lake is steep, averaging 6 to 7%. At this gradient, the potential for vertical degradation is very high. Were the channel left to naturally degrade, adjacent slopes would become over- steepened and threaten adjacent structures and roadways.

TRT Response:

TRT would like a better understanding of the predicted scour including an estimate of the number of cubic yards which may degrade from the project reach. Does the design team predict downcutting will be caused by the channel shape or resulting from the water crossing structures? In the natural reach upstream, the channel does not appear very incised, which may indicate that the structure size is influencing the scour potential. We would like to review any scour analysis that has been completed to better understand potential vertical degradation. If degradation is indeed a concern, efforts to

restore natural channel roughness (i.e. LWM) are important in order to reduce adverse impacts to the channel as well as fish passage.

Constraint 3: King County has completed design and permitting for the two fish passage culverts underneath ELSSL and ELSRT that will replace two fish barriers. Both are proposed to be new four-sided concrete box culverts with fixed inlet/outlet design elevations that this project needs to accommodate.

TRT Response:

TRT recognizes that King County has obtained their HPA for the two downstream fish passage culvert replacements and that adjacent infrastructure are considered in these designs. TRT will continue to work with the design team to pursue these barrier removal projects that meet the requirements Manual 22 and WAC 220-660-190 with a goal to provide the most benefit to fish life as possible. TRT continues to express concern over the 4-sided structure, particularly if there is high potential for downstream degradation (as noted above). This could perch the outlet, creating a depth barrier to fish. A 3-sided structure allows the stream to act more naturally and better accommodate vertical adjustments. Please also see comment 3 below.

Constraint 4: The most problematic buried utility is an existing underground gravity sewer line immediately upstream of ELSP, which would be fully exposed if a straight grade was made from the existing sedimentation pond to the lake's ordinary high-water mark (OHWM). This sewer line can be relocated horizontally, but vertical adjustments are limited, restricting channel bottom elevation. Additionally, buried water and gas mains are shallow and can only be adjusted minimally due to pipeline pressure constraints, which restrict the top elevations of the stream crossing structure.

Discussions with the sewer, water, and natural gas providers have indicated that rerouting any of these utility structures outside of the project area is not viable. Therefore, the proposed culvert and channel profile needed to thread through all conflicting utilities, coupled with realigning the lines that could not be avoided.

The existing sanitary sewer gravity main intersects with the proposed stream alignment at the channel surface, and this line cannot be adjusted without causing sewer surcharges and unsanitary low-point conditions. The proposed design reroutes the line to the east, where it will be buried by approximately 3-feet of streambed sediment and cobbles. The culvert and the channel cannot be lowered without compromising protection of the realigned sewer main.

The existing water and natural gas mains intersect with lid of the proposed split- box culvert and are proposed to be realigned to the west where adequate utility cover depths can be achieved. The culvert top cannot be lowered since a shortened culvert opening would not meet WDFW requirements for minimum 2-feet of freeboard above the 100-year flood conditions.

From a utility standpoint, the proposed horizontal and vertical alignment of the culvert and channel is the sole option that satisfies all utility providers, while meeting all hydraulic, hydrologic, and geomorphic requirements.

TRT Response:

TRT recognizes these utility constraints. In the meeting on March 16, 2022 the design team mentioned that they will continue to explore options for moving the utility to provide for additional freeboard. Please provide any alternative designs which maximize freeboard for potential debris passage.

2. The average BFW provided in the Hydraulic Report, dated June 1st, 2020, is 10 ft. Martin Fox commented on 7/9/2021 "calculating the BFW using the WDFW regression (Barnard et al. 2013), we calculate a BFW of over 19 ft" and WDFW calculated up to 24 ft BFW using Stream Stats.

Please see Martin's full comment attached. The BFW measurements were taken in the reference reach upstream of the crossing in a confined ravine influenced by approximately 70 installed LWD structures. Other creeks nearby of similar basin size and gradient may provide a better reference to drive the design. TRT is concerned that designing a structure using the 10 ft. BFW may not accommodate potential sedimentation and predicted flows. Please help us understand how BFW measurements meet WAC 220-660-200 (3) (e).

Response: It's acknowledged that BFW measurement on George Davis Creek is challenging due to the steep setting and varying longitudinal channel conditions. For these same reasons, locating analogue reaches elsewhere would also be difficult. The following is our response to Martin Fox (10/28/2021) regarding his comment (1) on the WDFW BFW regression equation:

The difference between the field measurements and regression appears to stem from assumptions related to the contributing basin area. The regression does yield a BFW value of over 19-feet when using the basin area and mean annual precipitation generated from USGS StreamStats, i.e., 4.41 sq mi and 45.9 in, respectively. However, the actual contributing basin area to George Davis Ck appears to be much smaller. The total basin area, according to the County HSPF model, is closer to 2.7 sq mi, and doesn't consider infiltration that occurs into outwash deposits over much of the upper plateau. NHC (2020) concluded the basin area contributing to surface flow is closer to 0.7 sq mi, i.e., the portion of the basin immediately adjacent to the creek (see Section 3.1, page 15, paragraph 3). This assumption was supported by observations made during the 2019/20 flood season. Using a basin area of 0.7 sq mi. in the WDFW regression equation yields a BFW of 8.4 feet, which is very similar to field observations (8-12 feet, Table 5). For reference, the computed BFW, with a 2.7 sq mi basin, is approx. 15.3 feet, i.e., slightly larger than the widest measured BFW. It's also worth noting the current plans show a culvert width of 17 ft; back calculating from the Barnard et al. (2013) regression relation, this yields a BFW of 13 ft. Given the field measurements, basin area assumptions, and upsized culvert design width, we are confident in the BFW estimates and sizing of the structure.

