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To: Lowland/In-Water Operable Unit Interim Removal Action Measure – Consulting Project Team

From: Stacy Benjamin, Wetland Solutions Northwest

Re: Permitting Support – Restoration Design Recommendations

Introduction and Background Information

Wetland Solutions Northwest (WSNW) and Lotic Solutions (Lotic) have been subcontracted by GSI Water Solutions, Inc. (GSI) to provide permitting technical support services for the Interim Removal Action Measure (IRAM) project (Project). This memo is intended to provide conceptual recommendations to facilitate the development of the Restoration Plan by Dalton, Olmsted & Fuglevand, Inc. (DOF). Multiple sources of background information have been previously prepared for the Project and were reviewed alongside other applicable studies and Project documentation from similar sites to inform our recommendations. These references are included at the end of this memo. This is a working document that was prepared to support the development of the Joint Permit Application (JPA). Language in this memo may differ from the final language included in the JPA.

Existing Conditions

Existing conditions in the IRAM Area including topography, hydrology and plant communities were mapped and described in the Baseline Habitat and Ecological Evaluation (BHEE) Report (GSI et al. 2024). The primary habitats present in the IRAM Area are summarized by elevation (all elevations in feet NAVD88) in Table 11 of the BHEE. The primary habitats identified include:

- Unvegetated mudflats from below elevation 6 ft (ordinary low water) to 8.1 ft
- Inundated emergent wetlands dominated by wapato and bullrush from elevation 8.1 to 9.5 ft
- Saturated emergent and scrub-shrub wetlands dominated by reed canary grass and Himalayan blackberry from elevation 9.5 to 10.3 ft
- Forested and scrub-shrub wetlands dominated by Oregon ash, willow and Himalayan blackberry from 10.3 to ordinary high water at elevation 17.5 ft

Restoration Design Recommendations

These recommendations have been developed based on the goals of restoring a range of elevations and associated native vegetation communities in the IRAM Area similar to existing conditions as well as adjacent wetland areas at similar elevations.

Leave (Post-Grading) Surface

- Preserving native soils buried under anthropogenic impacts would facilitate restoration and plant re-establishment; therefore, to the extent practicable and assuming acceptable contaminant levels, we recommend excavating only to the deepest elevation of the combined depth of contamination/ wood waste (Figure 2-11 in the Basis of Design Report [BODR]).
- The leave surface should be a variable elevation surface, including reductions in existing elevation as practicable to favor mudflats and native emergent wetland species.
- Leave several higher elevation islands or “hummocks” (>10.3 feet) to provide additional area for re-establishment of native shrubs and trees.
- Reduce the ground surface area remaining between the elevations of 9.5 to 10.3 feet to the extent practicable without compromising slope stability, to reduce habitat for invasive plants that tend to thrive within this zone.
- Monitoring should occur during the excavation by an engineer/soil scientist/biologist that can identify the elevation where buried native wetland soils are present to ensure that buried native soils are preserved during excavation to the extent practicable.
- In order to facilitate revegetation, three elevation-based approaches for the sand residual management layer (RML) and growing media are recommended per the bullets below.
 - In inundated areas (6.0 to 8.1 feet), a 6- to 12-inch sand RML would be placed after excavation is completed. We recommend incorporating compost by hand into individual planting holes in the sand layer at the time of planting.
 - In saturated areas (8.1 to 10.3 feet) we recommend applying a 6-inch layer of 60% sand/40% compost planting media on top of the 6-inch sand RML. Planting media depth is the minimum thickness after being lightly tamped. Consider use of biostabilization material (matting, wattles, fascines) over planting media to limit erosion of fine-grained materials.
 - In the higher elevation, dryer areas (above 10.3 feet) we recommend a minimum 12-inch layer of topsoil (lightly tamped depth) be placed over the 6-inch sand RML. Consider use of biostabilization material over the topsoil layer to limit erosion of fine-grained materials.
- Positive drainage towards Scappoose Bay should be provided throughout the post-grade surfaces to avoid native fish strandings during periods of falling WSEL.
- To the extent that the post-grade surfaces are higher than ordinary low water (OLW), or approximately an elevation of 6.0 feet, the intertidal channel network should be restored to the maximum extent practicable to provide safe ingress and egress of native fishes.

