these changes will result in a new dynamic equilibrium in the Lower Columbia River ecosystem over the life span of the Project.

Notwithstanding the Corps' assessments, NMFS believes that the predicted changes to the physical system should not be extrapolated over the life span of the Project without additional monitoring and verification. In the OHSU/OGI modeling for the reinitiation of consultation, the predicted changes to habitat opportunity in Cathlamet Bay for five one-week model simulations (Table 6-1 of the 2001 BA) are from model simulation runs over a short time duration. Based on the information provided in the 2001 BA, extrapolating these results over the life span of the Project, instead of limiting those results to the period modeled, does not acknowledge model limitations or long-term variability in the ecosystem.

A key conclusion from both the SEI panel process and BRT discussions was that even using the best available scientific data, there remains a degree of risk and uncertainty with our ability to link the physical changes in habitat elements predicted from the Project with long-term effects - either positive, negative or neutral - to ESA-listed salmonids or their habitats. The BRT conducted a qualitative risk and uncertainly analysis (*see* Table 7-1 of the 2001 BA). That analysis documented the need for a precautionary approach to the protection of ecosystem elements (*i.e*., key indicators within each pathway of importance to salmonids). In order to address the risk and uncertainties associated with key salmonid pathways and indicators identified in this Opinion, the Corps proposes, and NMFS concurs, with the continued development and implementation of a robust monitoring program and adaptive management process.

7. CRITICAL HABITAT

7.1 Defining Proposed and Designated Critical Habitat

7.1.1 Status of Critical Habitat

ESA Section 3(5)(a) defines 'critical habitat' as the specific areas within: (1) The geographical area occupied by the species, at the time it is listed, on which are found those physical or biological features essential to the conservation of the species; (2) which may require special management considerations or protection; and (3) specific areas outside the geographical area occupied by the species at the time it is listed upon a determination by the Secretary that such areas are essential for the conservation of the species. In determining what areas are critical habitat, agency regulations at 50 C.F.R. 424.12(b) require that NMFS must "consider those physical or biological features that are essential to the conservation of a given species ..., including space for individual and population growth and for normal behavior; food, water, air, light, minerals, or other nutritional or physiological requirements; cover or shelter; sites for breeding, reproduction, and rearing of offspring; and habitats that are protected from disturbance are representative of the historical geographical and ecological distribution of a species."

The regulations further direct us to "focus on the principal biological or physical constituent elements . . . that are essential to the conservation of the species," and specify that the "known primary constituent elements shall be listed with the critical habitat description." The

regulations identify primary constituent elements (PCE) as including, but not limited to "roost sites, nesting grounds, spawning sites, feeding sites, seasonal wetland or dryland, water quality or quantity, host species or plant pollinator, geological formation, vegetation type, tide, and specific soil types." An occupied area must contain one or more of the PCEs at the time the species is listed to be eligible for designation as critical habitat; an area lacking a PCE may not be designated in the hope it will acquire one or more PCEs in the future.

PCEs consist of the physical and biological elements identified as essential to the conservation of the species in listing and recovery documents. These PCEs include sites essential to support one or more life stages of the ESU (sites for spawning, rearing, migration and foraging) and contain physical or biological features essential to the conservation of the ESU, for example, spawning gravels, water quality and quantity, side channels, and forage species.

The specific type of site and associated features most relevant to this Opinion is called **'estuarine areas'** free of obstruction with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh-and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation. The 2002 Opinion identified that the proposed Project may affect the following five essential features: Substrate, water quality, food, riparian vegetation, and safe passage conditions. These five essential features are encompassed in the newly-proposed PCEs and 'estuarine areas' site type in this Opinion. Therefore, this analysis of the effects of the proposed action on critical habitat focuses on the role that proposed and designated critical habitat must play with respect to the recovery of the species potentially affected by the Project. This analysis does not rely on the regulatory definition of "destruction or adverse modification" at 50 C.F.R. 402.02 of critical habitat recently invalidated by the Ninth Circuit in *Gifford Pinchot.*

NMFS reviews the status of critical habitat by examining the condition and trends of PCEs throughout the designated area, a region that corresponds approximately to the geographic range of the species. Within the action area, critical habitat has been designated for SR fall-run Chinook salmon, SR spring/summer-run Chinook salmon, and SR sockeye salmon. On December 14, 2004, NMFS proposed critical habitat for SR steelhead, UCR steelhead, MCR steelhead, UWR steelhead, LCR steelhead, UCR spring-run Chinook salmon, UWR Chinook salmon, LCR Chinook salmon, and CR chum salmon in the Lower Columbia River and estuary. 69 FR 74572; Dec. 14, 2004. Critical habitat was not proposed for LCR coho salmon (an ESU currently proposed for listing).

