US Army Corps
of Engineers®
Walla Walla District

YAKIMA RIVER DELTA ECOSYSTEM RESTORATION

FINAL FEASIBILITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

Richland, Washington

Section 1135 of the Water Resources Development Act of 1986

September 2024

EXECUTIVE SUMMARY

The U.S. Army Corps of Engineers (USACE) conducted this study under the Continuing Authorities Program, in accordance with Section 1135 of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL) 99-662], as amended by WRDA 1996, Section 204 (PL 104-303, and codified as 33 USC § 2309), for *Project Modifications for Improvement of Environment.* Section 1135 authorizes a non-Federal sponsor (NFS) to partner with USACE and cost-share the planning, design, and construction of a project to contribute to the restoration of habitat degraded by the construction or operation of a Federal project. The conditions of this authority require the NFS to provide all necessary lands and to conduct long-term project operations and maintenance. The Washington Department of Fish and Wildlife is the NFS of this project to restore the ecosystem on the Yakima River Delta, located in the Lower Yakima River, in Richland, Washington.

The purpose and need for the project are to improve ecosystem structure, function, and processes of the Yakima River Delta (Delta) near Richland, Washington, which was degraded by construction of the McNary Dam and Reservoir Project and the Tri-Cities Levees on the Columbia River, including an approximately 550-foot-long and 40-foot-wide earthen causeway connecting the southside of Bateman Island to the mainland. The intended goal of any preferred action, or the Recommended Plan, is to restore riparian and aquatic habitat and ecosystem functions for the benefit of ESA-listed salmonids and other fish, birds, and wildlife in the study area at the Yakima River Delta and, where possible, provide education and recreation access.

Restoration alternative plans were developed to satisfy the study's purpose and need while limiting impacts to authorized project purposes (e.g., navigation), safety, and the quality of the human environment. In addition, alternatives could not violate any project-specific constraints. The USACE planning process was used to develop a final array of three alternatives (including the No Action Alternative). The two action alternatives (Alternatives 2 and 3) would fully breach the causeway to allow for improvements to fish habitat with or without additional riparian habitat restoration, as follows:

- The No Action Alternative.
- Alternative 2a, Full Removal of Causeway with Riparian Habitat.
- Alternative 3a, Full Removal of Causeway without Riparian Habitat.

For each restoration alternative, benefits for aquatic habitat were estimated by the Project Delivery Team using the General Salmon Habitat Model developed by the Engineer Research and Development Center Environmental Laboratory. Juvenile Chinook salmon were used as the indicator species during modeling efforts. Additionally, cost estimates for each alternative were developed as an average annual cost and included amortized initial construction costs over a 50-year project life, plus annual maintenance costs from the base year (2020). Costs for each measure were annualized using the USACE Institute for Water Resources Planning Suite II decision support software and cost effective and incremental cost analyses were conducted.

Each alternative was evaluated and compared based on its ability to address the planning criteria of acceptability (environmental effects), completeness, effectiveness (biological benefits), and efficiency (cost benefits). This process identified the National Ecosystem Restoration plan and Total Net Benefits Plan that reasonably maximizes ecosystem restoration benefits relative to costs, in consideration of other effects.

The Recommended Plan is Alternative 3a, full removal of causeway without additional riparian habitat restoration. This plan provides the combined improved habitat net benefit of 53.6 Average Annual Habitat Units for the 50-year annualized cost of $455,000. Removal of the causeway would improve the flows around the island and allow for cooler water to improve habitat for salmonids.

The total project first cost for the Recommended Plan (not including the feasibility study) is estimated to be $12.4 million. The costs include excavation of the causeway with an estimated 30 percent contingency to include monitoring and adaptive management, and minimal long-term operation and maintenance costs. The unadjusted total first cost share split is Federal responsible for 75 percent and NFS responsible for 25 percent. Including the feasibility study and after appropriate waivers have been applied, this results in an estimated Federal cost of $10 million and an estimated NFS share of $3.2 million, see table below.

Table ES-1. Total Project Costs with Associated Cost Share (including feasibility study)*

Shared Costs	Project Costs
Federal Cost Share	$10 million
NFS Cost Share	$3.2 million
Total Project Cost Share	$13.2 million

*FY24 OCT 2023 Price Level

YAKIMA RIVER DELTA ECOSYSTEM RESTORATION
FINAL FEASIBLITY REPORT WITH INTEGRATED ENVIRONMENTAL ASSESSMENT

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Note to the reader: Sections of this report required for compliance with the National Environmental Policy Act of 1969 (NEPA) are marked by an asterisk (*) in the table of contents and have been integrated into the feasibility report for this project, in accordance with NEPA and Engineer Regulation 1105-2-100.

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ACRONYMS AND ABBREVIATIONS

AAC	Average Annual Cost
AAHU	Average Annual Habitat Units
AIRFA	American Indian Religious Freedom Act
AM&M	Adaptive Management and Monitoring
BGEPA	Bald and Golden Eagle Protection Act
BPA	Bonneville Power Administration
CAA	Clean Air Act
CAP	Continuing Authorities Program
CCT	Confederated Tribes of the Colville Reservation
CEQ	Council on Environmental Quality
CFR	Code of Federal Regulations
CTUIR	Confederated Tribes of the Umatilla Indian Reservation
CWA	Clean Water Act
DDT	dichlorodiphenyltrichloroethane
EA	Environmental Assessment
Ecology	Washington State Department of Ecology
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
ERDC	Engineer Research and Development Center
EO	Executive Order
EQ	Environmental Quality
ESA	Endangered Species Act
°F	degree Fahrenheit
FONSI	Finding of No Significant Impact
FR/EA	Feasibility Report with Integrated Environmental Assessment
FR	Federal Register
ft/sec	feet per second
FWCA	Fish and Wildlife Coordination Act
GHG	greenhouse gas
GSHM	General Salmonid Habitat Model
HMU	Habitat Management Unit
HIS	Habitat Suitability Index
HTRW	Hazardous, Toxic, or Radioactive Waste
HU	habitat unit
IDC	interest during construction
IPAC	Information for Planning and Consultation
IWR	Institute for Water Resources
LERRD	Lands, Easements, Rights-of-Way, Relocations, and Disposals
MBTA	Migratory Bird Treaty Act
MCF	Mid-Columbia Fisheries Enhancement Group
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NEPA	National Environmental Policy Act

NED	National Economic Development
NER	National Ecosystem Restoration
NHPA	National Historic Preservation Act
NMFS	National Marine Fisheries Service
NRHP	National Register of Historic Places
NFS	Non-Federal Sponsor
O&M	Operations and Maintenance
OSE	Other Social Effects
PL	Public Law
PCB	polychlorinated biphenyl
PED	Planning, Engineering, and Design
REC	recognized environmental condition
Reclamation	Bureau of Reclamation
RED	Regional Economic Development
SHPO	State Historic Preservation Officer
SMA	Shoreline Management Act
SMP	Shoreline
USFWS	United States Fish and Wildlife Service
USC	United States Code
WA	Washington
WDFW	Washington Department of Fish and Wildlife
WDNR	Washington Department of Natural Resources
WRDA	Water Resources Development Act
USACE	U.S. Army Corps of Engineers
USFWS	U.S. Fish and Wildlife Service
Yakama Nation	The Confederated Tribes and Bands of the Yakama Nation
YRBWEG	Yakima River Basin Watershed Enhancement Workgroup

SECTION 1 - INTRODUCTION

1.1 PURPOSE OF REPORT

This Yakima River Delta Ecosystem Restoration Feasibility Report with Integrated Environmental Assessment (FR/EA) presents the results of a collaborative ecosystem restoration feasibility study conducted by the U.S. Army Corps of Engineers (USACE), Walla Walla District and the Washington Department of Fish and Wildlife (WDFW), the non-Federal sponsor (NFS). The report considers, identifies, and evaluates alternatives for restoring aquatic habitat and ecosystem functionality to the Yakima River Delta in Richland, Washington, as well as any potential environmental effects. A recommended plan, also known as the preferred alternative, is identified. The report contains the following:

- A description of existing conditions for the study area.
- Problems identified and a description of future conditions without the project.
- An assessment of the alternatives and opportunities to restore the degraded habitat in the area.
- An evaluation of technical, environmental, and institutional feasibility of the proposed action to address environmental restoration opportunities.
- The recommendation of a recommended plan.

1.2 SCOPE OF THE REPORT

This FR/EA incorporates the USACE planning process contained in Engineering Regulation (ER) 1105-2-100 (Planning Guidance Notebook) and ER 1105-2-103 (Policy for Conducting Civil Works Planning Studies) with the requirements of the National Environmental Policy Act (NEPA) of 1969, as amended, 42 United States Code (USC) §§ 4321-4335 and implementing regulations, 40 Code of Federal Regulations (CFR) Parts 1500-1508, and 33 CFR Part 230. This report documents the results of the planning process, recommends a plan, and determines whether the project proposed by USACE constitutes a “major Federal action affecting the quality of the human environment” [NEPA, Section 102(c)], and whether an Environmental Impact Statement (EIS) is required. The USACE planning process is not a separate effort from the NEPA process. Planning implements NEPA into the alternative development and evaluation with overlap throughout feasibility. Table 1-1 includes a crosswalk between the USACE planning process and NEPA.

Table 1-1. Plan Formulation and National Environmental Policy Act Crosswalk

Plan Formulation Step	NEPA Compliance
Scope for Project	Scope for NEPA
Specify Problems & Opportunities, Objectives & Constraints	Describe Purpose & Need consistent with project scope
Inventory and Forecast Conditions (Future Without)	Describe existing conditions, trends, No Action alternative
Formulate alternative plans to address Objectives	Include reasonable range of alternatives that address Purpose and Need
Evaluate effects of alternative plans	Evaluate alternatives' effects to resources.
Compare alternative plans	Compare alternatives to No Action, ID the Environmental Alternative
Select a Tentative Selected Plan	Identify the Agency Preferred Plan
Release for Public Review	Release for Public Review

USACE implements the national objective for ecosystem restoration in response to legislation and administration policy (Engineer Regulations 1105-2-100 and 1165-2-501). This objective is to contribute to the Nation's ecosystems through restoration. National Ecosystem Restoration (NER) benefits are typically measured by changes in habitat quality and quantity. This study focuses on NER benefits.

1.3 STUDY AUTHORITY

This study was conducted under the Continuing Authority Program (CAP), which is comprised of nine authorities for small studies done in partnership with a non-Federal sponsor. This feasibility study was conducted under the authority of the Water Resources Development Act (WRDA) of 1986 [Public Law (PL) 99-662], Section 1135, as amended by WRDA 1996, Section 204 (PL 104-303, and codified at 33 USC § 2309a) for *Project Modifications for Improvement of Environment*. This authority states:

> "(c) Restoration of Environmental Quality
>
> (1) In general, if the Secretary determines that construction of a water resources project by the Secretary or operation of a water resources project constructed by the Secretary has contributed to the degradation of the quality of the environment, the Secretary may undertake measures for restoration of environmental quality and measures for enhancement of environmental quality that are associated with the restoration, through modifications either at the

> project site or at other locations that have been affected by the construction or operation of the project, if such measures do not conflict with the authorized project purposes."

Section 1135 authorizes USACE to modify and construct projects to restore ecosystem functions degraded by USACE projects. The USACE Project, creating the impoundment of the McNary pool (Lake Wallula) in the 1950s, flooded shallow benches along much of the reservoir shoreline. The construction of the Tri-Cities Levees eliminated natural shallow water aquatic habitat and removed riparian vegetation. Both actions resulted in an overall degradation of riparian and aquatic habitat throughout the entire reservoir, including Yakima River Delta. An estimated 82 percent of riparian and shallow water habitat that formerly provided critical rearing sites for juvenile salmonids, birds, wildlife, and other aquatic species listed under the Endangered Species Act (ESA) was lost following the construction of McNary Dam and the Tri-Cities Levees and the filling of Lake Wallula. Loss of habitat is one of the contributing factors leading to the decline of salmonid species.

1.4 STUDY SPONSOR AND COOPERATING AGENCIES

The NFS for the Yakima River Delta Ecosystem Restoration project is the Washington Department of Fish and Wildlife (WDFW). The NFS is responsible for 50 percent of the feasibility study costs over $100,000 for CAP 1135 projects and 25 percent of the costs of design and construction. The NFS is also responsible for all land acquisition and easements, as well as project operation and maintenance (O&M).

Cooperating Agencies for this project are United States Fish and Wildlife Service (USFWS), Washington State Department of Ecology (Ecology), Confederated Tribes of the Umatilla Indian Reservation (CTUIR), and Confederated Bands and Tribes of the Yakama Nation (Yakama Nation). These agencies and tribes participate in meetings throughout the planning process to provide data on local resources to support the development of alternatives.

1.5 PROJECT PURPOSE AND NEED*

The purpose of the proposed action is to improve ecosystem structure, function, and processes of the Yakima River Delta near Richland, Washington, which was degraded by construction of the McNary Dam and Reservoir Project (Figure 1-1), to benefit native fish and wildlife, including juvenile and adult salmon and steelhead as they migrate through the Delta.

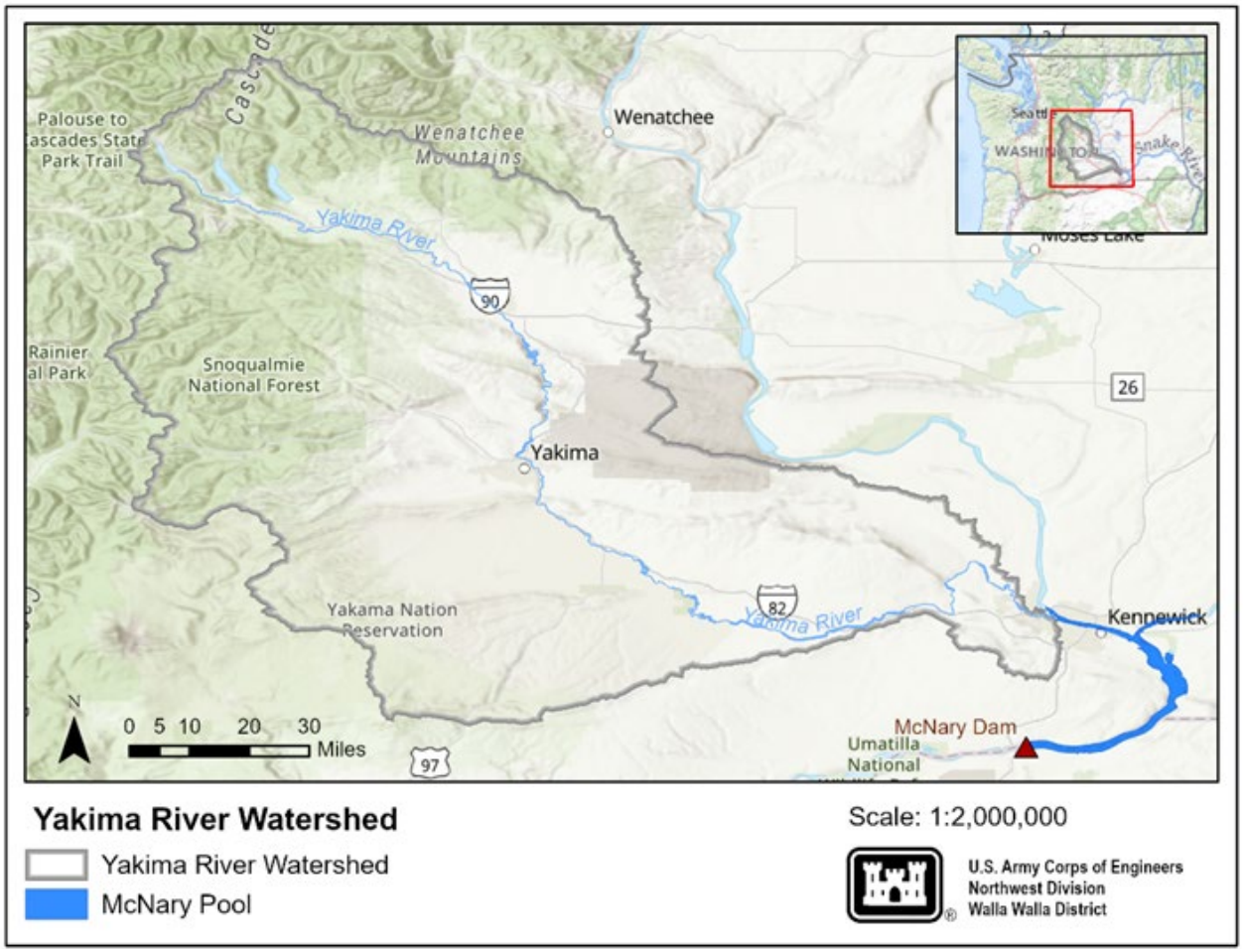

Figure 1-1. Location of Yakima River Watershed and McNary Dam

The proposed action is needed because the construction and ongoing Operation and Maintenance (O&M) of McNary Lock and Dam and the Tri-Cities Levees on the Columbia River have contributed to the degradation of the ecosystem within the Yakima River Delta including poor habitat conditions for native fish and reduced biodiversity. Impoundment of the McNary Dam reservoir (Lake Wallula) inundated the lower 2 miles of the Yakima River, eliminating riparian and aquatic habitat, and changing the hydraulic conditions within the Delta, impacting juvenile and adult salmonid migration through the Yakima River's confluence with the Columbia River. This inundation turned the southern side of the Delta into a backwater that became ideal habitat for non-native predatory fish and invasive plants. This backwater effect has reduced the ability of the Yakima River to carve and maintain shallow side channels and has promoted excess sediment deposition. These changes to the ecosystem have caused delays to upstream migration and contribute to increased straying (diverting from normal migration pathway), diminished health, and lower reproductive success in adult salmonids and the possible increase in predation on smolts.

Sedimentation from inundation, in combination with blocked flows south of Bateman Island, created a large stagnant, shallow backwater environment with higher water temperatures that supports large monotypic stands of stargrass and algal mats which cause extreme daily

fluctuations of dissolved oxygen (hyperoxic to anoxic). Dissolved oxygen levels are crucial for the respiration of aquatic organisms. Coldwater fish species, such as salmonids (salmon, steelhead, and trout), are especially sensitive to fluctuations in dissolved oxygen because their threshold for oxygen concentration is greater and narrower than other warm water fish species. In addition to the direct impacts on juvenile salmon and steelhead health, the backwater conditions support multiple species of predatory fish, which prey on juvenile salmon during their outmigration.

1.6 STUDY AREA

The Yakima River Delta is located at the confluence of the Columbia and Yakima Rivers, at approximately Columbia River Mile (RM) 335 (Figure 1-2 and Figure 1-3). It is situated within Richland, Washington. Bateman Island lies just east of the Delta, located adjacent to the mainland, directly north of Wye Park. An approximately 550 foot-long and 40-foot-wide earthen causeway extends from the mainland, south of the delta, directly to Bateman Island. Columbia Park Marina sits along the south side of the Delta to the south of Bateman Island and east of the earthen causeway. The zone of influence from McNary Dam extends up the Yakima River to just past the Interstate 182 (I-182) Bridge (around Yakima River Mile 2). The Yakima River flows into the Columbia River at the I-182 Bridge, downstream under the Highway 240 bridge into the Delta, and then back up around the northern tip of Bateman Island. Approximately 17 miles of Federal levees were constructed as part of the McNary Dam and Reservoir Project on the banks of the Columbia River to confine the Reservoir and maximize available upland, which also protects the cities of Kennewick, Richland, and Pasco, Washington, from inundation, especially during high water events.