The hydrologic setting and soils conditions of nearby tributaries to Lake Sammamish do not compare well with George Davis Creek, limiting their usefulness for cross-checking design values. For the sake of comparison, Ebright Creek, which drains 1.2 basin square miles, was estimated to have an 8.6-foot BFW based on an average of field measurements. Zackuse Creek, which drains 0.4 basin square miles, was estimated to have an 8-foot BFW. Despite the varying hydrology between these three creeks, estimated BFW appears to be relatively consistent among these Lake Sammamish tributaries.

TRT Response:

TRT recognizes that the BFW measurements taken by the design team as well as TRT were found to average 11 feet and 12.4 feet respectively. Martin Fox has voiced concerns that the ravine may not be representative of the downstream project area which is much less confined and using BFW averages to size the structure may result in an undersized structure. TRT recommends increasing the BFW throughout the relocated stream reach and within the structure. Additionally, the design team is encouraged to explore incorporating diversity of channel widths to more readily mimic nature.

3. The structure type identified for E Lake Sammamish Pkwy is a "47 ft x 17 ft x 10 ft split box culvert." It is the preference of FBRB as well as WDFW Water Crossing Design Guidelines to first consider abandonment, which is not an option, then a bridge when replacing a fish passage barrier. The Correction Analysis Form uploaded to PRISM provides two alternatives neither of which explore a 3-sided structure or bridge. Please describe why you feel a 47 ft x 17 ft x 10 ft split box culvert will accommodate potential sedimentation, scour, and predicted flows, and why a 3-sided structure or bridge have not been considered.

Response: We understand WDFW's preference for a bridge or three-sided culvert, but through the alternatives analysis, a four-sided box culvert was selected as the most appropriate option. The results of this analysis informed the City's grant application and included the selected culvert type in the project agreement based on the constraints of the project and site conditions.

According to the WDFW WCDG document, installing a bridge stream crossing is best for traversing wide channels greater than 15' wide, while George Davis Creek (GDC) falls under medium-width channel, for which a culvert is most applicable. Additionally, the floodplain utilization ratio (FUR) is very close to 1.0 for the portion of the creek along the reach conveyed by the culvert, for which the WCDG designates a stream simulation culvert as the proper crossing type. Also, the steep grade of this stream combined with velocities not sufficient to mobilize large woody material makes George Davis Creek moderately debris prone, for which the WCDG identifies stream simulation culvert as well-suited. Similarly, channel slope, channel stability, and channel constraint factors add to the concurrence that a stream simulation culvert is equally desirable to a bridge, if not more so.

Geotechnical and structural engineering analyses indicated that a three-sided culvert was prone to differential settlement, reducing the design life of the culvert and posing structural risk to the ELSP roadway. Due to the importance of ELSP for regional transportation connections, the City prefers the greater certainty provided by a box culvert.

Multiple underground utilities exist along ELSP and pose conflicts and are critical distribution lines. A four-sided culvert provides additional protection and longevity, especially during a code-based seismic event.

The proposed four-sided box culvert design includes countersinking with streambed cobbles and sediment, which will protect the base slab from exposure to a possible extreme scour situation.

Note that King County has completed design and permitting for a 17-foot-wide split box culvert, with concrete bottom, for the stream crossings underneath ELSRT and ELSSL. The possible benefit from a bottomless structure underneath ELSP is effectively negated when four-sided structures are immediately downstream.

TRT Response:

We recognize that this structure meets the minimum requirements for stream simulation, but the TRT requests to review the geotechnical report to better understand the potential differential settlement.

In the March 16, 2022 meeting Martin Fox pointed out that the George Davis Creek basin is delineated by USGS StreamStats to be nearly 4.5 sq. miles, a lot of flow is infiltrated in to the glacial till, and that the Stream Simulation formula will generally only pass a 10-yr flood before the culvert walls begin to constrict flow. Additionally, the reference reach which was used to calculate the minimum hydraulic opening is a narrow canyon and may not be an appropriate reference reach to design the structure opening. As noted in the hydraulic report the channel morphology at the ELSP crossing is mapped as an alluvial fan which historically would allow for lateral channel migration and experience increased sediment deposition compared to the relatively undisturbed upland ravine used as the reference reach.

TRT continues to be concerned that the structure size selected may be too small to accommodate the potential debris loading and pass LWM. The proposed crossing structures along with the two downstream structures will be act as grade breaks from the relatively natural upstream reach. The ELSP crossing will be the first gradient change and as a result TRT is concerned that when the stream experiences high flow yields during big rain events large amounts of debris are likely to aggregate at this crossing and therefore the ELSP crossing warrants a more resilient structure despite smaller crossing planned downstream. TRT suggest modeling a 3-side 19 ft crossing which may more readily manage potential lateral and vertical adjustments.

In addition, the diversion dam which is proposed to be removed is holding back a lot of sediment. TRT is interested in reviewing any available sediment budget analysis to further inform the appropriateness of the structure size.

3a. This stream has “excessive sediment loading” which required a high flow bypass and sediment basin to be installed upstream of the E Lake Sammamish Pkwy crossing. Annual maintenance is required to remove 60-120 cubic yards per year and the Area Habitat Biologist has issued HPA permits to remove even larger volumes.

Response: The following is our response to Martin Fox (10/28/2021) regarding his comment (13) on sediment transport and deposition:

The creek does have a high sediment load; however, past and current sedimentation at ELSP is controlled by the current crossing structure. Under proposed conditions, excessive deposition is not expected as the creek is intended to maintain a relatively uniform slope of 6 to 7% (see plan profile), and at this gradient, the full project segment (ELSP to Lake Sammamish) will mainly function as a transport reach with some retention of alluvium around large woody material (LWM). Transported sediment will deposit at the creek-lake interface to form the delta.