The December 14, 2004, proposed critical habitat rule identified the following characteristics of the Lower Columbia River corridor:

- The corridor was acknowledged to be of high conservation value to all the ESUs that migrate through the estuary.
- Estuarine areas are crucial for juvenile salmonids, given their multiple functions as areas for rearing/feeding, freshwater saltwater acclimation, and migration (Simenstad *et al*., 1982; Marriott *et al*. 2002, as cited in 69 FR 74572).

- The corridor connects every watershed and salmonid population with the ocean and is used by rearing/migrating juveniles and migrating adults.
- The Columbia River estuary is a particularly important area for these ESUs as both juveniles and adults make the critical physiological transition between life in freshwater and marine habitats (Marriott *et al*.2002, as cited in 69 FR 74572).

Therefore, all ESUs have proposed or designated critical habitat that includes the lower Columbia River to the Pacific Ocean, ending at the submerged potions of the North and South Jetties.

7.1.2 Analysis of Effects to PCEs of Proposed and Designated Critical Habitat

NMFS' review of the Project's effects on designated and proposed critical habitat (as it relates to the recovery of ESA-listed species) re-examined each of the analytical components of the consultation that resulted in the 2002 Opinion. The effects analysis was based on the conceptual ecosystem model, the underlying physical modeling, and associated ecosystem pathways and indicators that describe estuary functions that will likely be affected by this Project. The essential features of critical habitat, including the new PCEs proposed in NMFS' December 14, 2004, proposed rulemaking, are also encompassed by the conceptual ecosystem model and associated ecosystem pathways and indicators (*see* Chapter 5 of the Corps 2001 BA).

The conceptual ecosystem model, the underlying physical modeling and the associated ecosystem pathways and indicators not only address short-term, direct impacts from the Project, but also long-term indirect effects during the period of operation and maintenance (50 years and beyond) that could affect the recovery of ESA-listed salmonids. Therefore, these tools and the analysis in this Opinion also address the potential effect of the Project on the conservation value of proposed and designated critical habitat.

For the existing disposal sites identified in the amendment letter to the 2001 BA and analyzed in section 6.2.1 of this Opinion (Direct Effects), the disposal operations at existing upland sites are likely to have limited, localized negative effects on the PCEs for proposed and designated critical habitats, with longer-term benefits. Because of their location, the new upland disposal sites identified in the Corps' April, 2002, letter do not provide PCEs for proposed and designated critical habitat.

Indirect effects are analyzed in section 6.2.2 of this Opinion. The effects analysis from NMFS' 2002 Opinion addresses the newly-proposed PCEs. This is because the essential features addressed in the 2002 Opinion (*i.e*, substrate, water quality, food, riparian vegetation, and safe passage conditions) are encompassed by these new PCEs.

The similarity between essential features and PCEs for critical habitat can be illustrated in reviewing the analysis for physical habitat indicators such as bathymetry and salinity. For example, changes in the ecosystem indicators of bathymetry (and its impact to velocity) and salinity can affect PCEs in the action area of the Project. NMFS reviewed the Corps WES model and the OSHU/OGI CORIE model in order to address physical changes to the system, such as bathymetry, stemming from the Project. The CORIE model is particularly relevant to the critical habitat analysis because it translates physical effects into the concept of "habitat opportunity."

For example, the CORIE model translates changes in bathymetry to velocity to assess effects to habitat opportunity. NMFS has determined a range of velocities that are favorable for juvenile salmonids (Bottom *et al.* 2001). Actions that do not reduce habitat opportunity would generally be considered to satisfy the requirement that an action not appreciably diminish the value of critical habitat to recovery. Actions that increase habitat opportunity would likely support recovery.

Modeling results for the Project indicated a small difference between pre- and post-Project velocity differences. Pre-and post-Project velocity differences in shallow salmonid habitat areas outside the navigation channel ranges from approximately -0.05 to 0.05 foot per second. The post-Project velocities are well within the range of favorable velocities identified for juvenile salmonids, as defined by NMFS (Bottom *et al.* 2001). The OSHU/OGI model used pre-and post-Project velocity to measure effects to habitat opportunity. The model runs for the post-Project scenario estimated higher habitat opportunity hours than the environmental baseline (pre-Project condition).

Another ecosystem indicator that can affect critical habitat is salinity. As discussed in Section 6 of this Opinion, the concentration of salinity in important habitat and rearing areas of the estuary and the longitudinal gradient of salinity between the freshwater and ocean environments that bound the estuary are important to salmonid growth and survival. In shallow areas of Cathlamet Bay and Grays Bay, where important juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted a post-Project salinity increase of 0.1 to 0.15 ppt. The OHSU/OGI model confirmed these predictions. Within the deeper navigation channel, where limited juvenile salmonid habitat and food resources exist, the WES RMA-10 model predicted post-Project salinity increases in the range of 1.0 to 1.5 ppt. The OHSU/OGI model confirmed these findings, but predicted slightly larger increases in salinity than those predicted by WES RMA-10 modeling for Youngs Bay and along the Oregon side of the navigation channel up to Tongue Point. Using the OHSU/OGI model an example of the potential changes to habitat opportunity was developed by modeling Cathlamet Bay for five one-week model simulations (*see* Table 6-1 of the 2001 BA). While the Project will change the estuary's cross-sectional profile that affects estuary salinity gradients, the model predicted, for important, shallow water Cathlamet Bay salmonid habitats, there was virtually no difference in the pre- and post-Project habitat opportunity for salinity between 0-5 ppt.

