United States Department of the Interior

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Subject: Draft Technical Memorandum Eklutna River Geomorphology and Sediment Transport Considerations for Flow Augmentation, and Potential Dam Spillway Release Options for Year-round Flows (Service file number 2022-0074477)

Dear Ms. Owen:

Thank you for providing the draft Technical Memorandum (TM), dated October 14, 2022, regarding preliminary results for the Eklutna River geomorphology and sediment transport analysis, as well presenting examples of dam spillway release scenarios for year-round flow into the upper river. The TM and dam spillway options were presented at the Technical Working Group (TWG) meeting on October 17, 2022.

The Eklutna River geomorphology and sediment transport analysis was initiated in 2021. Tasks completed in 2022 included additional field work and data analysis to analyze sediment source areas, grade controls, and substrate; comparison of 2020 and 2022 laser imaging, detection, and ranging (LiDAR) topographic surfaces; and development of a one-dimensional (1-D) Hydrologic Engineering Center's River Analysis System (HEC-RAS) sediment transport model. One of the goals of the Eklutna River geomorphology and sediment transport analysis is to estimate flows that do geomorphic work in the river, known as "flushing flows" or channel maintenance flows. The analysis for the 2-D HEC-RAS model, which includes analysis of channel migration is still under development, and the report will be included in the upcoming Year-2 Study Report.

The U.S. Fish and Wildlife Service (Service) appreciates the extensive field work and analysis that went into the geomorphology and sediment transport study. This information provides the background necessary for understanding the evolution of the historical lake and river system in the context of glaciation, water flow, and sediment transport. An integrative understanding of these watershed processes is fundamental as the TWG considers geomorphology and future flow augmentation. It was also encouraging to see spillway engineering scenarios presented with infrastructure capable of accommodating year-round flows, flushing flows, and fish passage.

We offer the following comments on the draft TM and look forward to upcoming discussions on fish passage.

Draft Technical Memorandum

Page 1: The TM describes flow levels of interest, one of which would move substantial amounts of sediment from behind the old lower dam site. The TM states the 2021 release of 150 cubic feet per second (cfs) moved a "substantial" amount of the sediment wedge from the old dam. This was shown in the comparative cross sections and photo points presented during the TWG meeting. We recommend comparing pre and post flow release cross sections to understand the design channel cross sectional area suitable for routing flows of this 150 cfs magnitude. This could also be used to validate models that estimate cross sectional area based on assumed flow and channel roughness.

Page 2: The TM states, "if peak flow levels and durations are too high/long compared to input of sediment (particularly spawning-sized sediment), some components of aquatic habitat may decrease in value in some reaches of the river." We recommend acknowledging the other extreme as well— if flows are too low or too short in duration, excessive deposition of fines may occur along with insufficient influx of spawning-sized gravels.

Page 2: Section 2.1, states, "the currently active alluvial fans have been providing more sediment to the valley than the [post dam] river can transport…" Please add the term 'post dam' to emphasize diminished sediment transport competency and capacity is a result of dam operations.

Page 15: Section 4.1, describes the development of the HEC-RAS 1-D model, which considered just two reaches on the Eklutna River, from the dam to the confluence of Thunderbird Creek, and from Thunderbird Creek downstream. We would like to know if there would be added benefits to looking at sediment transport reaches broken down by factors other than perennial flow (i.e., deposition versus transport reaches, slope, lateral stability, stream type, etc.). Example reach breaks could include the Eklutna tailwater (above upper Anchorage Water and Wastewater Utility portal), depositional zone (River Mile [RM] 5 to 11), Canyon (RM 3 to 5), below Thunderbird Creek (RM 2 to 3), and the delta. What would be gained through added resolution and a functional approach to reach identification?