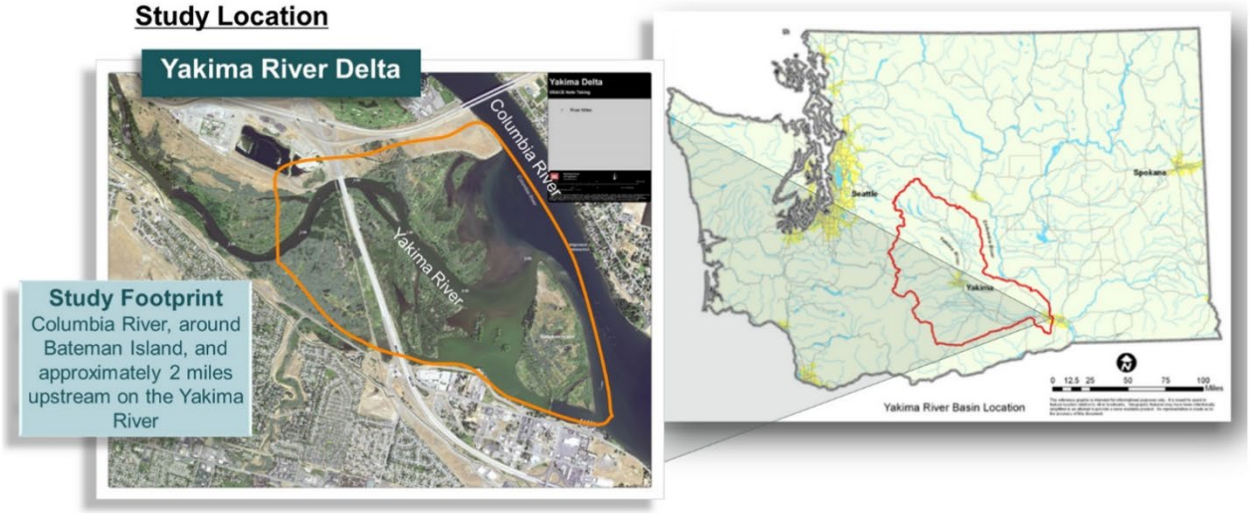

Figure 1-2. Study Location

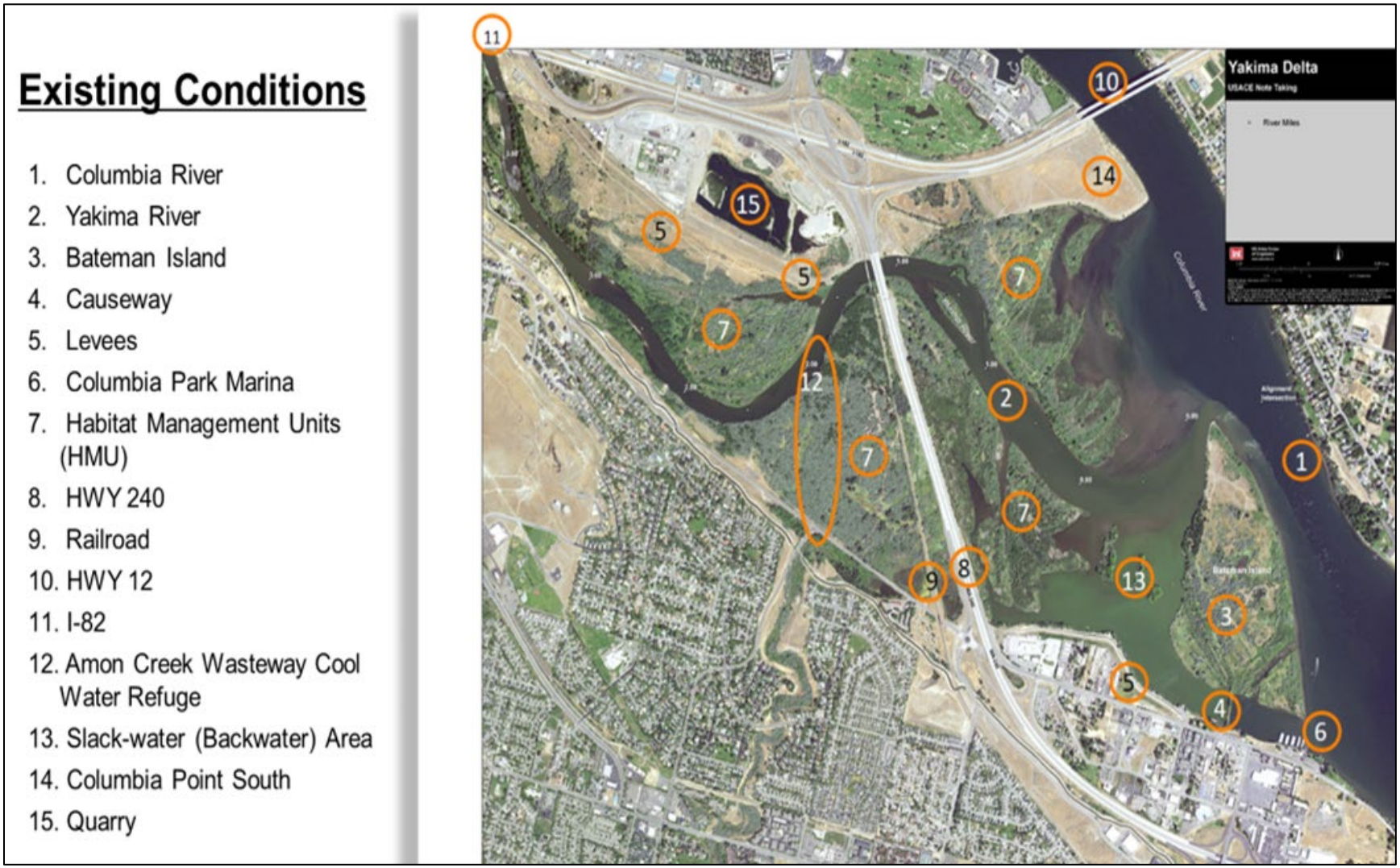

Figure 1-3. Locations of Existing Infrastructure and Landmarks

1.7 BACKGROUND

Prior to the construction of McNary Dam and the Federal levee system in the 1950s, the Yakima River Delta supported a variety of woody vegetation and shallow water channels that were inundated seasonally. Agriculture practices have been established since 1908 along the Columbia River shoreline. The existing causeway (Figure 1-4) to Bateman Island is estimated to be built around 1940, according to historic imagery (Figure 1-5), prior to the construction of McNary Dam.

Figure 1-4. Existing Causeway at Bateman Island

Figure 1-5. 1940 Aerial Photo Showing Location of Causeway

Even with agricultural development in the area, the habitat within the Delta supported an abundance of juvenile salmonids, birds, wildlife, and other aquatic species. When Lake Wallula was created by McNary Dam, many acres of riparian and aquatic habitat were inundated, changing hydrologic conditions within the Delta, and impacting the ability of juvenile and adult salmonids to safely migrate through the hot, stagnant waters of the Delta. In addition to the McNary Dam, other contributing factors resulted in the entire area becoming significantly degraded, and many of the species supported by this habitat are now listed under the ESA.

The southern side of the Delta became a backwater supporting ideal habitat for non-native and native predatory fish and invasive plants. This stretch of the Yakima River now has limited ability to carve and maintain shallow side channels, to flush out excess sediment, and maintain healthy riparian fringe habitat. Rather, the riparian fringe is dominated by non-native Russian olive trees and cattails with some common reed.

Because sediment transport is now impaired, more fine sediments settle in pool areas and cover the gravels needed by juvenile salmonids for camouflage and feeding. The temperatures in the summer and early fall within the backwater can be as high as 32 degrees Celsius (°C) (89.6 degrees Fahrenheit [°F]), creating a thermal barrier that impedes fish passage. These high temperatures, when combined with nearly stagnant backwater conditions, contribute to algal blooms and unsafe water conditions in the project area.

Loss of habitat and impediments to migration have long been recognized as contributing factors to the decline of several salmonid species. In the project area, several species are listed under the ESA: Middle Columbia River steelhead (*Oncorhynchus mykiss*) were listed as threatened on March 25, 1999 (64 Federal Register [FR] 14517); Upper Columbia River steelhead (*O. mykiss*) were listed as endangered in 1997 (62 FR 43937), but reclassified as threatened on January 5,

2006 (71 FR 7834); Upper Columbia River spring Chinook salmon (*O. tshawytscha*) were listed as endangered on March 24, 1999 (64 FR 14208); and bull trout (*Salvelinus confluentus*) were listed as threatened on June 10, 1998 (63 FR 31647).

In addition to the listed stocks, several salmon stocks have recently been reintroduced into the Yakima River through collaboration between the Yakama Nation and many other state and Federal agencies. These include coho salmon (*O. kisutch*), spring Chinook salmon, summer Chinook salmon (*O. tshawytscha*), sockeye (*O. nerka*), and Pacific lamprey (*Entosphenus tridentatus*).

Native plants such as tule (*Schoenoplectus acutus*), wapato (*Sagittaria latifolia*), and willow (*Salix* spp.) were once abundant in the Delta. Tule and wapato were both food sources when the Lewis and Clark Expedition came through the area, although use of these native plants changed over time as the plants declined. The restoration of riparian habitat in the Delta could facilitate a return of these plants.

1.8 RESOURCE SIGNIFICANCE

Yakima River Delta is in the middle reach of the Columbia River, an area estimated to have lost aquatic and riparian habitat available prior to the construction of McNary Lock and Dam, impoundment of Lake Wallula, and construction of the Tri-Cities Levees. The significance of the environmental resources lost in this reach of the Columbia River, including the Yakima River Delta, have been considered relative to Institutional, Public, and Technical Recognition. Each of these sources of recognition are analyzed below for ESA-listed salmon, steelhead, and bull trout, and their critical habitats.

1.8.1 Institutional Recognition

The NFS for the project (WDFW) is an active member of the Yakima River Basin Watershed Enhancement Workgroup (YRBWEG). The YRBWEG is a large regional group consisting of representatives from WDFW, US Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), Washington Department of Natural Resources (WDNR), Ecology, City of Richland, Benton Franklin Mosquito Control District, Benton Conservation District, Bonneville Power Administration (BPA), Mid-Columbia Fisheries Enhancement Group (MCF), the Yakama Nation, CTUIR, and Columbia Park Marina. The group also peripherally includes special interest groups such as the Audubon Society, boaters, and anglers. This large group of stakeholders has worked for over a decade to try and restore the functionality of the Yakima River and its delta and developed the Yakima Basin Integrated Plan for accomplishing this mission.

The group has several goals for the Basin and is developing ideas to protect the environment, improve water supply during drought scenarios, provide efficient and adaptable water supply management, and work towards a sustainable and resilient environment. They plan to achieve this through fish passage at all reservoirs, groundwater storage, surface water storage, habitat

and wetland protection and enhancement, and enhanced water conservation. It will also be accomplished through a series of structural and operational changes at facilities throughout the Yakima River Basin.

The Yakima River Delta project is one of several projects identified in the Yakima Basin Integrated Plan intended to balance water uses for fish and wildlife, irrigation, and consumptive water use. The YRBWEG Workgroup has implemented or planned over 60 projects in the Yakima Basin, focused on restoring ecosystems within the watershed. The full cost of the integrated plan developed by the YRBWEG Workgroup is over $4.1 billion and includes significant habitat improvements upstream of the proposed project area. These projects include stream restoration, passage improvements, riparian restoration, operational changes, and additional water rights. The Yakima River Delta project is the most downstream site that would impact the success of upstream basin investments.

Several individual projects are being planned, are in progress, or have already been completed as part of the Integrated Plan, including permanent protection and floodplain restoration of the 50,000-acre Teanaway Community Forest, construction of a juvenile fish passage facility at Cle Elum Dam, removal of Nelson Dam on the Naches River, multiple large woody debris projects on the mainstem of the Yakima River and tributaries, culvert replacements on the Little Naches River, and many others (see The Yakima Basin Integrated Water Resource Management Plan (arcgis.com).

The purpose of the ESA is to provide a means whereby ecosystems upon which endangered and threatened species depend may be conserved, and to provide a program for the conservation of such endangered and threatened species. Loss of habitat and migration impediments have been identified as contributing factors leading to the decline of ESA listed salmonid species at Yakima River Delta. This project would improve riverine ecological processes, fish migration, riparian habitat, and rearing/holding habitat for juvenile and adult salmonids for ESA-listed species [Middle Columbia River steelhead (Oncorhynchus mykiss), listed as threatened March 25, 1999 (64 FR 14517); Upper Columbia River steelhead (O. mykiss), originally listed as endangered in 1997 (62 FR 43937) and reclassified as threatened January 5, 2006 (71 FR 834); Upper Columbia River spring Chinook salmon (O. tshawytscha), listed as endangered March 24, 1999 (64 FR 14208); and bull trout (Salvelinus confluentus), listed as threatened June 10, 1998 (63 FR 31647).

1.8.2 Public Recognition

Public recognition of the significance of the resource comes in the form of natural resource conservation and birding groups, as well as from recreational groups. All these non-governmental organizations have united to find solutions to the problems in the Delta.

The project study area contains significant cultural resources. The area is partially encompassed within the National Register Listed Tri-Cities Archaeological District, underscoring the multitude of important resources located near the Delta. Additionally, the area contains a number of

historic properties of religious and cultural significance to Indian Tribes. USACE invests heavily in the management of these resources on Federally owned lands, and effects to these areas are of importance in the planning process for this project, the CTUIR, and the Yakama Nation.

1.8.3 Technical Recognition

The Delta is part of the migration corridor for several species of salmonids listed under the ESA, as well as the culturally significant Pacific lamprey. The loss of the natural dynamics of hydrology and geomorphic character caused by the inundation of Lake Wallula have taken a toll on the biodiversity of flora and fauna in the Delta. Stagnant backwater and extremely high temperatures have resulted in creating both a barrier to migrating fish and an eminently suitable habitat for predator fish such as smallmouth bass (*Micropterus dolomieu*) and northern pikeminnow (*Ptychocheilus oregonensis*), and channel catfish (*Ictalurus punctatus*).

1.9 PAST AND ONGOING STUDIES AND REPORTS

As part of the Yakima Basin Integrated Plan, numerous studies, reports, as well as projects, have been completed. In 2004, USACE prepared a draft report that presented the results of a CAP Section 1135 study to modify the Yakima River Delta through ecosystem restoration and enhancement. The NFS at that time was the City of Richland. The preferred plan would have breached the causeway in some fashion, while still providing access to Bateman Island. It would also have created several strips of riparian vegetation and added additional recreational opportunities (USACE, 2004). The historic City of Richland 1135 study was cancelled on or around 2004.

Benton Conservation District completed a report in 2011, entitled *Assessment of the Lower Yakima River in Benton County, Washington* (Benton Conservation District, 2011). This report evaluated conditions in the Delta and identified and prioritized actions to benefit both local and basin-wide salmon recovery efforts. It identified several high-priority actions, based on coordination with local government and the surrounding communities, ability for near-term completion, and probability of success in improving conditions in the Delta.

In 2016, MCF commissioned a report, entitled *Bateman Island Causeway Modification Conceptual Design Report* (MCF, 2016). This report is focused on the assumption that the Bateman Island causeway is the primary driver of high temperatures within the Delta and, using public input and scientific data, the group developed eight alternatives to modify conditions around Bateman Island.

Yakima River Basin Water Storage Feasibility Study, Final Planning Report/Environmental Impact Statement was released by the US Bureau of Reclamation (Reclamation) in December of 2008 (Reclamation, 2008a). This report evaluated the feasibility of water storage augmentation to benefit fish, irrigation, and future municipal water supply for the Yakima River Basin.

A technical report, entitled *Sediment Transport Modeling of the Yakima Basin*, was released by Reclamation in January 2008 (Reclamation, 2008b) as part of the larger feasibility study. This report provided information about substrate, scour, and sand deposition to support the water storage feasibility study being conducted in the Yakima River Basin.

In addition, numerous ongoing and/or proposed basin-wide projects are in the process of being considered or close to construction, shown in Table 1-2.

Table 1-2. Ongoing and/or Proposed Projects within the Yakima River Basin

Structural and Operational Changes
• Columbia River Systems Operations/McNary Dam Operations • Cle Elum Pool Raise • Modify Kittitas Reclamation District canals to provide efficiency servings • Decrease power generation at Rosa Dam and Chandler power plant to support outmigration of juvenile fish • Efficiency improvements to Wapato Irrigation Project
Provide Reservoir Fish Passage
• Cle Elum Dam • Tieton (Rimrock) Dam • Clear Lake Dam (bull trout and salmon passage) • Keechelus Dan • Kachess Dam • Bumping Lake Dam
Surface Water Storage
• Surface storage facility at Wymer Creek • Tap into additional water to inactivate • Increased storage at Bumping Dam
Groundwater Storage
• Evaluate recharging shallow aquifers via surface infiltration • Build an aquifer storage and recovery facility for Yakima to draw water from the Naches River during high flows and store it underground for use during low flow periods
Enhanced Water Conservation
• Implement agricultural water conservation program • Create fund to promote water use efficiency by offering incentives Basin-wide
Habitat/Watershed Protection and Enhancement
• Acquire and protect high elevation portions of the watershed and forest shrub and steppe habitat • Evaluate potential Wilderness, Wild and Scenic River, etc., designations to protect streams and habitat • Create habitat enhancement programs • Planting riparian vegetation and restoring floodplain function and values • Updating McNary Shoreline Master Plan

Market Reallocation
• Use a water market and/or water bank to improve water supply in the Basin by: Near-Term: Continuing existing water marketing and banking programs, but begin reducing barriers to water transfers Long-Term: Facilitate water transfers between irrigation districts

Source: Yakima Basin Integrated Plan, 2019

SECTION 2 - AFFECTED ENVIRONMENT*

All planning studies begin with a discussion of current conditions within the project footprint and the changes in those conditions that would be seen if a project is not implemented.

This section provides the inventory of general conditions that could be influenced by ecosystem restoration within the Yakima River Delta.

The following resource areas are assessed: Air Quality, Noise, Sediments, Hydrology, Water Quality, Aquatic Resources, Threatened and Endangered Species, Wetlands, Wildlife, Vegetation, Land Use, Recreation, Climate Change, Cultural and Historic Resources, Economics/Socioeconomics/ Environmental Justice, Public Infrastructure, Hazardous, Toxic, and Radioactive Waste, and Aesthetics/Visual. It was determined that it was not necessary to further evaluate Geology, Floodplains, or Public Utilities in detail, as implementation of the selected alternative would have no effects on these resources (Table 2-1).

Table 2-1. Resources Not Impacted

Environmental Component	Explanation
Geology	The proposed action would not modify the geology of the Yakima River.
Floodplain	The proposed action would not modify the floodplain. The floodplain is constricted by levees along the shoreline.
Public Utilities	The proposed action would not modify Public Utilities or utility corridors.