In addressing potential impacts critical habitat from the Project, NMFS also recognizes that the adaptive management process identified in the 2002 Opinion will be an essential tool to respond to new information generated from Project monitoring. This mechanism provides the ability to add future conservation measures to the Project if new information suggests that effects to habitat might diminish its value in a way that would affect species recovery.

Since the development of the 2002 Opinion, the Lower Recovery Fish Recovery Board utilized the conceptual ecosystem model and ecosystem pathways and indicators in the development of their December 2004, subbasin plan, *Lower Columbia Salmon Recovery and Fish & Wildlife Subbasin Plan*. The goal of the plan is to have Washington Lower Columbia salmon and steelhead recovered to healthy, harvestable levels that will sustain productive recreational, commercial, and Tribal fisheries. The plan outlines an adaptive management approach over the next 25 years. The subbasin plan is designed to integrate new information on successes of

recovery actions, as well as on threats to salmon and steelhead, so that future work can be tailored to support recovery efforts.

The Lower Columbia River Estuary Partnership (LCREP) is also completing a subbasin plan, the *Mainstem Lower Columbia River and Columbia River Estuary Subbasin Plan,* for the lower Columbia River and Oregon tributaries. The LCREP subbasin plan also refers to the conceptual ecosystem model and ecosystem pathways and indicators from the 2001 BA and the 2002 Opinion. The LCREP subbasin plan is consistent the LCFRB's document in that it provides strategies and recommendations for actions that result in fish and wildlife resources and their habitats maintained at healthy levels and clean, safe water that is available for people, fish, and wildlife.

In addition, the Corps is working with the Pacific Northwest National Laboratory, the LCREP, and a number of other interested partners to develop the *Columbia River Estuary Conceptual Model project* (https://www.nwp.usace.army.mil/Pm/LCR/docs/CREConceptmodel/START.htm). The Project's purpose is to develop an integrated conceptual ecosystem model of the Lower Columbia River and estuary. This model is intended to provide a technical basis for restoration planning, monitoring, and research needs identification and is built, in part, upon the conceptual ecosystem model developed in the Corps' 2001 BA.

Therefore, the conceptual ecosystem model, including the associated ecosystem pathways and indicators, has proven useful for broader recovery efforts in the Lower Columbia River. NMFS has again used the conceptual ecosystem model to review the direct and indirect effects of the proposed action on the physical and biological features that were the basis for proposing and designating critical habitat in the Lower Columbia River and estuary.

Based on the newly-proposed PCEs and specific type of site and associated features (*i.e.*, estuarine areas) and associated analysis presented in sections 6 and 7 of this Opinion, NMFS concludes that the Project will not modify PCEs of critical habitat within the action area in a manner that diminishes the potential of the ESA-listed salmonids to recover. Specifically, NMFS concludes that the Project's effects fall into one of the following general categories: (1) Effects that improve the value of critical habitat; (2) effects that are within the range that do not adversely affect ESA-listed salmonids; (3) effects that are minimal/limited, but do not affect habitat that is likely to be important to the recovery of the species, (4) effects that are uncertain over the long term, but that are being addressed through the adaptive management process. Neither the 2002 Opinion nor this reinitiation identified any adverse effects to proposed or designated critical habitat that would appreciably diminish habitat value to the recovery of the ESA-listed species.

7.1.3 Analysis of Essential Features of Proposed and designated Critical Habitat - Ecosystem Restoration Features

With the exception of the Cottonwood-Howard island translocation of Columbian white-tailed deer and Shillapoo Lake (no salmon access), the proposed ecosystem restoration features will have the potential to benefit proposed and designated critical habitat (*see* April 15, 2002, amendment letter [Table 6-3]). For the proposed wildlife mitigation features identified in Table

6-3 of the 2001 BA amendment letter, these sites are likely to have limited, localized negative effects on the elements of proposed and designated critical habitats during construction. Once constructed, these sites are likely to provide long-term benefits to the elements of proposed and designated critical habitat.

Direct effects to critical habitat will also occur from implementation of wildlife mitigation measures and implementation of ecosystem restoration features. Ecosystem restoration features that are proposed at the Bachelor Slough site are likely to result in initial, temporary adverse direct effects to critical habitat features, but over the long-term, are likely to produce beneficial effects that would improve current baseline conditions.

