GENERAL COMMENTS

Although these comments are directed at fluvial geomorphology, there is a tremendous amount of overlap with what is really a common technical platform representing the riverine physical environment – how patterns of water and sediment movement over time play out to produce spatial and temporal combinations of hydraulic, topographic, and biotic conditions.

The model selection portion is well considered and documented for this stage in the modeling process. However, it is unclear if mobile bed models will be used independently for geomorphic analysis or if they are going to be integrated in the instream flow habitat analysis too?

- If the mobile bed models will be used in calculating WUA, how will differing project operation scenarios be assessed? Mobile bed modeling requires every hydrologic iteration to be modeled since every flow has the potential to alter the channel compared to fixed bed models where a single bed geometry in used for all flow scenarios.
- By utilizing a fixed bed model (for a given channel geometry at a given point in time) over a range of flow conditions (ie. low flow to max flow), any number of hydrologic scenarios can be analyzed without having to re-run the model to calculate associated hydraulic conditions and resulting habitat suitability.

There are certainly some complex and uncertain steps in the overall modeling approach – e.g., integrating variation and simulation scales ranging from sub-meter to 100s of kms and potentially seconds and hours to decades; readjusting and analyzing channel dimensions, vegetated zones, representing altered topography in 1-d and 2-d; mechanical ice breakups; and ice behavior with intra-daily load-following.

Nonetheless, it is a very professional, rational, and well-considered approach. Given our comments provided below, we don't see a better way to proceed without having results from the current and ongoing field work and analysis that are being conducted. Pure validation with truly independent and replicated data sets is elusive if not impossible in this type of situation. However, there are a couple of activities that might provide some corroborating evidence.

- One is to use the historical depiction of channel locations, dimensions, and meta-habitat distribution described in the "Mapping of Geomorphic Features…", FREC 14241, T2012 Tech. Memo to edit the current topography. Then, re-run historical flows with that estimated historical topography to see if it matches the pattern of changes producing current topography.
- Another is to compare simulated stages of mechanical ice-break surges with maps of ice scar elevations. Determining elevation (+/- ~ 15 cm) and year of ice scars is a relatively accurate and inexpensive dendrochronology task (e.g., compared to year and elevation of establishment).

Specific Comments on the Technical Memorandum

- Page 8 – *"The 1-D model will provide the boundary conditions for the 2-D model in the Focus Areas, including starting water surface elevations and upstream sediment supply."*
    - How will potential changes in channel geometry due to aggradation/degradation and associated WSE from the 1D model output be accounted for in providing boundary conditions to the focus area when the 2D model is using pre-project topography?
- Page 8 – *"The 2-D model at the Focus Areas will provide an understanding of the hydraulic conditions and sediment transport processes that contribute to formation of individual habitat types."*
    - Will the formation of the individual habitat types (new bed geometry) be used in the habitat modeling analysis? i.e. will output from mobile bed 2D model be used to generate "future" channel geometry that would then be used to conduct fixed bed 2D hydraulic/habitat modeling.
- Page 11 – "*Calibrate and validate the sediment transport model.*
    - *Adjust sediment input values, bed layer properties, sediment transport time step (within reasonable limits) to calibrate the hydraulic results using available data including:*
        - *Gage station measurements sediment loads, specific gage plots, flow area, width, depth, and velocity measurements,*
        - *Comparison cross sections, and*
        - *Longitudinal profiles."*
    - While the input values can be adjusted to match current gage station measurements as listed in the first bullet, it seems like the calibration of the 1D mobile bed model for the second and third bullets should be conducted utilizing the 1980s cross-sectional data. This type of comparison is needed in order to determine if the model is able to properly simulate the change in channel aggradation/degradation or total volume of sediment transport over the past 30 year time period. Then the model could be used to estimate future channel change and sediment volumes throughout the project extent.
- Page 16 – *"Refine the network in areas of significant change or areas of significant habitat interest."*
    - Identify how 'significant change' and 'areas of significant habitat interest' will be defined.
- Page 16 –
    - How will LWD be represented in River 2D? How will flow both under and through LWD piles be represented and measured?
- Page 16 – *"Develop inflow hydrographs and sediment inflows for existing and with-project conditions"*
    - How many and what range of flows will used to develop inflow hydrographs and sediment transport models?