2.1 AIR QUALITY

Under the Clean Air Act (CAA) National Ambient Air Quality Standards (NAAQS) are established for six common air pollutants. These 'criteria' pollutants are Carbon monoxide (CO); Lead (Pb); Nitrogen dioxide (NO2); Ozone (O3); Particle or particulate matter (PM); and Sulfur dioxide (SO2). Ecology monitors these pollutants and takes action if levels become unhealthy. Washington's State Implementation Plan gives communities the tools to restore air quality to meet national air quality standards when an area fails to meet such standards. The Tri-Cities area, inclusive of the Yakima River Delta, currently meets air quality standards, but is subject to monitoring. The nearby Kennewick-Metaline site is an area of concern for PM criteria air pollutants, but the area remains in attainment of the State Implementation Plan for all criteria pollutants. The CAA General Conformity Rule ensures that the actions taken by Federal agencies in nonattainment and maintenance areas do not interfere with a state's plans to meet national standards for air quality.

2.2 NOISE

The Clean Air Act of 1990, Subchapter IV-A – Title IV - Noise Control designates subchapter IV, paragraph (c) "Abatement of noise from Federal activities" requires Federal agencies carrying out an activity resulting in noise determined to rise to the level of a public nuisance to determine possible means of abating such noise. Washington state considers any loud noise between 10:00 PM and 07:00 AM to be noise pollution unless a local ordinance sets different standards. The City of Richland sets the standard for prohibited public nuisance noise as any sound made by the construction, excavation, repair, demolition, destruction, or alteration of any building, property or upon any building site between the hours of 09:00 PM and 07:00 AM which is audible greater than 50 feet from a residential district, but provides exceptions for sounds originating from temporary construction sites.

The Project area is adjacent to a marina and busy public roadways where noise levels can be relatively high during active hours but is also adjacent to recreational areas (Bateman Island, Wye Park, and Columbia Park) where high noise levels can degrade the enjoyment of the sites. There are no residential areas close to the Bateman Island Causeway. According to the 2020 National Transportation Noise Map, the noise in the vicinity of the parks adjacent to the causeway can be as high as 70.0-79.9 decibels (dBA). The noise level of a backhoe can range from 79 to 89 decibels.

2.3 SEDIMENTS

Soils consist of loamy fine sands, silt sands, and sandy loams along the Yakima River from the Ice Ages to present day. The Delta of the Yakima River accumulates deposited sediments from upstream erosion. These deposits range from basalt gravels and cobbles to fine silt. Sediment accretion occurs within the backwater environment created behind the causeway and Bateman Island. Erosion also occurs along Bateman Island shoreline as a result of McNary Project operations. (See Section 2.5 for additional information regarding an evaluation of the potential for contaminants in the accumulated sediments of the Yakima River Delta). Sediments carried in the Yakima River continue to accumulate in varying amounts at the Delta depending upon the water year and upstream erosion conditions.

2.4 HYDROLOGY

The hydrology of the Yakima River Delta is influenced by upstream Yakima River flows, Lake Wallula, and the Columbia River. Yakima River flows are driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River are influenced by the free-flowing sections of the mid-Columbia River, operations of the public utility district (PUD) dams, and Lake Wallula. Lake Wallula, the impoundment formed by McNary Dam, extends approximately 2 miles up the Yakima River channel. Water within the Yakima River Delta flows along the northern extent of Bateman Island to the Columbia River. Water to the west and south of Bateman Island does not circulate because a constructed causeway blocks flows along the southern extent of Bateman Island, causing stagnant water and the accumulation of fine alluvial sediment along the western side of Bateman Island.

The lower Yakima River ranges from 2.5 feet to 5.5 feet deep from Prosser through West Richland but increases to more than 7 feet deep within the Lake Wallula backwater west of Highway 240 Bridge in Richland and continues to the confluence. The Delta along the western side of Bateman Island, has mean depths that are less than 2.5 feet. Deeper, cooler refugia exist throughout the lower Yakima River, typically coinciding with the location of incoming seeps and irrigation returns. There are two sites within the Yakima River Delta that feature persistent cool-water flow: Amon Creek Wasteway at RM 2.5 and a ground water collection system known locally as "the Bubble" at RM 4.9.

The rise of spring flows typically starts first with the Yakima freshet in March/April and extends through May. During this period, Yakima River flows into the study area at velocities up to 2.5 feet/second (ft/sec) very slowly mixed into the area west of Bateman Island with lower velocities (< 0.5 ft/sec) and shallow overbank inundation. The Yakima spring freshet recedes quickly through June, where the velocity in the main Yakima channel drops to < 0.5 ft/sec and velocities to the west of Bateman Island remain near-zero over extended durations for the remaining of the summer. The Columbia River freshet is generally a month after the Yakima freshet, starting in May and extending into July. During this period, velocities at the eastern edge of the Delta shelf near the main Columbia River channel exceed 2.5 ft/sec and taper to around 1.0 ft/sec to the west. The Columbia spring freshet recedes gradually through July and August, where baseline velocity in the north Delta slows to ~0.5 ft/sec.

2.5 WATER QUALITY

The lower Yakima River is currently meeting water quality standards for temperature, dissolved oxygen, pH, turbidity, and bacteria until it reaches Highway 240. Summer in-stream temperatures make the lower Yakima River inhospitable to salmonid species, and low dissolved oxygen levels threaten all aquatic life in the river.

During July and August, temperatures in the lower Yakima River are, on average, almost 4 degrees higher than in the Columbia River (source 2002 to 2009 data, US Bureau of Reclamation 2015, University of Washington Columbia River Data Access in Real Time (DART) 2015.)

The 303(d) list, so called because the process is described in Section 303(d) of the Clean Water Act (CWA), lists state waters in the polluted water category. Waters are listed on the 303(d) list when designated beneficial uses (e.g., drinking, recreation, aquatic habitat, and industrial use) are impaired by pollutants. These waters are placed in Category 5 of the water quality assessment, designating that they are impaired and will need a Total Maximum Daily Load (TMDL), pollution control program, or other action to bring the water into compliance with the water quality standards. The Columbia River and the backwater on the western side of Bateman Island are listed by Ecology as "impaired" for temperature, dissolved gas, and pH, but are Category 4 waters. Category 4 waters are still considered impaired but have an EPA-approved TMDL or pollution control program in place to address the cause of impairment.

Summer temperatures on the south and west sides of Bateman Island routinely exceed water temperature of 77°F (25° C) but can reach as high as 86°F (30° C) for sustained periods. These temperatures are a migration barrier to late-migrating salmon, including sockeye, summer Chinook, and fall Chinook.

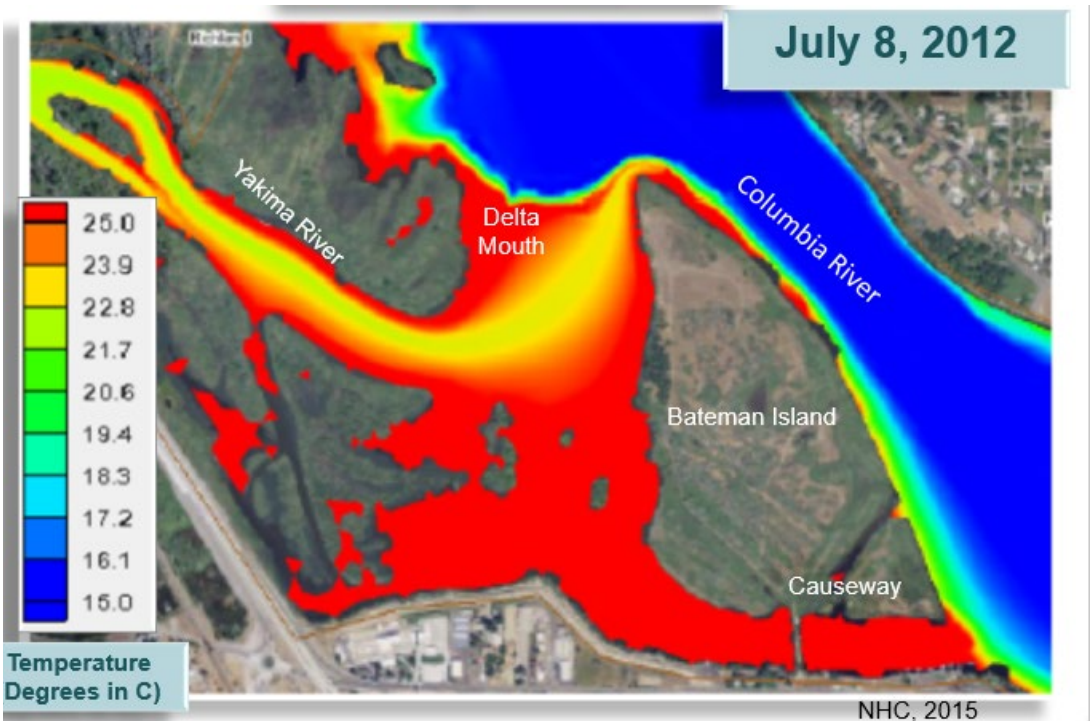

Figure 2-1. Existing near surface temperatures, NHC 2015.

Between 2008 and 2010, near surface water temperatures within the lower Yakima River mainstem (near the Highway 240 bridge) ranged from 80°F to 81°F, as compared to 82°F to 90°F at the confluence. The warmest waters in the lower Yakima River are found within the confluence, specifically within the stagnant pools located west of Bateman Island. In August 1997, thermal imaging data showed a 1- to 2-degree decrease in river temperature between the warmer Yakima River confluence and the Yakima River mainstem, and a 3-degree difference between the Columbia and Yakima Rivers (Holroyd 1998).

Data collected between May and September 2021 under the Sustainable Rivers Program (USACE 2021) measured maximum inflowing temperatures on the Yakima River of 89°F during the regional heat dome that lasted between late June and mid-July. Despite some thermal stratification, the presence of very warm inflowing Yakima River water was measured at depths up to 14 feet downstream of Highway 240. During that period, inflows from the Columbia River remained consistent with historical trends, gradually increasing towards a daily mean of 68°F through June into mid-July 2021. In the shallow waters west of Bateman Island, stagnant flow conditions and stratification of temperature and dissolved oxygen was measured. On the west side of the earthen causeway, near zero dissolved oxygen concentrations were measured during multiple periods. At the north end of Bateman Island, a narrow thalweg creates a recirculating mixing zone where temperatures tracked with Yakima River inflows through May,

then quickly transitioned in June to increase mixing of Columbia River flows once the Yakima freshet had passed. Measured fluctuations in water temperature, conductivity, and pH on the north end of Bateman were indicative of vertical stratification between the mixing of Yakima and Columbia River flows.

The earthen causeway at the southern end of Bateman Island reduces the ability of Columbia and Yakima River waters to freely mix by preventing flow around the large island (Holroyd 1998). This may result in a greater occurrence of stagnant water, increased surface water temperatures, and enhanced sedimentation rates within the Delta.

Between Highway 240 and the confluence, water quality has historically been degraded by contaminated sediments and legacy pesticide loading dichlorodiphenyltrichloroethane (DDT) from local agricultural practices. This section of the river also has problems typically associated with urban streams, including leaking septic systems and stormwater pollution (WDFW 1998). Contaminated sediments, DDT, and associated chemical concentrations have improved in the mainstem river, but still exceed state criteria (Johnson et al., 2007). In 2009, Washington State health officials determined that advisories on some Yakima River fish species could be dropped because of improved agricultural practices. Recent data indicate eating common carp (*Cyprinus carpio*) from the Yakima River is still not advised due to polychlorinated biphenyl (PCB) levels (Johnson et al., 2010). Legacy pesticides and chemicals in the water column and river sediments pose a risk to human and fish health.

In 2024, the accumulated sediments of the Delta were tested for potential contamination and found to meet state criteria (NHC, 2024).

2.6 AQUATIC RESOURCES

The Yakima River Delta consists of three primary aquatic habitats which consist of the cooler pools of the mainstem Yakima River, the mainstem of the Columbia River, and the warmer backwater environment west of Bateman Island. These areas provide habitat, both seasonally and year-round, for migratory anadromous fish, native resident fish, as well as non-native resident fish species. The biodiversity of fish species in the Delta is crucial to a healthy ecosystem, but also provide significant cultural, recreational, and aesthetic value to the region. The sections below provide detailed descriptions of the various types of fish species that inhabit the area surrounding the Yakima River Delta. For more information on species of special concern, such as salmon and steelhead, refer to the Threatened and Endangered Species.

Native Species: The Columbia and Yakima Rivers are home to many species of anadromous fish. These species include salmonids (e.g., salmon and steelhead) and non-salmonids (e.g., lamprey and shad). Anadromous salmonids include Chinook *(O. tshawytscha*), coho (*O. kisutch*), and sockeye (*O. nerka*) salmon, and steelhead (*O. mykiss*). Anadromous fish migrate as juveniles from tributaries or lakes (sockeye), where they hatch and rear, to the ocean, where they mature. During their outmigration, juvenile salmonids seek shallow water habitat to rest and

feed. Conversely, returning adults generally only require a suitable migration corridor. Once sexually mature (typically 1 to 3 years), the adults return (immigrate) to their natal waters to spawn.

Among the salmonids, various "runs" occur, characterized by adult returns (Figure 2-2). Chinook salmon exhibit spring, summer, and fall runs. The spring run occurs as a large portion of fish immigrate to spawn in the earlier part of the summer (April through June). Another large spawning migration occurs in late summer and early fall (approximately July through September). Steelhead are on the other end of the adult immigration spectrum. These fish may enter the river system year-round, but Snake and Upper Columbia River fish generally enter in September through October and are referred to as summer fish. The juvenile outmigration timing generally overlaps the adult immigration with some exceptions, as seen with coho salmon and steelhead.

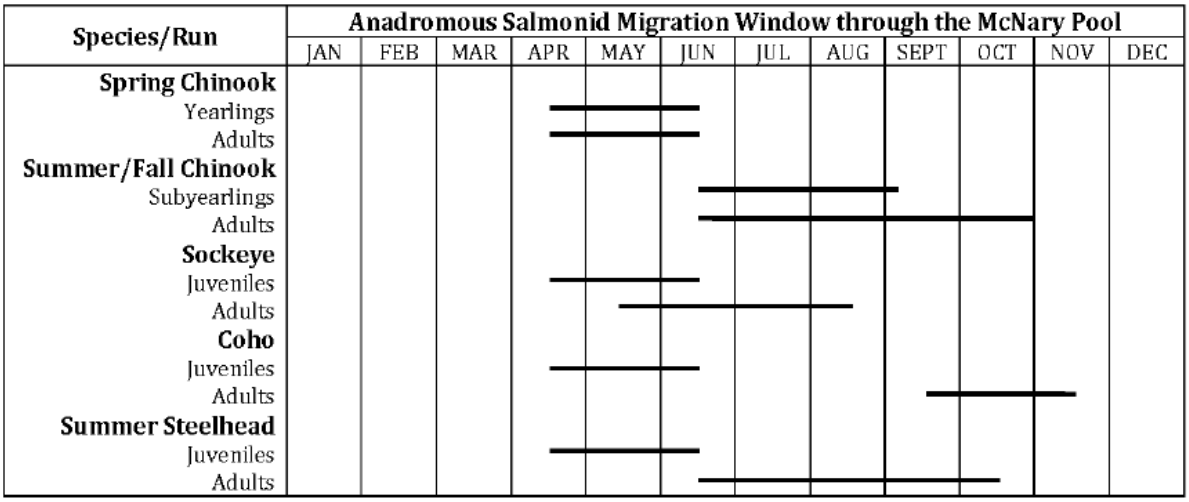

Figure 2-2. Approximate Adult and Juvenile Salmonid Run Timing through McNary Pool

Juvenile salmonid runs vary in size from year to year and are greatly influenced by hatchery supplementation. For the years 2010, 2011, 2012, and 2015, the average number of juvenile salmonids listed under the ESA outmigrating were estimated at 1.8 million upper Columbia River Chinook salmon yearlings, 1.1 million upper Columbia River steelhead, and 1.4 million middle Columbia River steelhead. On average, approximately 4.3 million ESA-listed juvenile salmonids outmigrate from the middle and upper Columbia River in any given year. Although these stocks will experience mortality from dam passage, predation, and other environmental factors, it is safe to assume that at least 1 million juveniles will survive to pass near in or around the Yakima River Delta during their outmigration.

Western Brook, River, and Pacific lamprey (*Entosphenus tridentatus*) are parasitic fish with a life history like salmonids, although lamprey have not historically been found around the Yakima River Delta. Adults migrate in the spring and summer, and spawn in the riffles and tails of pools with velocities generally 1.6 to 3.3 ft/sec and depths usually between 1.3 to 3.3 feet (Weitkamp et al. 2014, Wydowski and Whitney 2003). Lamprey larvae, or ammocoetes, occupy fine silt and

mud substrates in backwaters and quiet eddies. They have been found in isolated small pockets of the lower Yakima River, relying on cold water refuges to survive the summer in this segment of the river (Pacific Northwest National Laboratory, 2016).

Other native species found within the Yakima River Delta include California floater mussels, found within slower moving waters of the Delta. Upstream of the Yakima River Delta winged floaters and western ridged mussel can be found.

Resident Species: Resident fish that use the stagnant pools of the Yakima River Delta include rainbow trout (*O. mykiss*), northern pikeminnow (*Ptychocheilus oregonensis*), largescale sucker (*Catostomus macrocheilus*), three-spined stickleback (*Gasterosteus aculeatus*), sand roller (*Percopsis transmontana*), chiselmouth (*Acrocheilus alutaceus*), and sculpin (*Cottus* spp). These fish are native and are generally found in cooler waters of the Yakima River.

In addition, several invasive, non-native resident fish occupy the warmer, stagnant pools west of Bateman Island. These include American shad (*Alosa sapidissima*), largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieu*), walleye (*Sander vitreus*), and channel catfish (*Ictalurus punctatus*). Many of these invasive species' feed on out-migrating steelhead, Chinook, sockeye, and coho salmon smolts in the spring. WDFW estimated smallmouth predation on salmonids (primarily fall Chinook salmon) within in the lower 68 kilometers of the Yakima River (WDFW 2000). Fritts and Pearson (2006) also found that Chinook salmon were the most abundant food item in smallmouth bass stomachs in spring and summer, although coho salmon and steelhead were also present. Smallmouth bass travel between the Columbia and lower Yakima Rivers, with peak abundance in the lower Yakima River typically occurring in mid-May to early June. Smallmouth bass are capable of consuming salmonids up to 56.6 percent of their own fork length (Fritts and Pearsons 2006).

Other non-native species found within the vicinity of the Delta include alligator gar, recently discovered in the McNary Pool, and Asian clams, found in the Yakima River Delta and the Columbia River near Hanford.

2.7 THREATENED AND ENDANGERED SPECIES

USACE reviewed THENMFS threatened and endangered species lists and the US Fish and Wildlife Service (USFWS) Information for Planning and Consultation (IPAC) database, accessed April 25, 2022, to identify threatened and endangered species under the ESA that may be within the vicinity or the affected area downstream of this study area. Identified species are listed in Table 2-2.