Hydraulic modeling shows the similarly sized ELSSL, ELSRT, and ELSP crossings are not anticipated to constrict hydraulics that could result in excessive deposition. This is what happened at Zackuse Creek; the downstream ELSSL crossing there is much lower than the upstream ELSRT and ELSP crossings, and likely contributed to the upstream sedimentation observed there post-project. Zackuse Creek is also lower gradient (approximately 2 to 3%), thus more prone to deposition.

TRT Response:

As previously stated TRT would like to review any scour and sediment budget analysis the design team has modeled to better understand potential vertical streambed adjustments through the structure. The design objective is to not continue to manage sediment in the current manner, as it is impactful to salmon in numerous ways.

4. The Hydraulic Report recommends each structure to be buried a minimum of 4 feet to "provide for allowable vertical channel adjustment." In addition, the report states the potential for "rapid incision through alluvial deposits of 5 to 10 feet in the vicinity of ELSP and upwards of 20 feet upstream near the ravine outlet and possible formation of headcuts." We are concerned that the proposed culvert may scour to the concrete which could result in future impairment of fish passage.

Response: The following is our response to Martin Fox (10/28/2021) regarding his comment (4) on justification for 4 feet of burial: The 4-ft depth was determined using a combination of Barnard et al. (2013) culvert burial recommendations, utility crossings, and consideration of allowable profile adjustment (reach-average scour). Local scour (e.g. HEC-18) is not directly applicable as the 17-ft wide culverts do not constrict flow through the corridor. Plunge scour is more applicable but difficult to predict accurately. Effectively, the dual surface and subgrade streambed gradation is intended to limit scour and the possibility of exposing the culvert bottom. The proposed subgrade (1- and 2-man boulders) is intended to withstand scour up to the 100-yr discharge. Following conversation with M. Fox on 7/15/21, it was agreed the culvert height would be increased to provide an additional 1-ft of burial.

TRT Response:

TRT encourages the design team to continue to explore options to increase the culvert height. We also understand the limitations due to the road height, private property encroachment, etc. However, the risk for the development of a fish barrier is increased with a 4-sided structure as well as the effort to armor the culvert bottom. With a bridge or 3-sided crossing, the bed will have vertical mobility and subsequent lower risk of developing a vertical drop. It is the goal for FBRB projects to be designed in a manner that minimizes the likelihood for future corrections resulting from design problems and requiring mitigation for any temporal delay, should an adverse condition develop. These corrections could not be funded through FBRB.

4a. TRT would like additional information how the proposed structure addresses these variables and why a 3-sided structure is not being considered.

Response: See response to Comment 3 above.

TRT Response:

TRT acknowledges the limitations and appreciates the thorough explanation in the above comments. Please see TRT responses to constraint 3 and comments 4 above.

5. The structure crossing East Lake Sammamish Shore Lane NE changed from slab bridge cast-in-place deck w/ 18' opening shown in the 30% plan set to precast split box culvert w/ 17' opening. Please explain why the design was changed.

Response: Not applicable. The stream crossing design at ELSSL is a King County project, and the design change is under the purview of County designers.

TRT Response:

Thank you for the clarification.

6. Please provide an updated cross-section for each proposed structure labeled with OHW, 2- yr., and 100- yr. water surface elevations.

Response: Acknowledged. These elevations and more detailed depths of streambed materials and meander bars will be included to be added to culvert construction detail in the forthcoming 90% plan set.

TRT Response:

TRT looks forward to reviewing the forthcoming cross-sections.

7. The hydraulic report states "approximately 1.5 to 1.9 feet of clearance (freeboard) between the computed 100-year water surface elevation and culvert crowns. This is less than the 2 feet recommended for debris clearance in streams with bankfull widths ranging from 8 to 15 feet." Please explore ways to increase the freeboard given the history of sedimentation at this site.

Response: This comment is based on the review of a previous version of the report. The current design for the ELSP stream crossing provides for internal culvert freeboard of 2.2-feet at the downstream end to 2.4-feet at the upstream end. Additionally, the following is our response to Martin Fox (10/28/2021) regarding his comment (4) on clearance and sedimentation: Hydraulic modeling, using a high channel 'n' value (0.2), also indicates the upstream freeboard at ELSP and ELSSL are greater than 2 feet and therefore meets Barnard et al. (2013) standards for this size creek. The slightly lower clearances (1.5 feet) occur at the downstream ends of the crossings and would not be expected to be as critical as the structure entrances. As such, the wording in the report regarding the minimum hydraulic clearances is a partial misstatement and will be corrected. Because the creek is not large enough to transport LWM downstream very far and sediment deposition potential is limited, we are confident the existing freeboard is adequate.

TRT Response:

Please note that freeboard is measured at the lowest elevation between the soffit and 100-yr water surface elevation. If the "slightly lower clearances (1.5 feet) occur at the downstream ends of the crossings" is a correct statement, then the recommended 2 feet of freeboard is not being met. Please clarify the minimum freeboard clearance. In addition, TRT recommends exploring options to increase

the clearance for debris and LWM passage in case of larger than expected volumes of sediment being transported downstream and aggregating within the structure.

8. Please provide a cross-section of the creek mouth with LWD and rockery labeled with mean high and low lake levels, OHW, 2- yr., and 100- yr. water surface elevations.

Response: Acknowledged. Will be reflected in the forthcoming 90% plan set.

TRT Response:

TRT looks forward to reviewing the forthcoming cross-sections.

9. Please provide a cross-section of the relocated channel showing the channel shape, side slopes, and bank armoring labeled with OHW, 2- yr., and 100- yr. water surface elevations.