Planting Plan

Lists of plant species to be used for revegetation were prepared based on the goal of restoring the existing vegetation community types described in the BHEE (inundated emergent, saturated emergent, scrub-shrub and forested) as well as the anticipated post-excavation elevations in Table 5-1 IRAM Area Elevation Goals in the BODR and the excavation plan (DOF 1/17/2025). Reference documents for tidal plant communities used to develop the species compositions for revegetation include Estuarine and Freshwater Tidal Plant Associations in Oregon (Christy et al. 2007) and A Synthesis of Environmental and Plant Community Data for Tidal Wetland Restoration Planning in the Lower Columbia River and Estuary (Diefenderfer et al. 2013).

Based on the draft excavation plan and the subsequent discussions, the post-grading elevations are anticipated to be up to 0.5 feet lower than the elevations shown on the draft excavation plan (considering the -1 ft overdredge allowance and +0.5 ft of RML). We understand a minimum of 0.5 feet of sand RML would be placed on top of the excavated areas prior to revegetation. Hydrology (depth and duration of inundation) at the lower elevations would be increased over current site conditions which would increase the acreage of inundated emergent habitat in the IRAM. This should create conditions favorable for increasing submerged wapato and bulrush communities as well as saturated native emergent wetland communities.

Higher elevation revegetation areas should be incorporated as mounds or islands to provide habitat diversity. All temporary haul roads should also be at least partially decommissioned, buried under a layer of topsoil ranging from 12 to 18 inches (lightly tamped depth), and revegetated. Soil stabilization should include installing a biostabilization material over the topsoil in sloped areas, followed by application of a native grass seed mix over the entire area using a high-performance flexible growth medium hydromulch. The BODR recommends minimizing post-remediation elevations between 9.5 and 10.3 feet in order to reduce the presence of elevations that would favor the reestablishment of reed canarygrass. Therefore, the higher elevation areas to be restored would preferably range from 10.3 to 17.5 feet NAVD. Areas between 9.0 and 10.3 feet are recommended to be very densely planted with native shrubs at 3 feet on center (O.C.) to rapidly establish shrub cover to shade out reed canarygrass and minimize open areas for Himalayan blackberry to re-establish.

The following planting zones have been identified based on the excavation depths in the draft excavation plan. We understand that the required excavation plus the overdredge limit needed to hit the target elevations may result in 0.5 feet of additional excavation below the elevations shown in the draft maximum removal plan. All areas will receive a minimum of 0.5 ft of residual cover. The IRAM area will be restored to the following community types.

- Inundated emergent wetlands
- Saturated emergent and scrub-shrub wetlands
- Forested and scrub-shrub wetlands

Scientific Name	Common Name	Type	Elevation Range*	Planting Density
<i>Alisma plantago-aquatica</i>	American water plantain	Plug	6.0 – 8.1	Plant in clusters in species groups, overall spacing 1 foot O.C
<i>Sagittaria latifolia</i>	wapato	Plug	6.0 – 8.1	
<i>Schoenoplectus species</i>	bulrush/tule	Plug	6.0 – 8.1	

* Final restoration elevations after 6- to 12-inch sand residual cover layer.

Scientific Name	Common Name	Type	Elevation Range*	Planting Density**
Herbaceous				
<i>Bidens cernua</i>	nodding beggars-tick	Seed	8.1 – 10.3	TBD
<i>Carex aperta</i>	Columbia sedge	Plug	8.1 – 10.3	Plant in clusters in species groups, overall spacing 1 foot O.C
<i>Carex lyngbyei</i>	Lyngby sedge	Plug	8.1 – 10.3	
<i>Eleocharis palustris</i>	common spikerush	Plug	8.1 – 10.3	
<i>Equisetum fluviatile</i>	water horsetail	Plug	8.1 – 10.3	
<i>Glyceria borealis</i>	Northern mannagrass	Seed	8.1 – 10.3	TBD
<i>Leersia oryzoides</i>	rice cut-grass	Seed	8.1 – 10.3	TBD
<i>Polygonum hydropiperoides</i>	swamp smartweed/water pepper	Plug	8.1 – 9.5	Plant in clusters in species groups, overall spacing 1 foot O.C
<i>Sagittaria latifolia</i>	wapato	Plug	8.1 – 9.5	
<i>Schoenoplectus species</i>	bulrush/tule	Plug	8.1 – 9.5	
<i>Sparganium angustifolium</i>	narrowleaf bur-reed	Plug	8.1 – 9.5	
Shrub				
<i>Cornus sericea</i>	red osier dogwood	Container	9.5 – 10.3	Densely planted 3 foot O.C. to discourage re-establishment of invasives
<i>Rosa nutkana</i>	Nootka rose	Container	9.5 – 10.3	
<i>Salix fluviatilis</i>	Columbia River willow	Live stake	9.5 – 10.3	
<i>Salix sitchensis</i>	Sitka willow	Live stake	9.5 – 10.3	
<i>Spiraea douglasii</i>	Douglas spirea	Container	9.5 – 10.3	