Discussion

The LiDAR does a good job of showing the process by which sediment moves from head of gully features, down the fall line, to the alluvial fans, and potentially into the river below. Model outputs attempt to quantify sediment inputs to the river. We suspect the inputs are underestimated. Acknowledging that accuracy is an impossible goal given model limitations and the stochastic nature of mass wasting, model outputs provide a good representation of relative sediment contributions of the various active alluvial fans across the Eklutna River floodplain. This information is important for understanding stream channel restoration opportunities and design constraints. There will be portions of river (referred to as "unconfined") that are naturally laterally active and depositional. These dynamic areas are prone to channel migration and pose appreciable engineering challenges. We look forward to more discussion of channel restoration alternatives that support desired river function (water depths, scour, graded substrate) as well as the natural tendency of the river in the context of its watershed and sediment supply (laterally active, depositional) once a range of the base and peak flow regimes are determined. Channel form, base flow, and channel forming flows are inextricably linked. Given the considerable design challenges at this site, it is best for these integrative discussions to occur as soon as possible.

Like the LiDAR analysis, the HEC-RAS modeling does a good job of showing the distinctions between functional reaches. The tool excels at modeling in-channel transport across baseline conditions for the range of flows at which it was calibrated, in this case, up to 150 cfs. Sediment transport functions are a combination of theoretical and empirical science. Due to the empirical nature of the transport function, empirical data is needed to calibrate a HEC-RAS sediment transport model. This point was reinforced by Gibson et. al (2017), who demonstrated the importance of multiple calibration metrics when evaluating sediment transport models in HEC-RAS. We recommend acknowledging the empirical data, collected to date, represents only one data point and the model will likely require additional calibration flows and refinement to increase its reliability for use in this system under the selected flow regime. Additionally, the model must be considered within the context of the current channel. The existing channel, formed by historical bankfull flows of 1,500 cfs, received test flows that were an order of magnitude lower. This means the test flows only spilled onto the inner berm of the original channel. In many cases this inner berm is sparsely vegetated, has a different sediment profile and lateral extent than the original floodplain. Like the physical habitat simulation model, the results are extremely limited as new channel geometry will influence model outputs. We recommend clarifying the term "floodplain" to indicate whether it is referring to the historical floodplain extent, or to the lateral extent of inundation under test flow scenarios (i.e., historical inner berm).

At the incipient point of flooding, when the river accesses the bankfull flood stage, energy is dispersed across a depositional feature (floodplain) consistent with the size, pattern, and profile of the river. This results in reduced risk and maintains channel stability. Flow level 4 as described in the TM, are "flows that result in channel migration and floodplain inundation." However, that description links flood flows to channel migration. We recommend clarifying whether this is a reference to historical flood flows or project flood flows under a new regulated hydrologic regime.

There are river reaches that are, or have the potential to be, stable, single thread channels. There are other reaches, however, that are naturally laterally active, and potentially anastomosing, causing new channels to form. Physical surveys and modeling efforts help to identify these reach breaks and distinguish appropriate restoration tools. One common thread throughout the river corridor, however, is the importance of vertical stability. We recommend locations of known and suspected grade controls be identified throughout the system, including the elevation of the pool tail crest below the dam in relation to the proposed spillway gate, and in relation to the longitudinal profile. In addition, please provide a discussion of potential future river adjustments under various flow regimes, also include a figure, or overlay of the post-test flow release longitudinal profile in the TM to complement Figure 2-1.

Thank you for the opportunity to review and comment on the draft TM. For more information or if you have any questions, please contact Ms. Jennifer Spegon at 907-271-2768 or at jennifer_j_spegon@fws.gov, or Ms. Carol Mahara at 907-271-2066 or at carol_mahara@fws.gov.

Sincerely,

DOUGLASS COOPER

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Douglass M. Cooper
Ecological Services Branch Chief

Literature Cited

Gibson, S., B. Comport, and Z. Corum. 2017. Calibrating a sediment transport model through a gravel-sand transition: avoiding equifinality errors in HEC-RAS models of the Puyallup and White Rivers. World Environmental and Water Resources Congress. 179-191.