Table 2-2. List of Threatened and Endangered Species Listed as Potentially Present within the Yakima River Delta Ecosystem Restoration Project

Species	Scientific Name	Status	Critical Habitat
NOAA Fisheries Listed Species			
Middle Columbia Steelhead	*Oncorhynchus mykiss*	Threatened	Yes
Upper Columbia River spring-run Chinook	*Oncorhynchus tshawytscha*	Endangered	Yes
Upper Columbia River Steelhead	*Oncorhynchus mykiss*	Threatened	Yes
Snake River Sockeye	*Oncorhynchus nerka*	Endangered	Yes
Snake River Fall Chinook	*Oncorhynchus tshawytscha*	Threatened	Yes
Snake River Spring/Summer Chinook	*Oncorhynchus tshawytscha*	Threatened	Yes
Snake River Basin Steelhead	*Oncorhynchus mykiss*	Threatened	Yes
USFWS Listed Species			
Bull Trout	*Salvelinus confluentus*	Threatened	Yes
Yellow-Billed Cuckoo	*Coccyzus americanus*	Threatened	No
Gray Wolf	*Canis lupus*	Endangered	N/A

(NOAA 2022 and IPAC, 2022, Project Code 2022-0035300)

The Yakima River Delta is a migration corridor for Middle Columbia steelhead. Therefore, much of the Columbia River, as well as the Yakima River Delta, is designated critical habitat. Upper Columbia River steelhead and spring-run Chinook both use the Columbia River at the confluence during multiple life stages and the Columbia River is designated critical habitat for these species at the Delta. The Snake River salmonid runs do not have critical habitat in the Yakima River Delta but do further downstream in the McNary pool.

Bull trout, classified as “Threatened” under ESA, are a native salmonid exhibiting a fluvial, adfluvial, or anadromous life history. Most of these individuals are residents in high mountain tributaries, but a small portion migrate within the mainstem Columbia River and lower Yakima River, where they overwinter and feed and return the following summer to spawn in high

mountain tributaries. The Yakima River Delta is potentially a migratory and overwintering habitat for bull trout. The 2010 bull trout critical habitat final rule lists the entire mainstem Yakima River as designated critical habitat.

There have been only 20 sightings of yellow-billed cuckoos documented in Washington since the 1950s, with 19 of those sightings having occurred between 1974 and 2016, at an average rate of one sighting every 2.3 years. Sixteen of the twenty records occurred in eastern Washington. All or nearly all the birds recorded since the 1950s were likely non-breeding vagrants or migrants, indicating cuckoos are now functionally extirpated in the state (WDFW, 2017).

The gray wolf is a wide-ranging carnivore that uses a variety of habitats. Their primary prey includes deer and elk. Historic habitat for this species occurs in the Yakima River Delta; however, none have been recorded in the Tri-Cities area. Wolves tend to move away from areas with high road densities (Mech et al., 1988; Mech and Boitani, 2003). The project area has a fairly high road density, which reduces the likelihood of this species occurring on a regular basis. Gray wolves occasionally forage on spawning salmon and salmon carcasses, but it is not a main food source for wolves (Cederholm et al., 2001).

As yellow-billed cuckoos have been functionally extirpated from the state of Washington and grey wolves have not been found recently within the project area, there would be no effects to these species as a result of the proposed action. Therefore, it is unnecessary to reference these species in the remainder of this document.

2.8 WETLANDS

The National Wetlands Inventory classification system (Cowardin et al, 1979) identified 43,695 acres of wetlands within the entire Yakima River Basin, the majority of which are found in the lower basin. This includes approximately 20,000 acres of herbaceous or emergent wetlands, 20,000 acres of riparian wetlands, and 3,600 acres of unvegetated wetlands (e.g., mudflats). Those areas within the Yakima River Delta are highly influenced by operation of the McNary Pool (Lake Wallula) and are managed by USACE as part of the Chamna, Yakima River Delta, and Bateman Island Habitat Management Units (HMUs).

Unvegetated mudflats and shallow areas near the shore are important habitats for shorebirds. The backwater of the Yakima River Delta contains one of only two mudflat/delta habitat complexes in the region.

2.9 WILDLIFE

Various wildlife species are present on the Yakima River Delta including mink (*Mustela neovison*), muskrat (*Ondatra zibethicus*), river otter (*Lontra canadensis*), American water shrew (*Sorex palustris*), and American beaver (*Castor canadensis*). Many other species, however, spend much of their lives within the habitats immediately surrounding the waterways; they are dependent on mixed upland and lowland habitat. Species in this category include raccoon

(*Procyon lotor*), coyote (*Canis latrans*), mule deer (*Odocoileus hemionus*), and striped skunk (*Mephitis mephitis*). Bats often forage on insects above the water. All these species, as well as many others, occasionally use the Yakima River Delta as a migration corridor.

The most abundant wildlife in the Yakima River Delta are birds. Riparian and wetland habitats provide essential habitat for migrating birds and waterfowl. Many other shorebird species occur along rivers where mudflats develop. Belted Kingfishers (*Megaceryle alcyon*) patrol the river in search of small fish. Osprey (*Pandion haliaetus*) flourish along the river and many species of heron, rail, shorebirds, and waterfowl depend largely on riparian corridors for food, roosting, and nesting sites. Bald Eagles (*Haliaeetus leucocephalus*) frequent the ravine corridors in search of fish and roosting areas. Birds such as cormorants, night herons, and gulls follow the river systems for many miles inland in search of good foraging areas. The river is also a major migration route for many species of songbirds such as vireos, flycatchers, thrushes, tanager, and wood warblers. Summer and winter resident species include Red-Winged Blackbird (*Agelaius phoeniceus*), Bank Swallow (*Riparia riparia*), Song Sparrow (*Melospiza melodia*), Bullock's Oriole *(Icterus bullockii*), Black-Headed Grosbeak (*Pheucticus melancephalus*), Dark-Eyed Junco (*Junco hyemalis*), White-Crowned Sparrow (*Zonotrichia leucophrys*), Yellow Warbler (*Dendroica petechial*), and American Goldfinch (*Spinus tristis*) (ERDC, 2010)

Shorebirds and waterfowl are most abundant during spring and fall migration in marshes, along shorelines, and foraging or loafing on mudflats. Common waterfowl year-round residents include American White Pelican (*Pelecanus erythrorhynchos*) and California Gull (*Larus californicus*). Common migratory birds include Caspian Tern (*Hydroprogne caspinia*) and Red-Breasted Merganser (*Mergus serrator*). Common winter waterfowl include Common Loon (*Gavia immer*), Western Grebe (*Aechmophorus occidentalis*), Double-Crested Cormorant (*Phalacrocorax auratus*), America Wigeon (*Mareca americana*), Ring-Necked Duck (*Aythya collaris*), Green-Winged Teal (*Anas crecca*), Common Golden-Eye (*Bucephala clangula*), Bufflehead (*Bucephala albeola*), Greater Scaup (*Aythya marila*), Redhead (*Aythya americana*), Ruddy Duck (*Oxyura jamaicensis*), Canvasback (*Aythya valisineria*), American Coot (*Fulica americana*), Mallard, and Canada Goose (Branta canadensis).

Resident shorebirds include Virginia Rail (*Rallus limicola*), Great Blue Heron (*Ardea herodias*), and Killdeer (*Charadrius vociferous*). Migrants include Red-Necked Phalarope (*Phalaropus lobatus*), Wilson's Snipe (*Gallinago delicata*), Lesser Yellowlegs (*Tringa flavipes*), Semipalmated Sandpiper (*Calidris pusilla*), Black-Bellied Plover (*Pluvialis squatarola*), Long-Billed Dowitcher (*Limnodromus scolopaceus*), Dunlin (*Calidrius alpine*), and American Avocet (*Recurvirostra americana*).

Amphibians in the project area include salamanders, frogs, and toads. Reptiles, such as turtles, lizards, and snakes are also present.

2.10 VEGETATION

Riparian Vegetation. Riparian areas within the Yakima River Delta are dominated by riparian and grassland communities. Russian Olive (*Elaeagnus angustifolia*), a non-native invasive

species, remains the dominant riparian tree within the Yakima River Delta. However, there are patches of native mature cottonwoods (*Populus sp.*), willows (*Salix sp*.), currant *(Ribes sp.*), and Woods' Rose (*Rosa woodsii*) throughout the landscape. These riparian areas provide shade to cool the river, insects important for several fish species, and wildlife habitat as a transition zone between uplands and the river.

Invasive Species. Invasive species are found throughout the Yakima River Delta; and their spread is managed by local, state, and Federal agency programs. Terrestrial invasive species include spotted knapweed (*Centaurea maculosa*), cheatgrass (*Bromus tectorum*), Russian olive (*Elaeagnus angustifolia*), yellow star-thistle (*Centaurea solstitalis*), Canada thistle (*Cirsium arvense*), Russian thistle (*Salsola tragus*), purple loosestrife (*Lythrum salicaria*), common reed (*Phragmites australis*), tree-of-heaven (*Ailanthus altissima*), and non-native cattail (*Typha latifolia*). Terrestrial invasive plant species form monocultures due to their ability to out compete native plant species. Monocultures lead to a loss in biodiversity which have lasting impacts on the overall health of the ecosystem and surrounding environment.

Aquatic Invasive Species. Aquatic invasive species found within the Yakima River Delta include flowering rush (*Butomus umbellatus*), European milfoil (*Miriophyllum spicatum*), and water stargrass (*Heterantera dubia*). Shallow areas of the Delta support patches of stargrass and flowering rush. However, recent dramatic improvements in water clarity within the Yakima River have allowed sunlight to penetrate the water column at greater depths allowing invasive species to colonize deeper water. The lower 43 miles of the Yakima River below Prosser Dam are dominated by water stargrass. The pervasive expansion of aquatic invasive species negatively impacts stream flow, dissolved oxygen, and sedimentation and increases undesirable invasive fish habitat conditions.

2.11 LAND USE

The lower Yakima River is a highly regulated system with a landscape dominated by irrigated agriculture, irrigated pasture, and residential areas.

Prior to the arrival of Euro-Americans, the Yakima River Delta was occupied by Native American people. After Euro-American settlement of the area, residents used the Delta for agricultural purposes, accessing it from both land and water. Prior to the completion of McNary Dam and the impoundment of Lake Wallula, the previous landowners constructed a causeway granting access to Bateman Island by land. The City of Richland classifies the Yakima River Delta as a Natural Open Space to be used for recreation and wildlife viewing. The zones surrounding the Delta consist of largely commercial/industrial business and single/multi-family residential areas. The lower Yakima River above the Delta consists of floodplains, commercial recreation, residential, and agricultural zoning areas. A railroad and highway bisect the Delta into eastern and western sections.

The entirety of the south side of the Yakima River, as well as a portion on the west side of the river to the north of I-182, is contained within the Yakima River Delta Wildlife HMU which is managed by USACE.

To the north of the river and west of State Route 240 lies the 276-acre Chamna Natural Preserve, which is leased by the City of Richland, but jointly maintained with Tapteal Greenway. The preserve is home to 11 miles of hiking trails, with interpretive signage to provide visitors with descriptions of plants and wildlife that can be found within its boundaries.

2.12 RECREATION

Water-Related Sports. Recreationists in the area enjoy many types of water-related sports. The primary activity is boating and much of the boating is related to fishing. Boating is convenient due to the nearby Columbia Park Marina and the adjacent City of Richland public boat launch at Columbia Park West. The marina and boat launch are located on the southern end of the Delta and provide utility services and a parking lot with trailer parking. The boat launch offers access to the Columbia, Snake, and Yakima Rivers and provides moorage for approximately 104 boats (from previous lease agreement; current lease agreement is in a month-to-month tenancy to align the USACE and WDNR boat basin agreement), with overnight stays allowed up to 5 days/nights. Primitive launch sites are also available at nearby Wye Park and Columbia Point (although outside of the study area). Other water sports include swimming, wading, waterskiing, tubing, wake boarding, jet skiing, paddle boarding, sailing, kayaking, and canoeing. The Tapteal Water Trail (managed by the Tapteal Greenway, a local non-profit organization with the mission of preserving the rustic character of the lower Yakima River) is a horseshoe-shaped section of the lower Yakima River intended to mirror the popular land side Tapteal Greenway Trail. The Tapteal Water Trail begins at the Benton City Recreation Area and Boat Launch and ends 30 miles downstream at Bateman Island. It provides a smooth and shallow journey for kayakers, canoeists, and paddleboarders to experience gentle twists, turns, and settings that range from natural, agricultural, suburban, and urban.

Walking/Hiking Trails. The Columbia Park Trail and Sacagawea Heritage Trail (3.67 trail miles) provide visitors with an opportunity to explore the Delta through a network of trails that extend to the Yakima River Delta HMU. The Tapteal Greenway Trail (also managed by Tapteal Greenway) is the land side version of the Tapteal Water Trail and is used by bikers, hikers, and horseback riders and connects to Chamna Natural Preserve (greater than 11 miles of trails) and other recreational sites throughout the Tri-Cities area. Mountain biking is allowed on all of these trails. There is an easy 2.8-mile loop trail on Bateman Island accessed via the causeway from Wye Park open for foot and bicycle traffic. This trail accesses the river's edge at several locations and is known to be of value for bird watching and other recreational values.

Birdwatching. The Yakima River Delta area is designated as an Important Bird Area by the National Audubon Society Important Bird Areas (audubon.org). From September to June, on the first Saturday of the month, the Lower Columbia Basin Audubon Society conducts bird walks on Bateman Island, which is part of the Sun and Sage Loop of the Great Washington State Birding Trail. In addition to birdwatching on Bateman Island, there are many nearby locations (within ten miles of Bateman Island) that also provide exceptional birdwatching opportunities: the Yakima River Delta HMU, Chamna Natural Preserve, Two Rivers County Park, Riverview Natural Preserve, and W.E. Johnson Park are close by, and all have very similar habitat. Locations such

as Chiawana Park, Sacajawea State Park, the Umatilla National Wildlife Refuge, McNary National Wildlife Refuge, Big Flat HMU, and Windust Park are more than ten miles from the Yakima River Delta but also offer year-around birdwatching opportunities.

Park Activities/Picnicking. Fishing areas, day-use picnic shelters, pavilions, playgrounds, games, and other activities are available at Wye Park and Columbia Park West.

2.13 AESTHETICS/VISUAL RESOURCES

The Yakima River Delta consists of a moderate-size river flowing in a northerly direction to the Columbia River with extensive wooded shorelines**.** Many of these wooded shorelines are naturalized or park-like, with intermingled walking trails**.** The backwater on the western side of Bateman Island is often cloudy and brown because of a lack of flow and algae blooms.

The Yakima River Delta is surrounded by an urban environment and includes a marina and a public boat launch.

In 2017 there was a fire on Bateman Island that burned woody vegetation within the interior of the island. The effect of the fire is visible with charred tree trunks and sparse vegetation (Figure 2-3). Another fire occurred on Bateman Island in September of 2023 that resulted in approximately 6 acres burned and a temporary closure until March of 2024.

Figure 2-3. Bateman Island after 2017 Fire
Source: News Talk 870

2.14 GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

In accordance with the guidance Engineering Construction Bulletin (ECB) 2018-14, Guidance for Incorporating Climate Change Impacts to Inland Hydrology in Civil Works Studies, Designs, and Projects, (revised 19 August 2022), climate change is required to be assessed with a focus on existing and future challenges and risks facing the project due to past and future climatic changes (Refer to Appendix A, Climate Change Assessment). In addition, GHGs, such as CO2, methane (CH4), and nitrous oxide (N2O), contribute to climate change, including alteration of temperatures and precipitation patterns (EPA 2023c). Consistent with EO 13990, Protecting Public Health and the Environment and Restoring Science to Tackle the Climate Crisis, The Office of Management of Budget Council on Environmental Quality (CEQ) has issued interim NEPA Guidance on Consideration of Greenhouse Gas (GHG) Emissions and Climate Change. This guidance includes direction for agencies to quantify a proposed action's GHG emissions and to disclose and provide context for a proposed action's GHG emissions and climate effects. For the purposes of this report, GHG and Climate Change will be evaluated together in Section 2 and Section 4, Environmental Consequences.

Hydrology in the Yakima River Basin is characterized by high precipitation in the Cascade Mountains and low precipitation in the lower Yakima River Basin. Most annual precipitation occurs from October to March, and primarily falls in the form of snow. During the late spring and early summer, precipitation changes to rain and temperatures increase to produce snowmelt runoff. A portion of this runoff is captured in the five major Yakima River Basin reservoirs for storage and release during the summer and fall, when water demand is higher and there is less natural precipitation. This operation causes streamflows within the upper Yakima River to be higher than natural in the summer and fall and lower than natural in the winter and spring.

The Yakima River is representative of transient watersheds (mix between and rain- and snow-dominant), and the Columbia River is representative of snow-dominant watersheds. Inflows to the Yakima River Delta study area include outflow from Priest Rapids Dam (PRD on the Columbia River and outflow from Horn Rapids Dam (HRD) on the Yakima River. The flow and temperature of both systems are characterized by regional seasonality, larger volume, and cooler water in the spring versus smaller volume and warmer water in the summer and fall. Columbia River flows can be highly variable between May and November due to upstream operations through a series of coordinated run-of-river hydropower projects below Grand Coulee Dam (GCD), while Yakima River flows are more representative of a spring freshet followed by a descending hydrograph limb as upstream irrigation demands increase through the summer hydroperiod.

Climate change has already impacted the study area and alterations in the amount of snowpack and snowmelt timing and their consequences on salmon habitat are predicted to become increasingly more problematic within the 21st century. Within the Yakima River Delta, impacts of climate change are predicted to result in reduced summer/fall flows and increased water temperatures for the Yakima Basin. Historically warm reaches are predicted to have greater

increased summer water temperatures with lower flow volumes, resulting in increased thermal stress for migratory salmonids (Mantua et al. 2010).

2.15 CULTURAL AND HISTORIC RESOURCES

The Yakima River Delta is currently used primarily for wildlife and recreation and is surrounded by commercial and industrial development. The study area includes lands managed by USACE as mitigation for lands lost when McNary Dam was built, as well as two nature preserves and other shoreline lands along Lake Wallula. There is ample evidence, in the form of both oral histories and archaeology, that document a tribal presence in the Yakima River Delta since time immemorial.

Within the study area, numerous Historic Properties of Religious and Cultural Significance to Indian Tribes (HPRCSITs) have been documented and reflect traditional Native land use including habitation, subsistence, transportation, trade, and spirituality. A sacred site has been identified by interested Tribes within one of the HPRCSITs associated with Bateman Island. This area continues to hold cultural importance and values as traditional homelands of the Yakama Nation and CTUIR, as well as the Wanapum Band, the Confederated Tribes of the Colville Reservation (CCT), and the Nez Perce Tribe (NP).

Archaeological studies of the study area and the Columbia Plateau document human settlement since at least 16,000 years ago. Pre-Euromerican use of the study area, which is an ecologically important confluence of two major rivers, was characterized by repeated, intensive occupations that resulted in sites of confidential and/or sensitive nature. Overall, known cultural sites are consistent with the expectation of high likelihood of sub-surface remains. Bateman Island is particularly significant and was documented as a fish drying location during the Lewis and Clark Expedition of 1805. The study area lies partly within the Tri-Cities Archaeological District which currently includes 20 pre-Contact sites that contribute to its National Register status and more sites are likely inundated.

This area also contains numerous post-Contact cultural resources, which are not included within the District but may have historic significance through association with transportation, agriculture, cattle grazing, and water management. Around 1940, a causeway was constructed to Bateman Island by the farmers of the island. All residents were relocated circa 1950 after USACE took possession as part of the McNary Dam project.

2.16 SOCIOECONOMICS/ENVIRONMENTAL JUSTICE

The project is in southeastern Washington within Richland city limits in the Tri-Cities area.