Response: Acknowledged. Will be provided for multiple stream cross sections throughout restoration reach. Will be reflected in the forthcoming 90% plan set.

TRT Response:

TRT looks forward to reviewing the forthcoming cross-sections.

10. The 30% plan set showed hard armoring at the mouth of the creek, but the 60% plans show hard armoring along both sides along the entire relocated creek, between the structures, and extending beyond ELSP. The TRT are concerned that hard armoring beyond the mouth of the creek may exasperate scour and not allow for natural alluvial functions. Please explain the reason for the change to the plans sets and the function of this rock, as well as how the designs plan to incorporate natural materials laid out in WAC 220-660-130 (4) (b) (vi).

Response: The rock symbols in 60% plans are not hard armoring of the channel, but rather reflect rockery walls that are necessary to protect existing building structures adjacent to the property boundaries at the east end near ELSSL. No hard structures will be placed beyond the mouth of the creek. Due to the narrow corridor available for channel improvements within the parcel downstream of ELSP, as well as between NE 7th Court and the adjacent residential property upstream of ELSP, the proposed stream design uses 2:1 embankment bank slope to the greatest extent possible to keep grading within the property limits. This grading meets the edge of the available corridor, creating a cut face at both the north and south sides, and rockeries (rock walls) are designed to make up the elevation differential where necessary to reduce the risk to adjacent property owners as the creek shifts laterally in the new channel. Additional, cross-sections of the stream in this reach will be included in the 90% plan set to clarify the design intent.

It should be noted that to provide a natural channel straightening out the creek from its crossing under ELSSL, the City took the extraordinary step of purchasing a lakefront property.

Existing topography north and south of the City's parcel at the west end, near the creek mouth, do not appear to require rockery support walls. The stream reach will act as a depositional area and, due to the volume of sediment transported by this creek, the armoring will be buried by soil fines. Hydraulic modeling indicates that natural alluvial functions will be provided by the streambed design, and the proposed rockery walls are intended to facilitate this function while minimizing property risk and liability.

TRT Response:

Thank you for the clarification on the rockery placement. The TRT agrees that purchasing this downstream property was an extraordinary effort and wants to see this reach utilized to the greatest extent possible for the benefit of all fish life by providing fish passage to the upstream structures. TRT understands the physical limitation to the available corridor for the stream relocation and recognizes that natural bank processes are essential for the ecological health of the stream. Per WAC 220-660-130 (4)(b)(vi) stream bank protection designs should "use natural materials whenever feasible, including large wood and vegetation." The 2:1 bank slopes described are erodible which potentially may result in the proposed bank stabilization rockery to fall into the stream, or at least increase scour to the channel in the interim. Please explore options for using natural materials to increase bank stability and provide corresponding plans with cross-sections labeled with OHW, 2- yr., and 100- yr. water surface elevations. Additionally, TRT recommends the maximum steepness of side slopes to be 3:1 to reduce scour potential. Please see response to constraint 1 above.

11. Page 29 of 54 construction plan note 15 "rockery wall see sheet C-701 for detail" but C-701 does not show the detail for this rockery. It appears that these details may be on page C-708 and C- 709. Please clarify the correct detail for the rockery wall.

Response: Acknowledged. More detailed rockery cross sections will be included in the 90% plan set.

TRT Response:

TRT looks forward to reviewing the rockery cross-sections once they become available.

12. Page 24 of 54 construction plan note 2 states "install precast concrete wingwall per detail" it is

unclear from the detail on sheets C-701 and C-703 if these wing walls are intended to function as retaining walls. In addition, the wingwalls at the inlet of the ELSP structure appear to be parallel to the stream with the potential for the stream to be touching both walls. Please provide additional information explaining the need for these walls and explore options to eliminate this hard armoring.

Response: The concrete wingwalls mentioned are the proposed soldier pile/concrete fascia wingwalls and are for retaining purposes. The walls at the west end of the culvert are intended to support the ELSP road prism, since the proposed hydraulic design channel and streambed design has resulted in a much greater elevation differential of approximately 10 feet between the channel grade near 54-foot elevation and edge of roadway near 64-foot elevation.

The soldier pile/concrete fascia wingwalls east of ELSP are necessary due to the limited width available for the stream channel. NE 7th Court abuts the creek to the north, and, like above, the drop in channel grade versus existing conditions requires a retaining wall until simple bank grading can be utilized. A private property immediately to the south necessitates this retaining wall to protect the structural stability of the on-site residence and alternative dwelling unit (ADU) buildings.

These adjacent conditions are fixed, and armoring cannot be completely removed without greatly steepening the downstream channel to provide shallow streambed at the east end of the new channel and immediately east of ELSP. Finally, King County's culvert and trail projects between the new channel and ELSP have been designed and permitted, so the City's proposed retaining walls are necessary to match the County's proposed improvements.

TRT Response:

TRT recognizes that King County has obtained their HPA for the two downstream fish passage culvert replacements and that adjacent infrastructure needs to be considered in these designs. These design elements may be necessary for the protection of infrastructure and TRT will work with the design team to help shape these aspects of the project to provide for the most benefit to fish life as possible. Per WAC 220-660-130 (4) (b) (vi) stream bank protection designs should "use natural materials whenever feasible, including large wood and vegetation".

The plan views of the inlet to the ELSP show the channel constricting within the structure relative to the concrete wing walls immediately upstream. This will result in increased velocities through the structure. TRT encourages widening the structure width to match the upstream wingwall widths. Please provide cross-sections of the wing walls labeled with OHW, 2- and 100- year water surface elevations to enable TRT a better understanding when the steam will engage with the wing walls.