- Page 17 – "*Calibrate and validate the sediment transport model.*
    - *Adjust sediment input values, bed layer properties, sediment transport time step (within reasonable limits) to calibrate the hydraulic results using available data including:*
        - *Main channel bed level changes observed in the 1-D modeling,*
        - *Comparison cross sections, and*
        - *Longitudinal profiles."*
    - It doesn't seem clear what data will be used to calibrate the 2D mobile bed model. Where will the cross section comparisons and longitudinal profile data come from? Will this be generated from 1980s data or how will it be determine if the model is able to properly simulate the change in channel geometry over time?
    - What flows will be used to test the models and what amount of deviation from field measured conditions will be deemed suitable?
- Page 26 – *"The modeled reach of the Chulitna River will extend approximately 10 miles to a location of channel narrowing. Model topography for the upstream 6 miles of this reach will be developed from the LiDAR data that will be collected during low flow. The surveyed bathymetry from the lower 4 miles of the Chulitna River will be used to guide adjustments to the low flow channel to account for the missing topography below the water surface."*
    - What algorithms will be used to create the bear earth model from the LiDAR data?
    - How will the topography be determined under water, conifers and dense trees from the LiDAR data?
    - What portion (percentage) of the channel is under water during low flow and how will the underwater portion of the channel be constructed? i.e. dropping the edge of water points by a pre-determined amount (normal depth for the flow in the river at the time of the LiDAR data collect) and then connecting them with a slightly lower point in the middle of the low flow channel.
- Page 27 – *"Each of the tributary mouths and a nominal reach length will be included in the Focus Area models to simulate delta processes and tributary bed response. The length of the reaches will be determined in the field, but are anticipated to be between 0.2 and 0.7 miles. Approximately 5 cross sections will be surveyed in each tributary to develop sediment input rating curves to the Focus Area models."*
    - It is difficult to say if 5 cross sections would provide enough detail in these tributaries based on various lengths. It would better to identify the number of cross sections as a function of channel/trib width (ie. XSs will be spaced at a minimum of X-channel widths apart and no more than X-channel widths).
- Page 28 – *"Data from the Riparian Instream Flow Study, the Fish and Aquatics Instream Flow Study analysis of changes in hydrology operational scenarios, and 1-D sediment transport analysis provide a basis for adjusting the channel width in the 1-D model throughout the simulation. It is anticipated that adjustments will be made to the width in the with-Project scenario runs at up to five times during each simulation."*

    - What criteria will be used to determine when/how/why channel width adjustments are needed and how will that ultimately change the results of the modeling?
- Page 30 – Large Woody Debris Modeling
    - How will LWD be represented in the 2D models and how will flow in, under and through be accounted for?
- Page 32 – *"Boundary conditions for all of the 2-D model simulations, including downstream water surface elevations, and upstream flow and sediment supply, will be obtained from the 1-D modeling results."*
    - Is this the case for both the fixed bed and mobile bed models?
    - For the fixed bed case (current conditions), why not use field collected discharge and wse for inputs to the 2D models, vs, 1D model outputs for boundary conditions?
    - For the mobile bed modeling, it is unclear how changes in channel geometry and associated WSE in the 1D model output could be used to provide boundary condition input for the focus area 2D modeling when the channel geometries are different?
- Page 32 – *"The output values for the required hydraulic variables that include depth, velocity, and water-surface elevation, will be provided at each node along with the associated geo-referenced horizontal coordinates and elevations."*
    - Consider Froude number as a model output, as it is may be an important habitat metric for some species (benthic fish and macroinvertebrates).
- Pages 56-58 – Figures 4-5, 4-6, 4-7
    - Focus Areas 104, 138, 141, 144, 128 boundaries should be adjusted to incorporate geomorphology cross sections, in order to maximize the usability of collected field data in modeling Focus Areas.