<u>Population and Demographics</u>

The population in Richland, Washington, is estimated at 57,353 according to the 2020 American Community Survey 5-Year Estimates. The neighboring cities of Kennewick and Pasco, Washington have an additional 82,633 and 74,266 residents, respectively. The total combined

population of Benton and Franklin Counties is estimated at 294,396, and the population of the Tri-Cities area (Richland, Kennewick, and Pasco) comprises 72.78 percent of the two counties' total population. The population of Richland grew at an average rate of 2.3 percent from April 2020 to July 2021, while the populations of Benton and Franklin Counties grew at an average rate of 1.5 percent and 1.6 percent per year, respectively. These growth rates represent faster growth rates than Washington State (0.4 percent) and the nation as a whole (0.1 percent).

Age demographics of Richland are consistent with national averages, with the working age population (ages 18 to 64) representing 59.5 percent of the total population and the retirement-eligible population (ages 65 or over) representing 15.5 percent of the total population. Nationwide, the working age population represents 61 percent of the total population, and the retirement-eligible population represents 16.8 percent of the total population.

Richland's workforce has higher education attainment levels than the workforce in the surrounding areas, with a higher percentage of persons aged 25 or over who graduated high school (96.7 percent) than Kennewick (88.9 percent); Pasco (76.4 percent); Washington state (91.7 percent); and the United States (88.5 percent). In addition, 43.5 percent of Richland residents aged 25 or over have a bachelor's degree or higher. Comparatively, Kennewick at 26.6 percent, Pasco at 19.8 percent, Washington state at 36.7 percent, and the nation at 32.9 percent.

Minimum wage rates for the state of Washington increased steadily at approximately 2.4 percent growth per year between 2000 and 2016. In 2016, Washington voters approved a ballot measure to raise the minimum wage, at an average rate of 7.1 percent growth per year, to a target minimum wage rate of $13.50 per hour beginning January 1, 2020. From 2021 onward, the minimum wage is adjusted annually based on the Consumer Price Index CPI-W inflation measure.

Environmental Justice

As defined by the 15 March 2022 Assistant Secretary of the Army for Civil Works (ASA[CW]) memorandum titled "Implementation of Environmental Justice and the Justice40 Initiative," environmental justice is the "fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income regarding the development, implementation and enforcement of environmental laws, regulations, and policies, with no group bearing a disproportionate burden of environmental harms and risks."

The ASA(CW) issued Interim Environmental Justice Strategic Plan directs USACE to conduct technical analyses to identify disadvantaged or underserved communities within the study area, followed by development of an outreach strategy to ensure meaningful engagement. This environmental justice evaluation includes identification of disadvantaged and underserved communities, identification of any negative project impacts that would disproportionally affect these disadvantaged and underserved communities and proposed mitigation to offset the projected negative impacts.

The CEQ and the Climate Policy Office have issued an Addendum to the Interim Implementation Guidance for the Justice40 Initiative, M-21-28, on using the Climate and Economic Justice Screening Tool (CEJST), M-23-09 (January 27, 2023) ("Addendum to the Justice40 Interim Guidance"). The Addendum to the Justice40 Interim Guidance directs Federal agencies to transition to the CEJST to identify disadvantaged communities that can be geospatially mapped. A community is considered disadvantaged if the tract is (1) at or above the threshold for one or more environmental, climate, or other burdens, AND (2) at or above the threshold for an associated socioeconomic burden.

The evaluation of environmental justice issues includes an identification of high minority and low-income populations in the Tri-Cities area. The CEJST has identified two tracts within the City of Richland as disadvantaged communities. One is based on project flood risk and low income; low life expectancy and low income; and lead paint and low income. The second is based on projected wildfire risk and low income; asthma and low income; lead paint and low income; and water discharge and low income. These communities could be disproportionately affected via the disadvantages that come from these burdens.

Minority Groups

A high percentage of the Tri-Cities area is white. The second highest racial identity is Hispanic or Latino (Table 2-3). Approximately 0.4 percent of the population identifies as American Indian and Alaska Native. Many of the American Indian population in the Tri-Cities area identify with the local tribes including the Yakama, Umatilla, and Nez Perce. These native populations rely on Tribal Treaty rights to harvest salmonids, wapato, and tule for ceremonial and subsistence purposes.

Table 2-3. Race and Ethnicity Demographics for Tri-Cities and Washington State

Race	Richland, WA	Kennewick, WA	Pasco, WA	Washington State
White	82.9%	78.6%	62.4%	73.5%
Black or African American	1.9%	2.1%	2.4%	3.9%
American Indian and Alaska Native	0.4%	1.2%	1.4%	1.2%
Asian	5.4%	2.4%	2.0%	8.8%
Native Hawaiian and Other Pacific Islander	0.0%	0.0%	0.2%	0.7%
Some Other Race	3.2%	10.5%	20.6%	4.8%
Two or More Races	6.1%	5.1%	11.1%	7.1%
Hispanic	11.8%	27.4%	56.0%	12.9%
Non-Hispanic	88.2%	72.6%	44.0%	87.1%

Low-Income Populations

Based on the Census Bureau's poverty thresholds, the percentage of Richland residents living in poverty is 8.2 percent and is less than the poverty levels for Kennewick (12.5 percent) and Pasco (14.3 percent). Although Richland is lower than Washington State (10.2 percent) and national averages (14.1 percent), Kennewick is higher than the national average, and Pasco is higher than both the state and the nation.

2.17 PUBLIC INFRASTRUCTURE

The new Duportail Street Bridge, which opened to the public in December 2020 between Queensgate Drive and Birch Avenue, crosses the Yakima River north of Highway 182.

The Yakima River Delta is bisected by State Route 240 and is bound by Columbia Park Trail to the south and Interstate 182 (I-182) to the north. A small portion of road extends to the north of I-182 between Queensgate Drive and the Bypass Highway toward Duportail Street Bridge.

A railroad parallels State Route 240 and intersects the Yakima River Delta HMU.

The Bateman Island causeway is maintained for emergency vehicle and recreational foot traffic access to the island. The causeway is approximately 500 feet long by 40 feet wide. It was constructed around 1940 for agricultural access. It is composed of earthen material and has been reinforced with rock riprap over time. It is a complete barrier to river flow, boats, and fish.

Columbia Park Marina and the adjacent City of Richland public boat launch at Columbia Park West are located on the southern end of the Delta and provide utility services and a parking lot with trailer parking. The public boat launch offers access to the Columbia, Snake, and Yakima Rivers, and the marina can provide moorage for approximately 104 boats (from previous lease agreement, current lease agreement not yet available), with overnight stays of up to 5 days. Primitive launch sites are also available at nearby Wye Park (and Columbia Point, although outside of the study area).

Amon Creek Wasteway, a major irrigation return flow facility located on the Yakima River Delta HMU, seasonally supports a limited number of salmonids, especially coho, but its carrying capacity is limited. There are reports of rainbow trout/steelhead, coho salmon, and fall Chinook salmon sighted or collected in the wasteway (Child, 2010).

There are two levee systems within the project area. Levee 2a is approximately 2,800 linear feet long and is located along the northern side of Chamna Natural Preserve and is about 1,000 feet away from the Yakima River at its closest point. Levee 4a is located between Bateman Island and Hwy 240 on the South shore of Yakima River and is approximately 4,400 linear feet long.

There is an underground sewer line main pipe that bisects the western side (upstream side) of the Yakima River Delta HMU.

2.18 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

A Phase I HTRW) Environmental Site Assessment has been conducted for the project area in accordance with ASTM Standard Practice E-1527-13 and USACE Engineer Regulation (ER) 1165-2-132. The investigation relies on site reconnaissance and review of reasonably ascertainable environmental records, including regulatory database information and historic information, to determine the likelihood that the project area contains a recognized environmental condition (REC) or HTRW. No RECs were identified in the study area. One REC was identified adjacent to the study area and should be avoided, more details in the Environmental Condition of Property Report included in Appendix B, HTRW Report. Additionally, it is known that previously accumulated sediments do contain pollutants.

Further, in 2024 the accumulated sediments in the Delta were systematically tested for potential contamination and found to meet state criteria (NHC, 2024).

Thirty-three (33) samples were collected from the Delta and background areas, characterized, and composited into six laboratory samples designated SU-1, SU-2, SU-3, SU-300, SU-B (background conditions near Bateman Island), and SU-CI (background conditions near Clover Island). Four references (Sediment Management Standards [SMS], Sediment Evaluation Framework [SEF], Dredged Material Evaluation and Disposal Procedures User Manual [User Manual], and Sediment Cleanup User's Manual [SCUM]) identify contaminants of concern (COC) at two screening levels:

Lower screening value (no known adverse effects on freshwater benthic organisms)

- Sediment cleanup objective (SCO) = screening level 1 (SL1)

Higher screening value (more than minor adverse effects on benthic organisms)

- Cleanup screening level (CSL) = screening level 2 (SL2)

SEF, SCUM and SMS use the same screening values as the User Manual with the exception of Nickel for purposes of this discussion. The SL1 for Nickel is 26 milligrams per kilogram (mg/kg) per SEF, SCUM and SMS rather than 38 mg/kg in the User Manual. For this analysis, the more conservative value of 26 is used. The conclusions and discussion section of the report call out Nickel and dieldrin.

Nickel:

- SCO/SL1 = 26 mg/kg
- CSL/SL2 = 110 mg/kg

Nickel Discussion: The chemical analytical laboratory results for Nickel found (mg/kg) in samples SU-1 (26.4); SU-2 (20.2); SU-3 (29.1); SU-300 (25.5); SU-B (30.6); SU-CI (25.5). SU-B represents background conditions in the Columbia River east of Bateman Island, suggesting that naturally

occurring nickel concentrations in this area are greater than the SCO, and that the nickel values measured in the Delta are not indicative of contamination, but rather natural, in-situ conditions. Metal concentrations tend to be higher in fine-grained sediments and the fine-grained sediment in project samples ranged from 53.0 percent to 92.1 percent. No values exceed the User Manual SCO/SL1 threshold of 38 mg/kg.

Dieldrin:

- SCO/SL1 = 4.9 µg/kg
- CSL/SL2 = 9.3 µg/kg

Dieldrin Discussion: The chemical analytical laboratory results for Dieldrin found (µg/kg) in samples SU-1 (<1); SU-2 (<1); SU-3 (<1); SU-300 (<1); SU-B (<1); SU-CI (<5) with the annotation 'analyte not detected above reporting limit'. Dieldrin in SU-CI was non-detect with a reporting limit of 5.00 µg/kg versus the SCO of 4.9 µg/kg. Based on the analytical results, it is not clear whether the presence of dieldrin in SU-CI is greater than, equal to, or less than the SCO. Clover Island is ~30,000 feet downstream of the project area, and the sample results are not indicative of sediment conditions that could become mobilized.

Based on the results of this investigation and our experience with similar sites, we believe the chemicals of potential concern (COPCs) analyzed for in Delta sediment present low risk to human health and the environment.

SECTION 3 - FORMULATION OF ALTERNATIVES*

This section identifies problems, opportunities, planning objectives, and study constraints, based on an assessment of existing, and expected future without-project conditions in the project area. Additionally, this section provides information on the process used to develop and screen project measures and formulate alternatives. This section provides description of each alternative, an environmental benefits evaluation, a comparison of alternatives using cost effectiveness, and incremental cost analysis. The Project Purpose and Need (Section 1.5) is incorporated into the formulation of alternatives as part of the described problems, opportunities, objectives, goals, and constraints, and associated screen criteria. This information is then used to identify the National Environmental Restoration (NER) plan, which reasonably maximizes ecosystem restoration benefits compared to costs.

3.1 PROBLEMS AND OPPORTUNITIES

Problems and opportunities define a potential project. The problems are undesirable conditions in a community for which resolution is being sought. Opportunities are conditions that could be positively altered as the result of a project.

3.1.1 Problems

Many hydrological and water quality changes occurred within the Yakima River Delta because of the construction of McNary Dam and the Federal levees throughout the Tri-Cities in the 1950s. The impoundment of Lake Wallula has completely changed the flows within the Delta, with the effects felt approximately 2 miles upstream in the Yakima River. These problems are compounded by a 500-foot causeway between the mainland and Bateman Island, which stops flow from moving around the south side of the island. The main two problems that this study focuses on addressing are as follows:

- Impoundment of the McNary Dam reservoir (Lake Wallula) inundated the lower 2 miles of the Yakima River, eliminating riparian and aquatic habitat, and changing the hydraulic conditions within the Delta, impacting juvenile and adult salmonid migration through the Yakima River's confluence with the Columbia River.
- Blocked flows south of Bateman Island and increased sedimentation contributed to a large, shallow backwater environment.

3.1.2 Opportunities

In addition to the specific problems identified above, there are several opportunities to improve conditions, not only in the Delta, but possibly to enhance work already being done in the upper Yakima River Basin. Through these below identified opportunities, the land may be managed to not only provide improved resource stewardship, but to satisfy public needs and protect the important cultural and historic values on Bateman Island. These efforts can be done outside of this 1135 project and not necessarily for USACE to implement.

- Improve riparian habitat for avian species using traditional native plantings.
- Provide important contributions to the Yakima River Basin Integrated Plan.
- Identify potential recreational opportunities.
- Identify potential educational opportunities.
- Reduce public health risks through the reduction of mosquito habitat, etc.
- Improve water quality.
- Other projects can build upon this 1135 project, resulting in cumulative habitat improvements within the Delta.

In accordance with the Federal Water Project Recreation Act of 1965, Policy Guidance Letter No. 59, June 1998; and ER 1105-2-100, a CAP Section 1135 project allows recreation facilities to be added to take advantage of education and recreation potential of an ecosystem restoration project, but the project may not be specifically formulated to focus solely on recreation.

USACE may participate in recreation features as long as they do not adversely impact the ecosystem restoration purpose. USACE is also limited to the type of features allowed (ER 1105-2-100). Generally, allowable features at a day use site are for access (pathways and trails), safety facilities (lighting and railings), seating areas (benches, shade shelters, trash receptacles), signs and interpretive media (education and information), and associated utilities (water/electric).

Justified recreation and allowable recreation features included as part of this CAP Section 1135 project are all cost-shared facilities, as listed in ER 1165-2-400, Recreation Benefits Analysis, which describes the analysis of the recreation value and the allowable costs. The USACE costs for projects that include recreation may not exceed the Federal portion of the total project costs by more than ten percent. The NFS is required to acquire all necessary lands and to cost share 50 percent of the costs for the recreation features. Costs above the allowed Federal costs are entirely the responsibility of the NFS.

3.2 PROJECT GOAL, PLANNING OBJECTIVES, AND CONSTRAINTS

Specific project goals and planning study objectives are developed to contribute to Federal Objectives and NER in accordance with national environmental statutes, applicable Executive Orders (EOs), and other Federal planning requirements and policies. Contributions to national improvements are increases in the net value of the national output of goods, services, and ecosystem integrity. Contributions to the Federal objectives include increases in the net value of those goods, services, and ecosystems that are or are not marketable.

The use of the term “Federal objectives” is distinguished from planning/study objectives. Study objectives are more specific in terms of expected or desired outputs, whereas Federal objectives are considered a national goal. Federal Objectives were established for water resources investments. Federal water resources investments must reflect national priorities, encourage economic development, and protect the environment by: (1) Seeking to maximize

sustainable economic development; (2) Seeking to avoid the unwise use of floodplains and flood-prone areas and minimizing adverse impacts and vulnerabilities in any case in which a floodplain or flood-prone area must be used; and (3) Protecting and restoring the functions of natural systems and mitigating any unavoidable damage to natural systems.

Restoration of the Nation's environment is achieved when the local ecosystem's structure, function and processes are restored, and important cultural and natural aspects of the Nation's heritage are preserved. Various environmental statutes and EOs assist in ensuring water resource planning is consistent with restoration. The objectives and requirements of applicable laws and EOs are considered throughout the planning process to meet the Federal Objective.

This project and the planning study objectives fall under the NER objective. Specific guidance on Federal objectives and NER may be found in ER 1165-2-501, Civil Works Ecosystem Restoration Policy (1999), and ER 1105-2-100, Planning Guidance Notebook (2000), and ER 1105-2-103, Policy for Conducting Civil Works Planning Studies (2023).

3.2.1 Project Goal

The goal of this project is to restore aquatic habitat and ecosystem functions to benefit salmonids and other native fish, birds, and wildlife in the Yakima River Delta.

3.2.2 Planning Objectives

Planning study objectives represent desired positive changes intended to meet study goals. They are generated to describe how problems could be addressed by taking advantage of identified opportunities. Within the framework and constraints of the Section 1135 Program, and relative to a "No Action Alternative" over a 50-year horizon, the following objectives were developed to address habitat problems in the study area:

- Restore, for the 50-year period of analysis, the aquatic ecosystem functions and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.
- Improve the quality and complexity of aquatic and riparian habitat within the Yakima River Delta by increasing flows, reducing predator habitat, and providing native plant diversity for the 50-year period of analysis.

3.2.3 Constraints

Universal constraints are resource, legal, or policy considerations that limit the range or type of actions that could be implemented to meet study objectives. All USACE projects must comply with Federal and applicable state and local laws, regulations, and policies. In addition, projects authorized under Section 1135 of WRDA 1986 must promote self-sustaining solutions without exceeding the Federal funding limit for a CAP project ($10 million).

The following project-specific study constraints were identified for this study:

- Project alternatives will avoid or minimize impacts, to the extent practicable, to coldwater refugia and springs, as these areas provide resting areas for migrating adult salmon and steelhead during periods of high-water temperatures.
- Selected alternatives will avoid or minimize impacts, to the extent practicable, to areas of known human interment or cemeteries.
- Alternatives will avoid or minimize impacts, to the extent practicable, to authorized project purposes.

3.3 Future without Project Condition/No Action Alternative

The future without-project condition, also known as the "No Action Alternative," is the most likely condition expected to occur in the future in the absence of the proposed action or action plans. In this case, the No Action Alternative means that no ecosystem restoration activities would be undertaken in the future, beyond those already being implemented or those that have been authorized through other means. Under NEPA, the No Action Alternative is necessary to provide a reference point, enabling a comparison of environmental effects of the action alternatives. Refer to Section 4 for more details on the Future without Project Conditions.

Looking at a 50-year horizon, the overall future without-project condition of the Yakima River Delta is expected to decline from the existing condition. The Project Delivery Team (PDT) determined **hydrology and hydraulics, water quality, and aquatic habitat** as resources that would be significantly impacted with the No Action Alternative. In other words, without intervention these resources will continue to degrade, emphasizing the importance of the project.

***Hydrology and Hydraulics*:** The lower Yakima River would continue to flow to the Columbia River along a channel that flows around the north end of Bateman Island. The southern extent of the Delta would continue to be blocked by the causeway to Bateman Island. Stage and depth within the Yakima River Delta would continue to be influenced by McNary Dam operations downstream. Along the western side of Bateman Island, fine sediment would continue to accumulate at the mouth of the Yakima River and the slackwater would continue to stagnate.

***Water Quality (Temperature, Nutrients, and Toxins)*:** Mantua et al (2010) reported that rising water temperatures will thermally stress salmon throughout Washington watersheds, becoming increasingly severe later in the twenty-first century. They indicate that while winter and spring warming may benefit parts of the freshwater life cycle of some salmon populations, the combined effects of warming summertime stream temperatures and altered streamflow will likely reduce the quality and extent of freshwater salmon habitat and increase strain to many salmon populations.