Additionally, the use of heavily engineered materials to harden stream and bank features will likely increase scour downstream, potentially resulting in a fish passage impediment. Therefore, we need a robust monitoring and contingency plan to address these impairments in a timely manner. Please note that if this were a FBRB restoration grant, only the aspects of the project that are directly connected to fish passage are eligible for funding or to be used as match.

13. Page 24 of 54 shows the stream channel narrowing between the two structures of the Lake Sammamish Trail and ELSP. Please explain the reason for this narrow section of stream.

Response: Acknowledged. This was a visual discrepancy and will be corrected in the 90% plan set.

TRT Response:

Thank you for the clarification.

14. Page 25 of 54 construction plan note 6 states "Install rockery per detail. See sheet C-708. Height varies from 1.01-4.5'." Please clarify the intended functionality of the walls, provide the heights and include them in the channel cross-section.

Response: See response to Comment 10 above. Rockeries are to address elevation differential at the property lines when channel banks are graded at 2:1 slope. The 90% design will include rock wall profiles and details and the rockeries will be included in the channel cross-sections.

TRT Response:

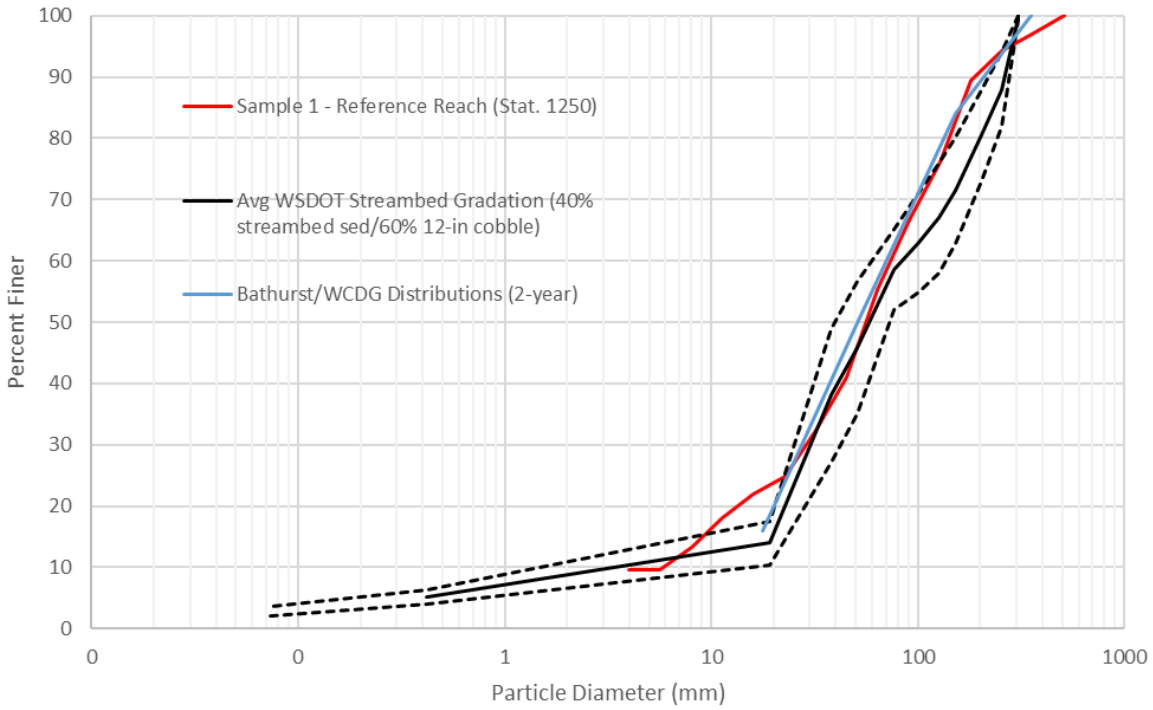
Thank you, please see TRT response to comment 10 above.

15. The Hydraulic report identifies the pebble count from reference reach as a "well-graded mixture" with a D50 of 54 mm or 2.1 inches. WAC 220-660-190 (6)(a)(vi) states "The median particle size of sediment placed inside the stream-simulation culvert must be approximately twenty percent of the median particle size found in a reference reach of the same stream." The proposed sediment mix 1 "three parts 12 inch" cobbles mixed with two parts streambed sediments". Please provide the gradation curve identifying the D16, D50, D84, D100 confirming the proposed mix meets twenty percent of the median particle size found in the reference reach.

Response: This coarse subgrade mix is proposed along the entirety of the lower project reach, not just the culvert crossings, to prevent excessive incision. Finer WSDOT-specified streambed material will be washed into the coarse subgrade layer to seal the bed and prevent subsurface flow. Gradation curve and characteristic grain sizes of the mix are provided below:

Characteristic Grain Diameter	Reference Reach	Proposed Surface Mix #1
D100	20″ (512 mm)	12″ (305 mm)
D90	7.1″ (180 mm)	10″ (254 mm)
D84	6.8″ (165 mm)	9″ (225 mm)
D50*	2.1″ (54 mm)	2.3″ (58 mm)
D16	0.4″ (11 mm)	0.7″ (18 mm)

* +/- 20-percent of D50 is 1.7″ to 2.5″ diameter



TRT Response:

Thank you for providing the sediment mix gradation.

16. The Hydraulic report identifies the pebble count from reference reach as a "well-graded mixture" with a D50 of 54 mm or 2.1 inches. TRT is concerned that this mix #1 has been coarsened relative to natural conditions and may resist mobility in some reaches, not allowing natural stream processes described in WAC 220-660-190 (2) (a), and therefore would not meet the guidelines laid out for a FBRB grant. Please provide the reasons for coarsening the mix and at which flows these sediments will mobilize.