* Final restoration elevations after 6-inch sand residual cover layer and 6-inch planting media.
** Seeding rate and design of planting areas to be determined by landscape architect.

Table 3. Forested and Scrub-Shrub Wetland Planting Plan Palette for Islands and Decommissioned Haul Roads				
Scientific Name	Common Name	Type	Elevation Range*	Planting Density**
Herbaceous				
<i>Agrostis exarata</i>	spike bentgrass	Seed	10.3 – 17.5	TBD
<i>Carex obnupta</i>	slough sedge	Plug	10.3 – 12.0	Plant in clusters 1 foot O.C
<i>Elymus glaucus</i>	Blue wildrye	Seed	10.3 – 17.5	TBD
<i>Festuca rubra rubra</i>	native red fescue	Seed	10.3 – 17.5	TBD
<i>Hordeum brachyantherum</i>	meadow barley	Seed	10.3 – 17.5	TBD
<i>Juncus tenuis</i>	Lesser poverty rush	Seed	10.3 – 17.5	TBD
<i>Lysichiton americanum</i>	skunk cabbage	Plug	10.3 – 12.0	Plant in clusters 1 foot O.C.
<i>Scirpus microcarpus</i>	small-fruited bulrush	Plug	10.3 – 12.0	Plant in clusters 1 foot O.C
Shrub				
<i>Cornus sericea</i>	red osier dogwood	Container	10.3 – 12.0	8 foot O.C.
<i>Lonicera involucrata</i>	twinberry	Container	12.0 – 17.5	8 foot O.C.
<i>Physocarpus capitatus</i>	ninebark	Container	12.0 – 17.5	8 foot O.C.
<i>Rosa nutkana</i>	Nootka rose	Container	10.3 – 12.0	5 foot O.C.
<i>Salix fluviatilis</i>	Columbia River willow	Live stake	10.3 – 12.0	8 foot O.C.
<i>Salix sitchensis</i>	Sitka willow	Live stake	10.3 – 12.0	8 foot O.C.
<i>Symphoricarpos albus</i>	Snowberry	Container	12.0 – 17.5	5 foot O.C.
Trees				
<i>Fraxinus latifolia</i>	Oregon ash	Container	10.3 – 17.5	15 foot O.C.
<i>Populus balsamifera ssp. trichocarpa</i>	black cottonwood	Container	12.0 – 17.5	15 foot O.C.
<i>Salix lasiandra</i>	Pacific willow	Live stake	10.3 – 17.5	15 foot O.C.
* Final restoration elevations after 12-inch topsoil layer.				
** Seeding rate and design of planting areas to be determined by landscape architect.				

Plant Installation

- Plugs are recommended for the majority of the emergent planting areas to facilitate quicker revegetation compared to seeding. Planting in the lower elevation areas will likely need to be conducted on foot.
- Seeds are recommended in addition to plugs to increase the diversity of the planting palette. All seeded areas should be tamped down to ensure good soil to seed contact.
- Use biostabilization techniques (matting, wattles, fascines) to stabilize seeds and plugs and facilitate plant establishment.
- Consider incorporating nurse logs that are drilled and seeded with woody species, and/or log cribs to facilitate re-establishment of shrubs and trees.
- Consider installing vertical willow bundles in the sides of the haul roads as they are being constructed to facilitate revegetation. See NRCS Technical Note TN Plant Materials No. 21
- Consider use of a stinger to revegetate haul roads per NRCS Technical Note TN Plant Materials No. 6.

Sourcing Plants

- Contract with a plant restoration partner as soon as possible to begin growing out plants.
- The planting strategy could include collecting seeds from wapato and tule at the end of summer/early fall to be used to grow out seedlings.
- Consider salvaging existing wapato tubers from excavation areas prior to the start of remediation. Only uncontaminated tubers to be used for restoration planting.
- Consider taking willow cuttings on the site to use for live stake plantings.