Sediment would continue to accrete and create shallow water within the backwater of the Yakima River Delta, between the Yakima River and the causeway. Sediment would continue to contain legacy pesticides, polychlorinated biphenyl (PCBs), and herbicides. The highest concentrations of contaminants would be buried in deeper sediments of the backwater environments. The contaminants would degrade and decline naturally as agricultural practices cease to use them in the same historical quantities.

***Aquatic Resources*:** The Yakima River Delta would continue to support Middle Columbia River steelhead and bull trout populations, but migratory passage through the Yakima River may be delayed due to high water temperatures in the summer through September. These delays could result in delays in spawning and adult steelhead migration. These conditions are anticipated to worsen with climate change. In combination with increased summertime stream temperatures, reduced summertime flow is likely to limit rearing habitat for salmon with stream-type life histories (wherein juveniles rear in freshwater for one or more years) and increase mortality rates during spawning migrations for summer-run adults (Madtua, et al. 2010). Sockeye salmon passed McNary Dam about 11 days earlier in 1993 than they did in 1954. Non-native salmonid predator fishes that inhabit the Yakima River Delta area would continue to benefit from the large area of slack water habitat west of Bateman Island. These areas would continue to warm much earlier than surrounding areas more heavily influenced by flows from the Columbia River. The presence of these predators in the Delta may contribute to predation losses of juvenile salmonids and impair lamprey migration through the Yakima River Delta Area.

3.4 MEASURE AND SCREENING CRITERIA

This section summarizes planning criteria and considerations used to formulate and evaluate restoration measures (e.g., a specific action or feature to address a problem) and alternatives (one or more measures combined). The planning criteria (acceptability, completeness, effectiveness, and efficiency) were used to evaluate measures and formulate alternatives.

Acceptability, completeness, effectiveness, and efficiency are four evaluation criteria used by USACE to develop and screen measures prior to the development of alternatives.

- **Acceptability.** An ecosystem restoration plan should be acceptable to Tribal, State, and Federal resource agencies, as well as local governments. An alternative meets this criterion if it is viable and appropriate from the perspective of the Nation's general public and consistent with existing Federal laws, authorities, and public policies.

- **Completeness.** A recommended plan must provide and account for all features, investments, and/or other actions necessary to realize the planned effects, including any necessary actions by others. This may require relating the plan to other types of public or private plans if these plans are necessary for the outcome of the restoration objective. Real estate, operations and maintenance, monitoring, and sponsorship factors must be considered.

- **Effectiveness.** The Recommended Plan identified in this report must alleviate the specified problems and achieve the specified opportunities.

- **Efficiency.** The Recommended Plan identified in this report must alleviate the specified problems and realize the specified opportunities at the least cost.

3.5 MANAGEMENT MEASURES

Management measures are the building blocks of any planning solution. A management measure is a single action that, either alone or combined with other management measures, could potentially provide a solution for one or more of the project problems. In order to develop measures, brainstorming of concepts is required first to understand these potential actions. An initial planning workshop was held October 8 and 9, 2019, in Richland, Washington to begin brainstorming (See Photos 1 and 2).

Photo 1. Planning workshop to brainstorm measures, held on Oct. 8 and 9, 2019.

Photo 2. Planning workshop to brainstorm measures, held on Oct. 8 and 9, 2019.

Additionally, a public scoping meeting was held on November 20, 2019, to gather more information on concepts. USACE received a total of 78 comments during the 30-day scoping period from November 20 through December 19, 2019, with the following general themes: scope of the project, purpose of the project, potential alternatives, environmental considerations, and cumulative effects. The following concepts were brainstormed for the project, based on ideas discussed in the planning workshop, the public scoping meeting, and literature and research of the Yakima River Delta:

- Plant riparian fringe habitat in various locations along the western edge of Bateman Island.
- Place submerged bend weirs in the Yakima River to direct and concentrate flows to the Columbia River.
- Dredge the Yakima River channel in the Delta.
- Reconnect the floodplain.
- Decrease channelization of the Yakima River to improve floodplain connectivity and function.
- Reduce non-native predation and mosquitoes. Increase flows over time and manage them to reduce spawning success.
- Create wetland between Bateman Island and WA-240.

- Provide improved habitat forage within the Delta by reducing competition for resources.
- Increase the influence of groundwater inputs.
- Protect cultural resources from erosion and looting.
- Investigate using the gravel pit to access deep cold water refugia and pipe it into the Yakima River.
- Completely remove or breach the causeway to improve ecological floodplain function.
- Build a water control structure at the causeway.
- Block off the backwater area and create riparian habitat.
- Control Flows to Improve Riparian and Aquatic Habitat in Backwater.
- Excavate New Side Channel through South end of Bateman Island.
- Cut through the northern point of the Delta and realign the Yakima River.
- Create deeper pockets of habitat near the riparian islands within the backwater to create cooler areas for holding and rearing fish and increase habitat diversity.
- Build a fishing pier.
- Educate the public regarding improvements and restoration opportunities.
- Disconnect the Yakima River thalweg to improve recreation conditions on the east side of Bateman Island.
- Move the marina to a new location.

The identified concepts were then further developed into measures by combining similar concepts together or by eliminating those that were determined to not be appropriate for this type of project. This resulted in 14 measures carried forward for consideration, as shown in Table 3-1, below, and Figure 3-1, in Section 3.6.

Table 3-1. Development of Measures

Concept	Measure Identification
Investigate using gravel pit to access deep cold water refugia and pipe into Yakima River	Measure 1
Increase influence of groundwater inputs	Measure 2
Build a water control structure at the causeway	Measure 3
Dredge Yakima River channel in Delta	Measure 4
Place submerged bend weirs to direct flows to Columbia River	Measure 5
Create wetland between Bateman Island and WA-240	Measure 6

Concept	Measure Identification
Completely remove or breach the causeway to improve ecological floodplain function	Measure 7
Excavate New Side Channel through South end of Bateman Island	Measure 8
Realign Yakima River	Measure 9
Decrease channelization of the Yakima River	Not within this project's scope. Would require study area to include upstream Yakima River. Eliminated from further consideration.
Block off backwater area and create riparian habitat	Measure 10
Control Flows to Improve Riparian and Aquatic Habitat in Backwater	Measure 11
Create deeper pockets of habitat for cooler area for fish	Measure 12
Planting riparian fringe habitat	Measure 13
Reduce non-native predation and mosquitoes.	Captured in project objectives; not an actual measure
Increase flows over time and manage to reduce predator spawning success	Captured in project objectives; not an actual measure
Provide improved habitat forage by reducing competition of resources	Captured in project objectives; not an actual measure
Protect cultural resources from erosion and looting	Impacts to cultural resources from alternatives will be avoided and minimized; not an actual measure
Build a fishing pier	Recreation opportunity; not main focus of ecosystem restoration
Educate public regarding improvements and recreation opportunities	Recreation opportunity; not main focus of ecosystem restoration
Disconnect Yakima River thalweg to improve recreation on the east side of Bateman Island	Recreation opportunity; not main focus of ecosystem restoration
Move marina to a new location	Recreation opportunity; not main focus of ecosystem restoration

These 14 measures continued to be further evaluated in more detail and screened based on if a measure met the planning criteria (complete, effective, efficient, and acceptable), was technically feasible, and was within project scope (purpose and need). The following are the results on whether a measure was retained or removed, and the associated rationale for the decision (see also Table 3-2).

- **Measure 1, Infuse Cool Quarry Water into the Yakima River.** A large, privately-owned rock quarry is near the north shore of the Yakima River, west of Highway 240. It was suggested during the scoping/brainstorming that cooler water from the quarry could potentially be discharged into the Yakima River when water temperatures become too high. Preliminary investigations indicate the quarry is a groundwater system. As a result, little head differential is available to discharge from the quarry to the river without additional infrastructure (e.g., flow control intake and outlet structures). Any inlet flow control structures used to charge the quarry during the spring freshet would not create higher quarry water elevations in the summer and, as groundwater drops, quarry water would drain into the aquifer, limiting the amount of cooler water provided to the river during the summer. Since the summer is when the temperatures are the highest and when cool water is needed the most, this measure would not provide enough benefits for listed salmonids. Therefore, this measure is deemed not effective and **removed from further consideration** because it was not technically feasible and/or did not satisfy the stated objectives.

- **Measure 2, Cool Yakima River with Spring Water.** There are two springs fed by groundwater, stormwater and irrigation runoff that are found within or near the footprint of the project. Amon Creek Spring and Wasteway discharges cool water in the Yakima River upriver of the Highway 240 Bridge on the south shore. It originates off site and runs under Columbia Drive and through the USACE HMU. The cooler water is used as a refuge by adult salmonids (coho and possibly other species). The bubble-up spring and wasteway is located near the I-82 Bridge upstream of the project and provides cool water which is also refuge during warm months. This measure is deemed not effective and **removed from further consideration** because it violates the constraint to not change or affect the cool water refugia.

- **Measure 3, Route Cool Water from the Columbia River to the Yakima River.** Using a gravity fed system or pump, route cooler Columbia River water from immediately upstream of the Yakima River Delta to the Yakima River in the area near the Highway 240 Bridge. This could be either an open channel or closed conduit system or a combination of both. Associated infrastructure would require an intake structure, fish screens, and outlet structure, and possible energy dissipation system such as a stilling basin. This measure is **removed from consideration** because it was not technically feasible and deemed inefficient as a result of elevation gradient challenges. These challenges are associated with the necessary routing of water required due to the long distance. This was deemed unsustainable as a long-term solution due to anticipated concerns with maintenance.

- **Measure 4, Dredge Yakima River at Confluence with Columbia River.** Dredge to deepen the Yakima River in the main channel to the confluence of the Columbia River. Could be combined with Measure 5 to help concentrate deeper flows. This measure could be scaled by depth and location. This measure is **removed from further consideration** because it is deemed unacceptable as the dredging action would have potential adverse

environmental impacts. Specifically, the accumulated sediments in the Delta may be contaminated, and avoiding and minimizing dredging of this material is important to comply with Section 404 of the CWA.

- **Measure 5, Concentrate Flows with Training Structures in the Yakima River, and Measure 10, Isolate Backwater from the Main Yakima River Channel.** Since these two measures would achieve the same outcome of concentrating flows, these were combined into one measure. Concentration of Yakima River flows could be accomplished using flow-training structures in various configurations constructed of rock and/or wood. Bendway weirs and stream barbs are relatively equivalent structure types that are installed in a series along the river bankline through a channel bend. Stream barbs would be shorter and spaced closer together than bendway weirs and are generally more effective in tighter (smaller) radius bends. Bendway weirs are generally configured as a series of level crested stills angled upstream to the current while stream barbs gradually slope down from the bank into the bed. Both extend from the bank into the channel flow and modify the helicoidal flow patterns of secondary currents in the outside of the bend to shift the channel thalweg to the streamwise end of the structure.

- Structures would be placed in select locations, as necessary to help to sustain a deeper thalweg for the Yakima River in the lower half-mile sub-reach below the Highway 240 Bridge and maintain conveyance past Bateman Island to the Columbia River confluence. The flow training structures would tie into a bankline, which could be configured to either isolate or control flow exchange to the backwater area west of Bateman Island. Initial habitat benefit modeling indicates this alternative does not provide a lift to the ecosystem as no change to temperature would be expected. Therefore, this measure was deemed not effective and was **removed from further consideration**.

- **Measure 6, Connect the Upstream and Downstream Aquatic and Riparian Habitat under the Railroad and Highway 240.** Topography would be altered to follow historic abandoned side channels. Channel depth would be increased, and bank slopes would need to be altered and graded to support native riparian habitat. The reconnected side channel would discharge into the slackwater area downstream of Highway 240. The new channel would avoid the Amon Creek Wasteway. This measure cannot be developed without impacting the cool water refuge; therefore, it violates a constraint, and it was deemed not effective and **removed from further consideration**.

- **Measure 7, Complete or Partial Removal of Causeway.** Removal of part or all of the 500-foot Bateman Island Causeway. Flows from the Yakima and Columbia River blocked from flowing around the island have resulted in a large slackwater area. NHC (2005) evaluated several causeway breaching alternatives with two showing demonstratively positive results: a 50 percent removal and 100 percent removal of the causeway. Scaling has already been evaluated. This measure is **retained for further evaluation** because it meets Planning Objectives 1 and 2 and does not violate the Planning Constraints.

- **Measure 8, Excavate New Side Channel through South end of Bateman Island.** A natural low area at the southeastern tip of Bateman Island would allow a channel to be dredged from the west side of the causeway to the Columbia River. The shoreline of the channel could be graded to create riparian habitat. The existing causeway would be retained. A small bridge would be constructed to traverse the new channel to provide emergency services and recreation access to the north end of Bateman Island. This measure is **removed from further consideration** because it may have adverse impacts to human interment sites, which violates a constraint and is therefore, deemed not effective.

- **Measure 9, Realign Yakima River Along the North Shore to the Columbia River.** A channel would be cut from the Yakima River to the Columbia River along the north shore south of the Highway 240 Bridge to the Columbia River. This would move the river channel north and eliminate the meanders of the Yakima River within the Delta area. To make this effect, a flow control structure downstream of the channel would be used to back water to the channel increasing water depth. This measure is **removed from further consideration** because it may have adverse impacts to human interment sites, which violates a constraint and is, therefore, deemed not effective.

- **Measure 11, Control Flows to Improve Riparian and Aquatic Habitat in Backwater.** Create additional and improve existing riparian habitats in several locations (e.g., along the backside of Bateman Island). An impermeable or semipermeable berm would limit Yakima River flows from the backwater area. This measure is **removed from further consideration** due to anticipated negative environmental impacts and was deemed unacceptable.

- **Measure 12, Create Deep Water/Deep Pool Habitat within Backwater.** Dredge portions of the backwater area to create deep water areas or pools. Dredging to 29 to 49 feet would create the opportunity for a gradient of habitat types. This would require a flow control system to seasonally manage the volume and duration of the flows that enter the backwater area. Additional sediment control structures may be required to prevent deposition within the backwater. This measure is **removed from further consideration** because it is not feasible under existing authorities to require USACE or the NFS to provide continued long-term maintenance to keep the pools deepened. Additionally, benefits are not anticipated for the entire 50 years of the planning horizon; therefore, this measure was deemed inefficient. This measure is also deemed unacceptable as the dredging action would have potential adverse environmental impacts. Specifically, the accumulated sediments in the Delta have potential to be contaminated, and avoiding and minimizing dredging of this material is important to be in compliance with Section 404 of the CWA.

- **Measure 13, Increase Fringe Riparian Habitat.** Shape shoreline along Bateman Island and smaller islands in the Delta on slope to allow for a diversity of emergent wetland and riparian habitat types. Depending on the slope and shoreline materials, this would

require toe stabilization, bank cut and fill to desired slope of no steeper than 2-vertical to 1-horizontal. Slope cover with appropriate soils and stabilized with material (bio-core) and planting would be required. Invasive species would be controlled while plants are getting established. This measure may be used at a variety of locations and in combination of other concepts. This measure is **retained for further evaluation** because it may meet an element of Planning Objective 2 and does not violate the Planning Constraints.

- **Measure 14, Change McNary Dam Operations.** Drawdown the McNary Dam operating pool by 32 feet during the spring freshet and summer. This would require a change to turbine operation, navigation lock intakes, spillway outlets, and fish bypass system operations and modifications to the adult fish ladder, channel outlet, and water intakes. This measure is **removed from further consideration** because it is impractical (under the 1135 authorization) to implement McNary operations different than those being considered as part of the regional Columbia River System Operation Review; therefore, the benefits would not be realized. Any changes to the McNary operations in this reach would require extensive coordination with stakeholders, agencies, and the public to ensure the entire Columbia River System is not impacted by these changes. This is deemed outside the scope of this CAP 1135 project.

Table 3-2. Further Screening of Measures

Measures	Future Consideration Retained / removed from further consideration	Summary for Retention or Removal
Measure 1, Infuse Cool Quarry Water into Yakima River	**Removed**	Not technically feasible and did not satisfy stated objectives
Measure 2, Cool Yakima River with Spring Water	**Removed**	Violates Cool Water Refuge constraint.
Measure 3, Route Cool Water from the Columbia River to the Yakima River	**Removed**	Costly and not efficient to continue maintenance to sustain long-term.
Measure 4, Dredge Yakima River at Confluence with the Columbia River	**Removed**	Unacceptable; eliminated to avoid potential environmental impacts.
Measure 5, Concentrate Flows with Training Structures in the Yakima River	**Removed**	Combined with Concept #10; Not effective; benefits not anticipated.
Measure 6, Reconnect Floodplain under Highway 240	**Removed**	Due to a relocation to the improvements to the Amon Wasteway, this measure violated the cool water constraint.
Measure 7, Complete or Partial Removal of Causeway	***Retained***	Benefits anticipated.
Measure 8, New Side-Channel through South End of Bateman Island	**Removed**	Expected to have impacts to human interment sites; violates constraint
Measure 9, Realign Yakima River to the Columbia River along the North Shore	**Removed**	Expected to have impacts to human interment sites; violates constraint

Measures	Future Consideration Retained / removed from further consideration	Summary for Retention or Removal
Measure 10, Isolate Backwater from Main Yakima River Channel	**Removed**	Combined with measure #5; Not effective; benefits not anticipated.
Measure 11, Control Flows to Improve Riparian and Aquatic Habitat in Backwater	**Removed**	Unacceptable; eliminated to avoid potential environmental impacts.
Measure 12, Create Deepwater/Deep Pool Habitat within Backwater	**Removed**	Unacceptable; eliminated to avoid potential environmental impacts.
Measure 13, Increase Fringe Riparian Habitat	***Retained***	Benefits anticipated and would be value added to other measures.
Measure 14, Change McNary Dam Operations	**Removed**	Infeasible to implement; benefits would not be realized.

3.6 ALTERNATIVES FORMULATION

Alternative plans are developed by combining one or more measures to form a plan that meets all planning objectives, satisfies the purpose and need statement, and avoids all constraints. The evaluation criteria of acceptability, completeness, effectiveness, and efficiency are considered in the development of the alternatives and confirmed for the Recommended Plan. Alternatives are compared and evaluated against the No Action Alternative, with respect to ecosystem outputs (habitat benefits) and by cost effectiveness and incremental cost analysis (CE/ICA). A No Action Alternative is required by NEPA and represents the Yakima River Delta as it currently is, without this ecosystem restoration project or any other improvements.

Alternatives considered must achieve project objectives:

- Restore, for the 50-year period of analysis, the aquatic ecosystem function, and processes within the mouth of the Yakima River Delta that have been degraded by alterations that resulted in a thermal barrier between the Columbia and Yakima Rivers.
- Improve the quality and complexity of aquatic and riparian habitat within the Yakima River Delta by increasing flows, reducing predator habitat, and providing native plant diversity over the 50-year period of analysis.

Alternatives considered must not violate the study constraints:

- Coldwater refugia and springs shall not be impacted by project actions, as such areas provide resting areas for migrating adult salmon and steelhead during periods of high-water temperatures.
- No alternative shall directly impact areas of known human interment or cemeteries.
- No alternative shall impact authorized project purposes

The two measures remaining after the initial screening were combined into alternatives, based on whether they were mutually exclusive, combinable, or dependent on other measures. Dependency relationships occur between solutions when the implementation of one solution is dependent on the implementation of one or more other solutions. Combinability relationships

occur between solutions when the implementation of one solution cannot be combined with the implementation of one or more other solutions. Each riparian site is dependent upon the implementation of the full causeway removal due to the main goal of the project centered around listed salmonids. Potential benefits from riparian sites alone would not be sufficient to provide enough restoration for fish habitat and would be limited to only providing shade and woody debris. Therefore, the following relationships exist:

- The No Action Alternative cannot be combined with any other measure.
- Only Measure 7, complete or partial removal of the causeway, could be considered a standalone alternative.
- Measure 13, riparian habitat, is dependent on Measure 7. Therefore, any habitat benefits with riparian habitat (Measure 13) can only be gained if improvements are made to the causeway (Measure 7).