Response: Only the subgrade (subsurface) material is sized to be stable up to the 100-year to prevent excessive channel incision and exposure of the culvert bottom. The bed material placed on the surface, with a 2-foot depth, will be more mobile, similar to natural reaches, and allowed to adjust. Therefore, the upper end of size fractions (>D50) is coarsened to provide framework materials intended to sort under moderate to higher flows (>2-year) and provide a matrix to assist natural step-pool formation among LWM features. The lower end of the mixture (<D50) is expected to be mobilized at lower, more frequent annual flows.

The goal is to provide a top 2 feet of streambed that will constitute a dynamic surface layer with particles coarse enough to form in-channel roughness features, which could assist in trapping smaller sediment transported from upstream. It is anticipated that this 'active' layer will allow for some geomorphic adjustment. LWM will help retain sediment and maintain overall slope. Sediment that is eroded will likely be replenished by material transport from the upstream ravine (that is, materials that are currently captured by the sedimentation pond at ELSP).

A secondary goal is constructability, that is, avoiding overly complex grading plans with multiple sediment gradations. That said, grading of pre-formed pool features will be considered in development of the 90% design.

The following is our response to Martin Fox (10/28/2021) regarding his comment (10) on the subgrade mix:

Only the subgrade (sub-surface) material is sized to be stable up to the 100-year to prevent excessive channel incision and exposure of the culvert bottom. The bed material placed on the surface, with a 2-ft depth, will be more mobile, similar to natural reaches, and allowed to adjust. It is anticipated that the top 2-ft of streambed will constitute an 'active' layer that allows for some geomorphic adjustment. LWM will help retain sediment and maintain overall slope. That sediment which is eroded will likely be replenished by material transport from the upstream ravine (i.e., materials that are currently captured by the sedimentation pond at ELSP).

It should be noted that hydraulic modeling indicates the proposed 17-ft wide crossing is not constricting the channel or impeding anticipated streambed mobility.

TRT Response:

Concerns still exit that the 12" sediment mix is overly coarse and may become a low flow depth barrier. In the meeting on March 16, 2022 the design team stated that "10-inch sediments are stable at 100-year" please confirm this metric as it seems to contradict the statement above "only the subgrade (sub-surface) material is sized to be stable up to the 100-year." TRT encourages considering adjusting the sediment mix to a less coarse mix and increasing the thickness of this layer. Please note, the central tenet of Stream Simulation is to mimic conditions through the crossing as found in the natural adjacent channel. It appears this effort to over-coarsen the bed is counter to the natural process of natural bedload routing.

17. The 60% plan set identify streambed mix #2 as a 1:1 mix of 1-man to 2-man boulders with streambed sediment. TRT is concerned that due to the confined nature of the stream and the high likelihood of scour, section B-B on page 36 of 54 which shows a minimum of 1.5' of streambed mix 1 that streambed mix #2 could be exposed and may pose future fish passage issues, additional maintenance needs, and a potential for subsurface flows. The natural stream most likely does not have a subgrade of this size. TRT recommends using a less coarse mix to ensure continued fish passage for the life of the structure to meet FBRB grant guidelines. Please provide reasoning for this mix.

Response: See response to Comment 16. Additionally, the 12-inch cobble component to the surface mix is intended to function as the 'framework' material observed in the reference reach. The D50 of this mix is nearly identical to that sampled (see Figure 12). As noted above (response to comment 10) it is anticipated that finer portions of this mix can be eroded but will be replenished from upstream sources.

Furthermore, the coarse component is relatively small, with only about 10% in the 8" to 12" (250 to 300 mm) range. Material in this size range is at the upper end of what would be transportable during typical high flows.

Exposure of Mix #2 material under high flows would likely be temporary and not inherently create a fish passage barrier. Local scour would create pools in areas of concentrated flow and likely be replenished by upstream sediment sources elsewhere. The final design of the project will include a multi-year monitoring and adaptive management of the stream restoration work that will regularly assess the condition of Streambed Mix #1 from year to year. Some local scour and natural geomorphologic processes are expected, and the stream adjustments will be documented and shared with the permitting agencies as part of the stream monitoring plan

The following is our response to Martin Fox (10/28/2021) regarding his comment (10) on the subgrade mix:

This coarse subgrade mix is proposed along the entirety of the lower project reach, not just the culvert crossings, to prevent excessive incision. Finer WSDOT streambed material will be washed into the coarse subgrade layer to seal the bed and prevent subsurface flow. Alternatives to the continuous subgrade mix can be considered, e.g., use of buried grade control, in development of the 90-percent design.

TRT Response:

The use of the coarse subgrade mix #2 suggest a need to overengineer the entirety of the lower project reach and crossing to prevent lateral and vertical migration. This prevents natural stream processes and suggests that the proposed structure is undersized.

In the March 16, 2022 meeting the design team indicated that they are no longer pursuing mix #2 1:1 mix of 1-man to 2-man boulders, instead designing the subsurface bed with buried coarse bands. Please provide plans indicating the thickness of mix #1 and locations and specifications of the proposed buried coarse bands including a cross-section. TRT encourages the use of buried wood to achieve the coarse bands.

18. Page 34 of 54 Section A-A Precast Split Box Culvert plan view identifies “one-man boulder barbs” to be used for stream meander. Meander bars should be deformable over time. TRT is concerned that one-man boulders buried at 50% will not be deformable.

Response: The boulder barbs are intended to help maintain a defined low flow channel by discouraging plain bed formation as well as prevent the channel from becoming entrained against the side of the culvert for long distances. Construction of deformable ‘bars’ will not likely persist within the culvert because culvert walls do not have the roughness, which help to form bars, that natural banks do. Further, the incoming sediment load is likely too fine to form natural bars at this slope. The proposed barbs will still be somewhat deformable as adjacent streambed sediment is eroded and boulders shift.