Anticipated Performance Objectives and Monitoring

Performance criteria and monitoring needs will be dictated by the permitting agencies. An example of typical permit conditions is provided below for informational purposes; the requirements for this Project may differ. Typical vegetation performance standards required by the wetland regulatory agencies (DSL and Corps) include the following:

Emergent Wetlands

- The cover of native species, as defined in the USDA Plants Database, is at least 60%
- The cover of invasive species is no more than 10%
- Bare substrate represents no more than 20% cover
- By year 3 and thereafter, there are at least 6 different native species. To quality, a species must have at least 5% average cover in the habitat class and occur in at least 10% of the plots sampled

Shrub and Forested Wetlands

- The cover of native species in the herbaceous stratum is at least 60%
- The cover of invasive species is no more than 10%
- Bare substrate represents no more than 20% cover

- The density of woody vegetation is at least 1,600 live native plants (shrubs) and/or stems (trees) per acre or the cover of native woody vegetation on the site is at least 50%
- By year 3 and thereafter, there are at least 6 different native species. To quality, a species must have at least 5% average cover in the habitat class and occur in at least 10% of the plots sampled

Monitoring and Maintenance

Monitoring and maintenance to ensure goals and performance standards are being met are standard permit conditions as is submittal of annual monitoring reports. Monitoring would likely be required to be conducted in accordance with DSL's Routine Monitoring Guidance for Vegetation (DSL 2009). On large complex sites, the monitoring period is typically a period of five to ten years. Monitoring should be based on an adaptive management approach. It should include monitoring vegetation cover trends, analyzing the effectiveness of seeding and invasive species control, and adapting techniques to improve site conditions with effective treatment. Corrective actions would be implemented as needed throughout the monitoring period to facilitate plant establishment. Contingency tasks include, but are not limited to, corrective grading, installation of supplemental plantings and/or seed, and control of invasive plant species using physical or chemical methods. It is likely that some replanting will be necessary during the first few years, and there may be revisions to the species to be replanted based upon hydrology, seed and plant availability, or other factors. Revisions to the planting specifications should be approved by a wetland biologist.

Large Woody Material Reuse

Trees removed to facilitate sediment excavation should be salvaged to the extent practicable provided that they are in locations or can be handled so they are not covered with impacted sediment. Suitable logs and large branches should be reused to provide for beneficial microhabitat forming processes, such as pool formation, flow velocity dissipation, and accretion. We recommend using the salvaged Large Woody Material (LWM), if available, to stabilize meanders and direct water flow toward the restored intertidal channel network. Although logs with the root wads attached are very desirable for LWM structures, for the IRAM, we've assumed that root wads would need to be cut from the log and disposed alongside the other contaminated materials due to their exposure to COCs.

All LWM will need to be anchored to limit movement during high river water events and to help capture and retain small organic materials. There are numerous techniques for anchoring LWM and passive or flexible anchors may be used (WSDOT 2024). Natural materials are preferred (e.g. boulders). To minimize habitats for resident warm water piscivorous fishes, we recommend that LWM structures are not installed at an elevation below the elevation of + 7.0 ft NAVD88. Rather, these LWD installations are intended to support intertidal/floodplain habitats for listed juvenile salmonids that tend to out-migrate and rear during the spring and fall. Therefore, these structures should be installed at elevations that are greater than 8.1 ft NAVD88 which corresponds to inundation frequencies that are less than 60 percent (GSI et. al., 2024). They may extend down toward OLW and/or further upslope. To the extent that

adequate and suitable salvage materials are available, LWM structures should be installed at select locations alongside, across, and within the restored intertidal channel network.

Additionally, select salvaged wood may be installed to mimic snags providing perch and nesting habitat for birds or as basking logs for turtles and frogs. Snag installations typically involve tree trunks (16 inches or more in diameter breast height) with mostly intact bark, with three or more large branches. These are vertical structures that are driven or buried 10 or more feet into the ground with 20 or more feet extending upward out of the ground. Basking logs may be placed directly on the ground in arrangements of three or more logs that mimic natural distribution anchored using boulders and threaded rod or similar method. Smaller branches and willow stakes may be incorporated to enhance these structures. They may also be combined and used alongside snag installations. This type of LWM structure should be located at elevations of 9.5 ft or above and oriented to maximize their southern exposure.

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