Based on these interrelationships, two alternative plans with two options, in addition to the No Action Alternative, were compared with respect to habitat benefits and costs estimated to implement, operate, and maintain the project. Table 3-3 identifies the initial array of alternatives, and the following list contains a brief description of these alternatives. These alternatives were carried forward to assess potential environmental consequences, as discussed in Section 4.

Table 3-3. Initial Array of Alternatives

Alternatives
1. No Action
2. Causeway Removal with Riparian Habitat
2a*. Full Causeway Removal
2b*. Partial Causeway Removal
3. Causeway Removal without Riparian Habitat
3a. Full Causeway Removal
3b. Partial Causeway Removal

*Upon CE/ICA, the addition of "-1," "-2," and "-3" to Alternative 2's naming convention indicates the different riparian sites added

- **The No Action Alternative** is required by NEPA and is also considered the Future Without Project Condition. If this alternative is selected, no USACE work will be done to restore ecosystem functions at Yakima River Delta. It is the baseline condition against which all other alternatives are compared to determine potential benefits.

- **Alternative 2a, *Full Removal of Causeway with Riparian Habitat***. This alternative combines Measures 7 and 13 to fully remove the causeway and provide a submerged bench with aquatic habitat, emergent wetland, and multi-storied riparian shrub and tree plantings on a stabilized slope along the western and southern side of Bateman Island.

  The causeway itself is approximately 500 linear feet long, 10 feet high, and 40 feet wide at its base. Full removal of the causeway would require the excavation of approximately 37,000 cubic yards of soil and concrete along the entire 500 linear feet, from the mainland, northward towards Bateman Island. Construction equipment required would include earth moving vehicles such as excavators, bull dozers, loaders, and dump trucks. The use of a barge(s) may be required to haul sediment to an upland disposal site. During construction, Wye Park would be utilized as a staging area for excavated material or construction equipment. Temporary disposal areas would be maintained with erosion and sediment measures to prevent excavated materials from re-entering the Yakima River.

  The causeway is wide enough to support one way excavator and dump truck movements. Construction would begin with an excavator traveling to the Bateman Island side of the causeway and beginning excavation, working southward towards Wye Park. At this point, excavated material would either be directly placed into dump trucks or placed temporarily in staging areas within Wye Park, in uplands, then transported to an approved upland disposal site. The proposed Project feature would remove the entire structure from 351 feet mean sea level at the causeway's centerline crest to approximately 340 feet mean sea level.

  Locations for riparian habitat were identified through NFS collaboration. Planting of riparian habitat would take place concurrently with the removal activities of the causeway. Desired riparian plant species would include primarily coyote willow, tule, wapato, and cottonwood. Four desired site locations (referred to as Riparian 1-4) for multi-storied riparian plantings are located along the northeastern and southern extent of Bateman Island. (See Figure 3-1). To avoid impacts to resources on the island, a stabilized slope would be created along the shoreline through the addition of earthen fill material. Fill material would be transported to the desired planting locations with floating barges and applied either using a small excavator or by hand. Fill would consist of sand, gravel, and organic material. Individual plantings would be placed 2 to 5 feet apart (from center to center) for plugs (tule and wapato) and 5 to 10 feet apart for willow. For optimal growth density, willows would be planted three plants to a single hole. Riparian plants would be placed either by hand or with a dibble stick. Under Alternative 2a, the 4 sites for riparian habitat were considered all together as well as separated for a complete analysis (Refer to Table 3-4).

- **Alternative 2b, *Partial Removal of Causeway with Riparian Habitat***. This alternative combines Measures 7 and 13. It provides the submerged bench and emergent wetland and multi-storied riparian shrub and tree plantings on a stabilized slope along the western and southern side of Bateman Island.

  Unlike Alternative 2a, the causeway would be partially removed, leaving an approximately 275-foot portion of the causeway extending from the mainland side towards Bateman Island. Unlike the full removal alternatives, the ground disturbing impact would be less at approximately 20,000 cubic yards of soil and concrete material removed compared to 37,000 cubic yards under the full removal alternative. The structure would be leveled to the same 340 feet mean sea level. Regardless, construction activities (excavation, staging, sediment disposal, and preparation and planting of riparian habitat) for partial removal of the causeway would remain the same as with the full removal alternatives. Under Alternative 2b, the 4 sites for riparian habitat were considered all together as well as separated for a complete analysis (Refer to Table 3-4).

- **Alternative 3a, *Full Removal of Causeway without Riparian Habitat***, provides fish passage with no riparian habitat creation. Only Measure 7 would be implemented in this alternative. It is anticipated that vegetation would naturally become established without active plantings.

  Regarding the full removal of the causeway, the alternative 3a would involve the same level of ground disturbing activity, equipment, procedures, and staging areas as the other full removal alternative. The alternative 3a differs in the exclusion of riparian habitat and the corresponding construction procedures, equipment, and impacts.

- **Alternative 3b, *Partial Removal of Causeway without Riparian Habitat***, provides fish passage with no riparian habitat creation. Only Measure 7 would be implemented in this alternative. It is anticipated that vegetation would naturally become established without active plantings.

  Regarding the partial removal of the causeway, Alternative 3b would involve the same level of ground disturbing activity, equipment, procedures, and staging locations as with the Alternative 2b. The Alternative 3b differs in the exclusion of riparian habitat and the corresponding construction procedures, equipment, and impacts.

Figure 3-1. Sites 1-4 of Potential Riparian Habitat

3.6.1 Environmental Outputs

Benefits for each alternative were developed using the General Salmonid Habitat Model (GSHM), a Habitat Suitability Index (HSI) developed by the USACE Research and Development Center (ERDC), which represents both riparian and aquatic habitat, but is focused on the quality of those habitats for adult and juvenile salmonids. This habitat evaluation procedure assumes that habitat for selected species can be described by the HSI. This index value (from 0.0 to 1.0) is multiplied by the area of applicable habitat to obtain HUs. Changes in HUs will occur as a habitat matures naturally or is influenced by development. These changes influence the cumulative HUs derived over the period of analysis (50 years estimated to begin 2025 and end 2075). Habitat Units are calculated for select target years for each alternative to include the future without project alternative (No Action), estimated future without project condition is subtracted to obtain a net HU, and annualized (using the Institute for Water Resources [IWR] Planning Suite II tool annualizer) over the period of analysis to derive net Average Annual Habitat Units (AAHUs). Net AAHUs are then used as the output measurement to compare the measures and alternatives for the proposed Project. (Refer to Table 3-4 for Net AAHUs and Appendix C for details on habitat modeling).

Riparian sites 1 through 4 are indicated in the Figure 3-1, above, and Table 3-4, below.

Table 3-4. Summary of Net AAHUs for Each Alternative

Alternative	AAHU
Existing Con (No Action)	-
Partial Breach (Alt 3b)	49.5
Full Breach (Alt 3a)	53.6
Partial Breach + All Riparian (Alt 2b)	54
Full Breach + All Riparian (Alt 2a)	58.5
In-stream Structures	(18.3)
Riparian site 1 + Partial Breach	50.6
Riparian site 2 + Partial Breach	51.6
Riparian site 3 + Partial Breach	49.7
Riparian site 4 + Partial Breach	50.6
Riparian site 1 + Full Breach	54.7
Riparian site 2 + Full Breach	55.8
Riparian site 3 + Full Breach	54.1
Riparian site 4 + Full Breach	54.7

This model does not project changes in population numbers of any life stage or species. The model captures changes in the ecosystem as a result of proposed USACE activities. Also, it does not project absolute system changes but rather relative differences between proposed restoration alternative actions. Finally, although the model parameters were chosen and quantified primarily using the life history requisites of salmonid species, the model represents suitability of the system for all anadromous and other fish species of concern expected to

benefit from habitat restoration. The GSHM is certified for regional use within all watersheds that support anadromous Pacific salmon species along the northwest coast of the continental United States (northern California, Oregon, and Washington).

3.6.2 Costs

Costs for the initial array of alternatives were calculated at the October 2022 FY23 price level to include construction, planning/engineering/design (PED)—which includes monitoring and adaptive management; long-term operation and maintenance costs—real estate, and construction management (CM) (refer to Appendix D, Cost Estimate). Costs are refined at the October 2023 FY24 price level for the Recommended Plan in Section 5.

Interest during construction (IDC) and 30 percent contingencies were applied. Costs were annualized using the IWR Planning Suite Annualization Tool (USACE certified version 2.0.9) using estimated construction cost, a one-year construction period for intIDC computations, estimated operations and maintenance (O&M), the FY23 Federal discount rate (2.50 percent), and a 50-year period of analysis estimated to begin 2025 and end 2075. Costs are as summarized in Table 3-5.

Table 3-5. Alternative Costs* ($1,000s)

Alternative ID	Alternative Description	First Cost	IDC**	Total Investment Cost	Average Annual First Cost	Annualized O&M	Total AAC
C	Causeway Removal - Partial	$7,225	$82	$7,308	$258	$0	**$257.7**
CFULL	Causeway Removal - Full	$12,757	$146	$12,903	$455	$0	**$454.9**
R/RF	Riparian Site 1	$1,902	$22	$1,923	$69	$2.051	**$71.3**
WS/WSFULLL	Riparian Site 2	$4,532	$52	$4,584	$165	$4.526	**$169.3**
NOTCH/ NOTCHFULL	Riparian Site 3	$106	$1	$107	$4	$0.539	**$4.7**
EE/EEFULL	Riparian Site 4	$810	$9	$819	$29	$0.861	**$30.3**

*FY23 OCT 2022 Price Level and 2.50% Federal Discount Rate

**IDC assumes 1-year construction duration at midpoint of construction

SECTION 4 - ENVIRONMENTAL CONSEQUENCES

This section evaluates potential environmental effects on the resources described in Section 2, Affected Environment, for each alternative**.** Alternative 1 (No Action), Alternatives 2a and 2b, and Alternatives 3a and 3b were carried forward for analysis in this section.

The following descriptors are used in this section for consistency in describing the type, intensity, and scale of potential impacts in relation to significance:

Impact Type

- **Adverse:** The action would result in a negative effect that could cause harm to the resource.

- **Beneficial:** The action would result in a positive effect that could cause the resource to improve.

Impact Intensity

- **No or Negligible:** The action would result in no effect, or the effect would not change the resource condition in a perceptible way. Negligible is defined as of such little consequences as to not require additional consideration or mitigation.

- **Minor:** The effect to the resource would be perceptible; however, the effect would not be major and unlikely to result in an overall change in resource character.

- **Moderate:** The effect to the resource would be perceptible and may result in an overall change in resource character. Moderate impacts are not significant due to their limited context (the geographic, biophysical, and social context in which the effects would occur) or intensity (the severity of the impact, in whatever context it occurs).

- **Major:** The effect to the resources would be perceptible and may result in overall change in resource character. Major impacts are not significant due to their limited context or intensity.

Impact Scale

- **Direct:** Impacts that are caused by the action and occur at the same time and place. Direct impacts are experienced upon implementation of the action.

- **Indirect:** Impacts that are caused by the action and are later in time or farther removed in distance but are still reasonably foreseeable.

- **Cumulative:** Impacts on the environment which result from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time.

Significance Determination:

- **Less Than Significant:** The effect to the resource may not be perceptible or severe. The effects would not result in an overall negative change in resource character. The determination of less than significant would not require the completion of an EIS and a Finding of No Significant Impacts (FONSIs) would be appropriate.

- **Significant:** The effect to the resource would be perceptible and may be severe. The effect would likely result in an overall change in resource character. The determination of a significant adverse impact to any resource would require the completion of an EIS.

The following table gives an overview of the impact determinations for each of the alternatives evaluated: Alternative 1 (No Action), Alternative 2a (Full Removal of Causeway with Riparian Habitat), Alternative 2b (Partial Removal of Causeway with Riparian Habitat), Alternative 3a (Full Removal of Causeway without Riparian Habitat), Alternative 3b (Partial Removal of Causeway without Riparian Habitat). Significance determinations for the above alternatives would all be considered less than significant as the impacts to the respective resources would all be localized to the Yakima River Delta and would not pose a severe or notable change in regional resource characteristics over time. Boxes with two impact determinations represent distinctions between the short-term and long-term impacts on the respective resource. Boxes with a singular impact determination indicate the same determination for both the short-term and long-term impacts to the respective resource.

Table 4-1. Effects Summary

Resource	Alternative 1	Alternative 2a	Alternative 2b	Alternative 3a	Alternative 3b
Air Quality	Negligible	Minor Adverse / Minor Beneficial	Minor Adverse / Minor Beneficial	Minor Adverse	Minor Adverse
Noise	Negligible	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Sediment	Negligible	Moderate Adverse /Negligible	Moderate Adverse /Negligible	Moderate Adverse /Negligible	Moderate Adverse /Negligible
Hydrology	Negligible	Major Beneficial	Major Beneficial /Moderate Beneficial	Major Beneficial	Major Beneficial / Moderate Beneficial
Water Quality	Negligible/ Moderate Adverse	Moderate Adverse/ Major Beneficial	Moderate Adverse/ Moderate Beneficial	Moderate Adverse/ Major Beneficial	Moderate Adverse/ Moderate Beneficial
Aquatic Resources	Major Adverse	Minor Adverse/ Major Beneficial	Moderate Adverse/ Major Beneficial	Minor Adverse/ Major Beneficial	Moderate Adverse/ Major Beneficial
Threatened and Endangered Species	Major Adverse	Major Beneficial	Moderate Beneficial/ Major Beneficial	Major Beneficial	Moderate Beneficial/ Major Beneficial
Wetlands	Negligible	Minor Beneficial	Minor Beneficial	Negligible	Negligible
Wildlife	Negligible	Minor Adverse / Negligible	Minor Adverse /Negligible	Minor Adverse /Negligible	Minor Adverse /Negligible
Vegetation	Negligible	Minor Beneficial	Minor Beneficial	Negligible	Negligible
Land Use	Negligible	Moderate Adverse /Negligible	Moderate Adverse/ Negligible	Moderate Adverse/ Negligible	Moderate Adverse/ Negligible
Recreation	Negligible	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial
Aesthetics/Visual Resources	Negligible	Minor Adverse and Beneficial	Minor Adverse and Beneficial	Minor Adverse and Beneficial	Minor Adverse and Beneficial
Climate Change	Negligible	Negligible	Negligible	Negligible	Negligible
Cultural and Historic Resources	Major Adverse	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial	Moderate Adverse and Beneficial
Economic/Socioeconomic/ Environmental Justice	Negligible	Minor Adverse	Minor Adverse	Minor Adverse	Minor Adverse
Public Utilities and Infrastructure	Negligible	Moderate Adverse	Moderate Adverse	Moderate Adverse	Moderate Adverse
Hazardous, Toxic, and Radioactive Waste	Negligible	Negligible	Negligible	Negligible	Negligible

4.1 AIR QUALITY

4.1.1 Alternative 1 (No Action)

Under the No Action Alternative, air quality in the area would continue to meet Washington state implementation plan standards and be subject to monitoring. The alternative would have ongoing negligible direct short-term impacts to air quality due to the continued urban area air pollutants from land- and water-based vehicles, or industrial activities. Similarly, the alternative would have negligible indirect long-term impacts to air quality for the same reasons. Therefore, the impacts to air quality would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.1.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

If Alternative 2a was implemented, air quality would be affected in two ways. 1) Direct pollution from the operation of construction equipment, and 2) temporary loss of vegetation, before longer-term benefits of vegetation establishment. Vehicular emissions would temporarily increase air pollutants to a moderate degree that would dissipate quickly and provide no long-term measurable effect.

The vast majority of shoreline vegetation would remain, but a segment of vegetation at the causeway would be removed as part of construction. This would have negligible effects to air quality due to eliminating a small area of pollutant absorbing vegetation. Similarly, the establishment of riparian areas would have the opposite effect by providing beneficial increases to the local riparian plant communities. In the long-term, vegetation would increase.

The alternative would differ from the No Action alternative in that it would have minor adverse direct short-term impacts to air quality due to the immediate equipment operation in removing the causeway, establishing riparian substrate, and removing causeway vegetation. The alternative would have minor indirect long-term benefits to air quality because riparian habitat would develop over time. As a result, the impacts to air quality would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.1.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

If Alternative 2b was implemented, the short-term impacts would be similar to but slightly less than for Alternative 2a as the amount of equipment operation needed for causeway removal would be halved. Otherwise, vegetation clearing impacts and riparian vegetation establishment would have the same negligible effects and minor benefits as Alternative 2a.

The alternative would differ from the No Action alternative in that it would have minor adverse direct short-term impacts to air quality due to the immediate equipment operation in removing the causeway, establishing riparian area substrate, and removing causeway vegetation. The alternative would have minor indirect long-term benefits to air quality because riparian habitat

would develop over time. As a result, the impacts to air quality would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.1.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

If Alternative 3a was implemented, the short-term impacts of construction equipment operation on air quality would be similar to but less than for Alternative 2a as the amount of equipment operation used to establish riparian area substrate is avoided. Otherwise, vegetation clearing impacts would have the same negligible effects. Minor benefits from air quality from additional vegetation establishment would not be realized.

The alternative would differ from the No Action alternative in that it would have minor adverse direct short-term impacts to air quality due to the immediate equipment operation in removing the causeway and causeway vegetation, but not the establishment of riparian substrate. The alternative would not induce benefits to air quality from riparian establishment. As a result, the impacts to air quality would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.1.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

If Alternative 3b was implemented, the short-term impacts would be similar to but slightly less than for Alternative 3a as the amount of equipment operation needed for causeway removal would be halved. Otherwise, vegetation clearing impacts would have the same negligible effects. Minor benefits from air quality from additional vegetation establishment would not be realized.

The alternative would differ from the No Action alternative in that it would have minor adverse direct short-term impacts to air quality due to the immediate equipment operation in removing the causeway and causeway vegetation, but not the establishment of riparian substrate. The alternative would not induce benefits to air quality from riparian establishment as Alternatives 2a and 2 b would. As a result, the net impacts to air quality would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.2 NOISE

4.2.1 Alternative 1 (No Action)

Under the No Action Alternative, noise in the area would continue to reflect traffic, boat, and related industrial levels. The alternative would have ongoing negligible direct short-term impacts to noise due to the continued urban area activities. Similarly, the alternative would have negligible indirect long-term impacts to noise levels for the same reasons. Therefore, the impacts to noise would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.2.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

If Alternative 2a was implemented, noise levels would be affected from the operation of construction equipment. Vehicular noise would temporarily increase to a moderate degree during daylight hours and provide no long-term measurable effect.

The alternative would differ from the No Action alternative in that it would have moderate adverse direct short-term impacts to noise due to the immediate equipment operation in removing the causeway, establishing riparian substrate, and removing causeway vegetation. The impacts to noise levels would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.2.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

If Alternative 2b was implemented, noise levels would be affected from the operation of construction equipment. Vehicular noise would temporarily increase to a moderate degree during daylight hours and provide no long-term measurable effect. The effects would be slightly reduced as the causeway removal element would be reduced in comparison to Alternative 2a.