TRT Response:

TRT encourages the use of wood within the structure to act as forcing features to help maintain a defined low flow channel and to discourage entrainment and plain bed formation. Boulder barbs aka meander bars may not be appropriate for a stream this steep. We also note that barbs have failed in other projects (e.g. Ebright Cr.), and the coarse material is cast over the bed downstream. This will likely also fail in time, and in the interim, will constrict flows through the crossing and create velocity

impediments for fish passage. We recommend using wood to form these features that discourage thalweg formation along the culvert walls and maintain fish passage during low flows.

19. The LWM layout on the plans show many pieces that are perpendicular to the banks. When LWM is placed like this they have the potential to act more like a weir than a habitat feature. TRT recommends more diversity in the lateral and vertical positioning of the LWM placement and structure sizes, which would allow them to be engaged at a diversity of flows to maximize their habitat benefits. The TRT also suggests placing the wood pieces into the thalweg to allow them to interact with all flows, providing more fish and riparian benefits. Please see Martin Fox's comment on 7/9/2021 for additional LWM layout recommendations.

Response: The densely spaced wood at the mouth is intended to prevent headcutting over the short term. Over the longer term, as the delta grows, aggradation of 1 to 3 feet could be expected along the lower 40 feet of the creek. Partial wood burial is expected and would allow for some local lateral channel migration within the property at 635 ELSSL (King County parcel 0777100040).

WSDOT v.4 spreadsheet will be used to confirm wood metrics and included in the report.

The following is our response to Martin Fox (10/28/2021) regarding his comment (15) on LWM layout:

Wood layout will be diversified in 90% design; however, specific placement (wholly instream or jams) will need to consider risks to adjacent landowners, property, and infrastructure.

TRT Response:

In the meeting on March 16, 2022 the design team presented the target LWM number of pieces and volume. TRT recognized that in small streams it may be challenging to meet the Fox and Bolton targets, but we encourage increasing the volume metric by using larger diameter pieces with rootwads that engage with the thalweg and will sustain a 25-year flood. TRT recognizes that some ballasting may be necessary but recommends using larger LWM that self ballasts or pinning pieces between existing trees. This would accommodate some LWM adjustment at the 100-year event. Martin Fox commented that if the wood cannot adjust at the 100-year event it is analogous to using large rock.

Martin also noted that at least 25% of the LWM pieces are recommended to be wholly within the low flow channel to benefit fish habitat. He suggested that some of the LWM with rootwads could be placed within the channel parallel to the flow, but not against the bank like a toe-log which acts as bank protection instead of fish habitat. While perpendicularly placed pieces provide desirable habitat diversity, often, much of the flows merely pass underneath these logs and channel and habitat response is minimal. TRT encourages additional LWM conversation as the designs progress prior to moving to the 90% designs, so that a diversity of wood designs and functions can be explored.

20. Page 26 of 54 show LWM which is being used as bank protection. The construction plan notes 3 states "install large woody debris feature per detail. See sheet C-703", but detail on C-703 does not

show this LWM configuration. Please provide detail on how this LWM configuration will be installed. It is the preference of the TRT that all wood installations function as habitat and be unanchored.

Response: Acknowledged. Detail will be added to the 90% plans. Regarding function, this structure is intended to act as both habitat and bank protection. Anchoring options will be investigated, but burial and/or use of overburden will take precedence.

TRT Response:

TRT encourages additional LWM conversation as the designs progress prior to moving to the 90% designs.

21. The FBRB guidelines, as well as WAC 220-660-190 (3) (a), state that this structure must provide unimpeded fish passage at all life stages. TRT is concerned that the proposed 6.3% grade at the mouth of the stream may preclude access to the creek for juvenile fish. Please describe how the relocated stream design structure address this.

Response: The channel gradient is generally fixed given the project constraints at the Lake Sammamish Ordinary High-Water Mark and the upstream topography in the ravine, as well as development in the vicinity. Providing access to the upstream habitat is intended to mostly benefit Kokanee salmon life cycles. Adults will be able to swim up and down George Davis Creek, along the 6 to 7% grade, to access spawning habitat just over 1/4-mile upstream of the lake. Juvenile usage of the creek will be exclusively to escape into Lake Sammamish, which the moderately steep grade will help facilitate.

TRT Response:

TRT recognizes that "kokanee salmon residing in Lake Sammamish are intended to be the primary beneficiary of this project" but as previously mentioned to meet the criteria in Manual 22 and Stream Simulation the design must provide passage for all fish at all life stages for fish migrating through the reach. Additional considerations will be needed to ensure the proposed design accommodates fish passage for any fish at all life stages to pass through all aspects of this project.

22. The proposed slope of 6.3% indicates stream simulation design option 2 which defines the channel type as step-pool. Please provide plans illustrating how this will be accomplished using LWM and boulder including pool spacing and low flow channel layout.

Response: At a channel slope of 6 to 7-percent, the stream is expected to alternate between step-pool and cascading channel morphologies. The LWM loading will create local pools, and some preformed scour pools will be identified in the 90% plan set for field installation, but the design intent is to allow the stream to create other pools in vicinity of LWM structures as part of the natural stream process following the first few seasons, post construction.

TRT Response:

TRT looks forward to reviewing plans illustrating the channel morphology including the proposed cascades and step-pools. TRT encourages the use of deformable LWM in designing the steps. Plans should include the height and spacing of the proposed steps and the depth of the proposed pre-scoured pools. These designs should mimic what was observed naturally occurring on George Davis Creek. TRT discourages the use of full-spanning pieces unless they are angled, pitched, and buried appropriately to reduce the likelihood of becoming fish passage barriers in the future. To note, this channel bedform should be continuous through the project reach, which includes the channel within the culvert. Therefore, it is expected that some wood is placed within the crossing to form and maintain features to which sustainable fish passage conditions are provided.