Ecosystem restoration features at Tenasillahe Island (interim and long-term) and for the associated tidegate improvements will likely have limited adverse direct effects to proposed and designated critical habitat associated with construction, but over the long term, the direct effects to critical habitat of these actions will improve access to a larger habitat base and improved export of vegetative detritus, insect fauna and large woody debris. The introduction of white-tailed deer at Cottonwood-Howard Island has no direct effect on ESA-listed salmonids or their proposed and designated critical habitat.

The ecosystem restoration feature to reduce purple loosestrife will use the release of up to four species of beetles as biological control agents to reduce purple loosetrife distribution. This action will help control this invasive plant species in the Columbia River estuary and thereby re-establish the diverse native vegetation of tidal marsh habitats. Accordingly, this restoration feature is likely to benefit critical habitat for ESA-listed salmonids. These removal of purple loosestrife should benefit habitat complexity, connectivity, or conveyance, feeding habitat opportunity, refugia, and habitat-specific food availability within the Columbia River estuary.

The ecosystem restoration feature to improve water flow and water quality circulation at Lord-Walker and Fisher-Hump Islands via creating a network of channels would result in temporary adverse, direct effects to proposed and designated critical habitat, but over the long term would improve habitat conditions for ESA-listed salmonids.

7.1.4 Summary of Effects of the Proposed Action on Critical Habitat

In addressing potential impacts critical habitat from the Project, NMFS reviewed how the ecosystem pathways and indicators that describe estuary functions as described in conceptual ecosystem model will be affected by this Project. The conceptual ecosystem model and associated ecosystem pathways and indicators not only addresses short-term, direct impacts from the Project, but also long-term indirect effects during the period of operation and maintenance (50 years and beyond) that could affect the recovery of ESA-listed salmonids. Therefore, these tools and the analysis in this Opinion also address the potential effect of the Project on the conservation value of proposed and designated critical habitat.

For the existing disposal sites identified in the amendment letter to the 2001 BA and analyzed in section 6.2.1 of this Opinion (Direct Effects), the disposal operations at existing upland sites are likely to have limited, localized negative effects on the PCEs for proposed and designated critical habitats, with longer-term benefits. Because of their location, the new upland disposal

sites identified in the Corps' April, 2002, letter do not provide PCEs for proposed and designated critical habitat.

Indirect effects are analyzed in section 6.2.2 of this Opinion. The effects analysis from NMFS' 2002 Opinion addresses the newly-proposed PCEs. This is because the essential features addressed in the 2002 Opinion (*i.e*, substrate, water quality, food, riparian vegetation, and safe passage conditions) are encompassed by these new PCEs. The analysis for physical indicators such as bathymetry and salinity illustrated that the potential effects from the Project are limited in nature and not anticipated to affect critical habitat to any appreciable degree.

In addressing potential impacts critical habitat from the Project, NMFS also recognizes that the adaptive management process identified in the 2002 Opinion will be an essential tool to respond to new information generated from Project monitoring. This mechanism provides the ability to add future conservation measures to the Project if new information suggests that effects to habitat might diminish its value in a way that would affect species recovery.

8. CUMULATIVE EFFECTS

8.1 Introduction

Cumulative effects are defined in 50 C.F.R. part 402.02 as "those effects of future State or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation." The action area of the proposed action under consideration encompasses the Lower Columbia River (from Bonneville Dam downstream to the upper end of the estuary at RM 40), estuary (RM 40 to RM 3), and river mouth (RM 3 to the deep water disposal site).

The Project area is currently a disturbed estuarine ecosystem altered by previous dredging to establish the navigation channel, disposal of dredged material, diking and filling, sewage and industrial discharges, water withdrawal, and flow regulation, to highlight a few of the anthropogenic activities that have occurred over the last 100 years. Future Federal actions, including the ongoing operation of hydropower systems, hatcheries, fisheries, and land management activities are being (or will be) reviewed through separate Section 7 consultation processes and are not considered cumulative effects.

State, Tribal, and local government actions are likely to be in the form of legislation, administrative rules, or policy initiatives. Government and private actions may include changes in land and water use patterns, including ownership and intensity, any of which could affect ESA-listed salmonids or their habitats. Even actions that are already authorized are subject to political, legislative, and fiscal uncertainties. These realities, added to the geographic scope of the action area, which encompasses numerous government entities exercising various authorities and many private land holdings, make any analysis of cumulative effects difficult. This section identifies representative actions and ongoing state and Tribal fish and habitat restoration plans that, based on currently available information, are reasonably certain to occur. It also identifies, to the extent currently possible, existing goals, objectives, and proposed plans by state and Tribal governments. However, NMFS is unable to determine at this point in time whether such