23. The hydraulic report states "Computed maximum flow velocities are low, ranging from 3.5 to 5 feet per second (fps), reflecting the high roughness coefficient selected" and "Detailed hydraulic model output can be found in Appendix X." but the report did not include Appendix X. TRT would like to see the hydraulic model to compare the natural conditions to the proposed conditions and understand the predicted velocities at each structure and throughout the stream channel.

Response: Appendix X as referenced is actually Appendix A, including discussion of hydraulic output, was provided to the TRT by the City on December 17, 2021, and is included in this comment response package to TRT. The original hydraulic report as reviewed by the TRT team reflected a conservatively high Manning's n-value, resulting in the low computed velocities for the channel. Further observation and monitoring of George Davis Creek indicate actual flow velocities may be higher. On January 7th, 2022, field staff observed velocities on the order of 8 fps for approximately a 2-year event. This measurement was taken at the upstream limit of the proposed limits of improvements. Additional information will be provided in the final hydraulic report, prepared by NHC.

TRT Response:

Thank you for providing Appendix A. Please confirm the Manning's n that was used to generate the out puts for Appendix A was 0.2 and the appropriateness of this roughness value which seems quite high. If a final hydraulic report has been prepared TRT requests to review it.

Upon further review of Appendix A, it appears that the crossing was modeled as a 15-ft crossing. TRT would like to review model outputs for the proposed 17-ft crossing as well as a 19 ft crossing to understand impacts of increasing the minimum hydraulic opening.

TRT has noticed that the model elevations do not match elevations on the plans. Please review the elevations of both. When comparing these discrepancies, the proposed freeboard is less than 1 ft.

TRT would like to know if your hydraulic model outputs incorporate the lake level elevation changes during the 10- and 100- year flood? And if so, what elevation was used for the 100-year event?

Please explain the two different OHW lines: COE elev 30.6 and City of Sammamish 31.8 shown on the plans sheet 23 of 53. These should be addressed prior to moving to the 90% designs.

24. Please describe how these designs address future climate change and what the predicted flow increase is over the 100-year WSE.

Response: Climate change has not been explicitly evaluated in the current designs. Future analysis will utilize available tools (for example, WDFW's Culverts and Climate Change web app) to document estimated 2080 flow and bankfull width conditions. Preliminary analysis using this tool indicates the current 100-year flow (128 cfs) could increase by as much as 38% by 2080, yielding a future 100-year flow of 176 cfs. Preliminary modeling suggests water surface elevations could rise by approximately 0.5 feet. The final hydraulic report will detail these findings, and any updates to the hydraulic recommendations to size for climate change will be reflected on the 90-percent plans and documents.

The following is our response to Martin Fox (10/28/2021) regarding his comment (14) on future conditions:

The proposed 17-ft wide culvert includes a 10% size increase for climate change. The City also has a stormwater code that limits increased runoff from new development. The City is also in the process of developing a revised basin plan.

TRT Response:

Thank you for the above explanation.

25. The 60% plans identify a bypass pipeline with pump – please provide details on fish exclusion and the stream bypass plan including pump and fish screen sizes.

Response: The proposed design includes the bypass design based on the WSDOT GSP for Temporary Stream Diversion (7-06). This GSP includes all design requirements for fish exclusion and pump and fish screens. The 90% plan set will include references to this bid item and GSP. Details will be included, as necessary.

TRT Response:

Thank you we look forward to reviewing the bypass design details as the project progresses.

26. Demolition notes state "remove existing concrete dam." Please provide details on how this work will be accomplished.

Response: Detailed information and construction notes/details will be including in the 90% plans and described in the Special Provisions package.

TRT Response:

To date very little information has been provided regarding the removal of the existing concrete dam or any restoration plans in this project area. Please provide details on how this work will be accomplished, post-removal project site description and plans, and the anticipated upstream and downstream impacts of removing this concrete dam which currently acts as sediment and grade control.

27. The deconstruction plans state that a septic system will be removed please clarify if there is an existing drain field.

Response: A thorough search for as-built records of this private on-site septic system was conducted but none were located. According to the previous property owner, the septic tanks were decommissioned, and the existing drain field is located just west of the ADU along the eastern property line.

Geotechnical site investigation, test pits, and soil samples will be taken to ascertain if there is contamination that must be removed or special disposal procedures that should followed during construction. The results of this investigation will be incorporated into the final design, reflected in the 90% plans and detailed in the Special Provisions package.

TRT Response:

Thank you for the additional information, no further action is needed at this time. As a side note, when the project reaches the permitting phase the area biologist may request additional information to ensure measures are taken to prevent contamination resulting from disturbing pipes, soils or other septic infrastructure.

28. TRT request that all trees that are removed from the project area >4" DBH and 6' tall remain onsite with rootwads intact and utilized in LWM layout.

Response: Acknowledged. This will be addressed for the 90% plan set. Instructions will be provided to the contractor regarding re-use of tree materials.

TRT Response:

Thank you for the additional information.

29. Please identify any ditches within the project area and show these on the next plan set. We recommend ending all ditches above the 100-year WSE to prevent road and tire toxicants from entering the stream and increasing the likeliness of salmonid mortality.

Response: Acknowledged. The project basemap (existing conditions) provided in the Plans is based on topographic survey of the project site and accurately depicts site conditions. Roadside ditches are not present along the ELSP within the project corridor. The same is true for NE 7th Ct. Roadway runoff from NE 7th Ct sheet flows to ELSP, and runoff from ELSP sheet flows to the vegetated embankment to the west side. There is no other collection and conveyance for roadway runoff in the project site.

TRT Response:

Thank you for the additional information.