The alternative would differ from the No Action alternative in that it would have moderate adverse direct short-term impacts to noise due to the immediate equipment operation in removing part of the causeway, establishing riparian substrate, and removing causeway vegetation. The impacts to noise levels would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.2.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

If Alternative 3a was implemented, noise levels would be affected from the operation of construction equipment. Vehicular noise would temporarily increase to a moderate degree during daylight hours and provide no long-term measurable effect. Less noise would be produced as riparian substrate construction would not occur.

The alternative would differ from the No Action alternative in that it would have moderate adverse direct short-term impacts to noise due to the immediate equipment operation in removing the causeway and removing causeway vegetation. The impacts to noise levels would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.2.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

If Alternative 3b was implemented, noise levels would be affected from the operation of construction equipment. Vehicular noise would temporarily increase to a moderate degree during daylight hours and provide no long-term measurable effect. Less noise would be produced as riparian substrate construction would not occur and less causeway removal would be conducted.

The alternative would differ from the No Action alternative in that it would have moderate adverse direct short-term impacts to noise due to the immediate equipment operation in removing part of the causeway and removing causeway vegetation. The impacts to noise levels would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.3 SEDIMENT

4.3.1 Alternative 1 (No Action)

Under the No Action Alternative, sediment would continue to accrete within the backwater environment and erode along Bateman Island shoreline because of McNary Project Operations. As a result, the alternative would have negligible direct short-term impacts to sediment due to the continued accretion caused by McNary Project Operations. Similarly, the alternative would have negligible indirect long-term impacts to sediment for the same reasons. Therefore, the impacts to sediment resources would be less than significant because there would not be a severe or negative overall change in resource character over time.

(See Sections 2.5 and 4.3 for additional information regarding sediment quality testing in the Yakima River Delta.)

4.3.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

If Alternative 2a was implemented, sediment within the backwater environment would mobilize during and immediately following the removal of the causeway and spring freshet events. Shoreline erosion may occur due to breaching the causeway. Riparian habitat would stabilize sediments along the shoreline over time. In the long-term, erosion would decrease, and new areas would accrete within the Delta and Columbia River (NHC 2024).

The alternative would have moderately adverse direct short-term impacts to sediment due to the immediate erosion caused by the removal of the causeway. The alternative would have negligible indirect long-term impacts to sediment because riparian habitat would stabilize the shoreline over time and has the potential for limited sediment benefits with more natural accretion. As a result, the impacts to sediment resources would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.3.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

If Alternative 2b was implemented, sediment within the backwater environment would mobilize during the partial breach following spring freshet events. The remaining portion of the causeway would trap some sediment within the Delta. Shoreline erosion may occur because of partial breaching of the causeway. Riparian habitat would stabilize sediments along the shoreline. In the long-term, erosion would decrease, and new areas would accrete within the Delta and Columbia River.

The alternative would have moderate adverse direct short-term impacts to sediment due to the temporary erosion caused by the partial removal of the causeway. The alternative would have negligible indirect long-term impacts to sediment because riparian habitat would stabilize the shoreline over time. There is the potential for limited sediment benefits with more natural accretion. As a result, the impacts to sediment resources would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.3.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

If Alternative 3a was implemented, sediment within the backwater environment would mobilize during the full breach following spring freshet events. Shoreline erosion may occur because of breaching the causeway and may continue to erode unless stabilized. In the long-term, erosion would decrease, and new areas would accrete within the Delta and Columbia River.

The alternative would have moderate adverse direct short-term impacts to sediment due to the temporary erosion caused by removal of the causeway. The alternative would have negligible indirect long-term impacts to sediment, although it would take longer for the shoreline to stabilize without the presence of riparian habitat. As a result, the impacts to sediment resources would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.3.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

If Alternative 3b was implemented, sediment within the backwater environment would mobilize during the partial breach following spring freshet events. Shoreline erosion may occur because of partially breaching the causeway and may continue to erode unless stabilized. In the long-term, erosion would decrease, and new areas would accrete within the Delta and Columbia River.

The alternative would have moderate adverse direct short-term impacts to sediment due to the temporary erosion caused by partial removal of the causeway. The alternative would have negligible indirect long-term impacts to sediment, although it would take longer for the shoreline to stabilize without the presence of riparian habitat. As a result, the impacts to sediment resources would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.4 HYDROLOGY

4.4.1 Alternative 1 (No Action)

Under the No Action alternative, the hydrology of the Yakima River Delta would continue to be influenced by upstream Yakima River flows, Lake Wallula, and the Columbia River. Yakima River flows would continue to be driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River would continue to be influenced by the free-flowing sections of the mid-Columbia River, public utility district (PUD) dams, and Lake Wallula.

The lower Yakima River would continue to range from 2.5 feet to 5.5 feet deep from Prosser through West Richland but increase to more than 7 feet deep west of the Highway 240 Bridge in Richland and continue to the confluence. Along the western side of Bateman Island, however, the depths would continue to quickly decrease to 2.5 feet or less. Deeper, cooler refugia would continue to exist throughout the lower Yakima River, typically coinciding with the location of incoming seeps and irrigation returns. Amon Creek Wasteway at RM 2.5 and a ground water collection system known locally as the Bubble up near RM 4.9 would continue to provide persistent cool water flow.

Water within the Yakima River Delta would continue to flow along the northern extent of Bateman Island to the Columbia River. The causeway would continue to prevent the circulation of water on the western and southern extent of the island. This would continue to perpetuate the stagnant, back water environment.

Implementation of the No Action alternative would have negligible direct short-term and indirect long-term impacts to hydrology because there would not be any change to the current hydrological conditions without the removal of the causeway. As a result, the impacts to hydrology from the No Action alternative would be less than significant because there would not be a severe or negative overall change in resource character over time.

4.4.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under Alternative 2a, Yakima River flows would continue to be driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River would continue to be influenced by the free-flowing sections of the mid-Columbia River, public utility district (PUD) dams, and Lake Wallula.

However, the full removal of the causeway would permanently impact the flow characteristics, the thermal exchange, and possibly the depth of water within the Yakima River Delta. Hydrologic models predict that the cooler water from the main stem Columbia River would be diverted along the western and southern sides of Bateman Island, while the warmer water from the Yakima River would begin to flow along the mainland side of the newly formed channel. Mixture between the two water sources would result in a thermal distinction between the cooler water from the Columbia River and the warmer water of the Yakima River in the channel where the causeway was removed. As a result, the stagnant, back water environment would

increase in flow and the temperatures of the water in that area would be less impacted by thermal change from the ambient temperatures. In addition, it is anticipated that the increased flow would cause the mobilization of alluvial sediment which could potentially impact water depth over time. Although the extent to which the depth would change is unclear, sediment is anticipated to mobilize following the full removal of the causeway. The inclusion of riparian habitat would have marginal influence on the overall hydrological characteristics, however, the presence of vegetation along the shoreline would aid to slow down the velocity of water and help prevent erosion. (Refer to Appendix E, Hydrologic and Hydraulic Analysis.)

The implementation of Alternative 2a would have major beneficial direct short-term impacts, and major beneficial indirect long-term impacts to the hydrology of the Yakima River Delta. Removal of the causeway would permanently alter flow characteristics, increasing the flow rates and thermal exchange through the system, and possibly alter the depth of water west of Bateman Island through the mobilization of sediment over time. Overall, the impacts to hydrologic resources would be major and beneficial because there would be a positive and permanent change in resource character over time.

4.4.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under Alternative 2b, Yakima River flows would continue to be driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River would continue to be influenced by the free-flowing sections of the mid-Columbia River, public utility district (PUD) dams, and Lake Wallula.

As with the full removal alternative, partial removal of the causeway would permanently improve the flow characteristics, the thermal exchange, and possibly the depth of the water within the Yakima River Delta. Modeling of hydrologic and thermal characteristics predict that partial removal would introduce flow through the newly formed channel south of Bateman Island and promote thermal exchange between the warmer water of the Yakima River and the cooler water of the Columbia River. The tighter channel created, compared to the full removal of the causeway, would result in marginally faster flows through the channel and greater thermal exchange. As a result, there would be less distinction between the Yakima River and Columbia River water temperatures. In addition, alluvial sediment depositions from the western side of the causeway would be mobilized, however, the duration of mobilization is expected to be greater than that of the full removal alternative. The mobilization of sediment over a long period of time may impact the depth of the water in the area, however the extent to which the depth might change is unclear. The inclusion of riparian habitat would have marginal influence on the overall hydrological characteristics, however, the presence of vegetation along the shoreline would aid to slow down the velocity of water and help prevent erosion.

The implementation of Alternative 2b would have major beneficial direct short-term impacts, and moderate beneficial indirect long-term impacts. Partial removal of the causeway would increase flow through the channel, which, coupled with a tighter channel, would increase the rate of thermal exchange between the Yakima River and Columbia River systems. Sediment

mobilization would occur, and the duration of mobilization is expected to be greater than that of the full removal alternative. The inclusion of riparian habitat would have marginal influence on the hydrological characteristics of the alternative. Overall, the impacts to hydrologic resources would be major and beneficial because there would be a positive and permanent change in resource character over time.

4.4.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under alternative 3a, Yakima River flows would continue to be driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River would continue to be influenced by the free-flowing sections of the mid-Columbia River, public utility district (PUD) dams, and Lake Wallula.

The impacts to hydrological resources would be the same as in alternative 2a. Although the riparian habitat would have marginal influence on the hydrological characteristics of the action, the exclusion of vegetation along the shoreline would allow for some erosion to occur. The implementation of alternative 3a would have major beneficial direct short-term impacts, and major beneficial indirect long-term impacts. Removal of the entire causeway would permanently increase flow, increasing the thermal exchange, and possibly alter the depth of water west of Bateman Island through the mobilization of sediment over time. Overall, the impacts to hydrologic resources would be major and beneficial because there would be a positive and permanent change in resource character over time.

4.4.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under Alternative 3b, Yakima River flows would continue to be driven by irrigation returns, snowmelt timing, and upstream dams. Flows from the Columbia River would continue to be influenced by the free-flowing sections of the mid-Columbia River, public utility district (PUD) dams, and Lake Wallula.

The impacts to hydrological resources would be the same as in Alternative 2b. Although the riparian habitat would have marginal influence on the hydrological characteristics of the action, the exclusion of vegetation along the shoreline would allow for some erosion to occur. The implementation of Alternative 3b would have major beneficial direct short-term impacts, and moderate beneficial indirect long-term impacts. Partial removal of the entire causeway would increase flow, increasing the thermal exchange, and possibly alter the depth of the back-water environment as well. However, over time the impact to hydrologic resources is expected to stabilize. Overall, the impacts to hydrologic resources would be major and beneficial because there would be a positive and permanent change in resource character over time.

4.5 WATER QUALITY

4.5.1 Alternative 1 (No Action)

The earthen causeway at the southern end of Bateman Island would continue to inhibit the ability of Columbia and Yakima River waters to freely mix by blocking the flow of water around the island. This would continue to perpetuate the stagnant backwater environment and corresponding secondary adverse water quality through increased surface water temperatures, inconsistent dissolved oxygen levels, pH, and enhanced sediment deposition rates within the Yakima River Delta.

Stagnant water would continue to warm during the summer months promoting bacterial growth and algae blooms which have detrimental impacts to dissolved oxygen levels and pH. All these factors would continue to adversely impact the migration and spawning success of salmonids up the Yakima River. Implementation of the no action alternative would cause no direct short-term changes to the current conditions of the waters in the Yakima River Delta. The water in the Delta would continue to be classified by Ecology as “impaired” on the State’s 303(d) list for temperature, dissolved gas, and pH. The alternative would have moderate adverse indirect long-term impacts to water quality because the current conditions are expected to be exacerbated by the progression of climate change. Overall, the impacts would present a less than significant impact to water quality as the adverse impacts would be localized and not result in a severe or negative change to resource characteristics over time.

(See Section 2.5 for added information regarding water quality in the Yakima River Delta.)

4.5.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under Alternative 2a, full removal of the causeway would create a channel for water to freely flow along the western and southern extent of Bateman Island. The newly created channel would improve the water quality within the Delta and more specifically the backwater environment west of Bateman Island. Flowing water helps to prevent increases in water temperature by limiting the thermal exchange between the sun, ambient air temperatures, and the water. Increased flow and lower water temperatures discourage the growth of bacteria and algae during the summer months. These factors are conducive to ideal dissolved oxygen and pH levels, which in turn benefits the aquatic organisms which inhabit the Delta. The inclusion of riparian habitat could assist in the trapping and stabilizing sediments within the Delta as well.

However, the creation of a channel south of Bateman Island and the introduction of flow to the backwater environment would have adverse impacts to water quality through the temporary mobilization of alluvial sediments deposited by the Yakima River. Based on aerial imagery, it is assumed an approximately 150-acre area could generate 250,000 cubic yards of sediment slurry per foot of eroded depth. Furthermore, an additional 60 acres of sediment north of the Delta could be mobilized because of the additional mixing between the Yakima and Columbia Rivers.

These sediment depositions may contain contaminants from historic agricultural practices. Full removal of the causeway could result in the release of these contaminants into the aquatic environment. Sediment mobilization would temporarily increase the turbidity of the water, and therefore decrease water quality temporarily.

The Yakima and Columbia Rivers would experience a temporary increase in suspended sediment concentration and limited visibility, creating a brown appearance in the water. This condition would persist until the sediment laden waters mix with the much greater volume of the Columbia River, resulting in a negligible adverse impact. Under sustained mid to high flow velocities, the existing sediment would be transported downstream over 2 - 6 weeks under a full removal alternative. This estimate assumes high velocities are sustained over the entire period and is likely overly conservative; 2 - 3 months is a more reasonable estimate considering expected variation in velocities (NHC, 2015, 2024).

Implementation of Alternative 2a would have moderate adverse direct short-term impacts to the water quality of the Yakima River Delta and Columbia River. In the short-term, water quality would be adversely impacted by the mobilization of sediment depositions which could contain agricultural pollutants and increase the turbidity. However, implementation of the alternative would have major beneficial indirect long-term impacts on water quality through positive secondary attributes of the flowing water through the system. Flowing water would eliminate the backwater environment and promote the mixing of waters from the Yakima and Columbia Rivers. Lower water temperatures would discourage the growth of bacteria and algae during the summer months, which would help to improve the overall water quality in the Delta. This is crucial to increasing the migration and spawning success of migratory salmonid species. Overall, the impacts would be less than significant to regional water quality as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional water quality.

4.5.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under Alternative 2b, the partial removal of the causeway would have impacts to water quality that are comparable to the impacts caused by the full removal alternatives. Much like the full removal alternatives, the partial removal of the causeway would introduce flow to the stagnant backwater environment west of the causeway. This would cause sediment deposition from the back water system to mobilize, increasing turbidity and potentially releasing contaminants held within the sediment from past agricultural practices. However, the introduction of flow would help to eliminate the adverse impacts to water temperature and water quality caused by the stagnant backwater system. The inclusion of riparian habitat would have marginal influence on the impacts to water quality.

Implementation of Alternative 2b would have moderate adverse and beneficial direct short-term and long-term impacts to water quality. In the short-term, the introduction of flow to the system would have adverse impacts to water quality through turbidity and the potential release of pollutants. The introduction of flow would eliminate the backwater environment and help to regulate water temperature and discourage the growth of bacteria and algae. These changes

help to improve dissolved oxygen levels and pH, which is beneficial to the migration and spawning success of salmonids up the Yakima River system. Overall, the impacts would be less than significant to regional water quality as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional water quality.

4.5.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

As with Alternative 2a, the full removal of the causeway would have moderate adverse direct short-term impacts to water quality. Based on aerial imagery, it is assumed an approximately 150-acre area could generate 250,000 cubic yards of sediment slurry per foot of eroded depth. Furthermore, an additional 60 acres of sediment north of the Delta could be mobilized because of the additional mixing between the Yakima and Columbia Rivers. Adverse impacts in the short-term would occur due to the mobilization of sediment which would temporarily increase the turbidity of the water and potentially release contaminants held within the sediment from past agricultural practices. Under sustained mid to high flow velocities, the existing sediment would be transported downstream over 2-6 weeks under a full removal alternative. This estimate assumes high velocities are sustained over the entire period and is likely overly conservative; 2-3 months is a more reasonable estimate considering expected variation in velocities (NHC, 2015).

Overall, the alternative would have major beneficial long-term impacts to water quality from the introduction of flow into the system. Mixing of the waters from the Yakima and Columbia Rivers would help to regulate the temperatures of the water and prevent the growth of bacteria and algae during the summer months. This provides conditions that are conducive to salmonid migration and spawning success. The exclusion of riparian habitat would have marginal influence on the overall impacts to water quality. Overall, the impacts would be less than significant to regional water quality as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional water quality.

4.5.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under Alternative 3b, the partial removal of the causeway would have moderate adverse direct short-term impacts to water quality. Adverse impacts in the short-term would occur due to the mobilization of sediment which would temporarily increase the turbidity of the water and potentially release contaminants held within the sediment from past agricultural practices. However, the introduction of flow would help to eliminate the adverse impacts to water temperature and water quality caused by the stagnant backwater environment west of the causeway. The exclusion of riparian habitat would have marginal influence on the impacts to water quality.

Implementation of Alternative 3b would have moderate adverse direct short-term and long-term impacts to water quality. In the short-term, the introduction of flow to the system would have adverse impacts to water quality through turbidity and the release of pollutants. The

partial removal of the causeway would increase the adverse impacts caused by turbidity. However, in the long-term, the introduction of flow would eliminate the backwater environment and help to regulate water temperature and discourage the growth of bacteria and algae. These changes help to improve dissolved oxygen levels and pH, which is beneficial to the migration and spawning success of salmonids up the Yakima River system. Overall, the impacts would be less than significant to regional water quality as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional water quality.

4.6 AQUATIC RESOURCES

4.6.1 Alternative 1 (No Action)

Under the No Action Alternative, aquatic fish species would continue to utilize the habitats found within the Yakima River Delta to sub optimal capacities. Those fish species are classified as either migratory anadromous, native resident, or non-native resident species. The backwater environment west of the Bateman Island causeway would continue to contribute to the suboptimal water conditions required for migratory species, such as salmonids, to successfully migrate up the Yakima River system to spawn. High water temperatures and inconsistent dissolved oxygen levels act as a barrier to migration and could cause species to delay spawning and potentially cause mortality for these fish.

Pacific lamprey would continue to be low in numbers (e.g., less than 100 adults within the past 10 years) due to high temperatures in the Yakima River. Pacific lamprey would be discouraged from entering the Yakima River until later in the fall after water temperatures equilibrate between the Yakima River and Columbia River or would continue upstream in the Columbia River. Lamprey may also overwinter in the Columbia River and enter the Yakima River the following spring, but their numbers may be few.

Non-native salmonid predator fishes that inhabit the Yakima River Delta area would continue to benefit from the backwater habitat west of Bateman Island. This area would continue to warm much earlier than surrounding areas more heavily influenced by flows from the Columbia River. The presence of these predators in the Delta may contribute to predation losses of juvenile salmonids and impair lamprey migration through the Delta.

Vegetation along Bateman Island would remain sparsely vegetated along the shoreline, except in areas where the shoreline is not very steep.

Under the No Action Alternative, there would continue to be major adverse direct/indirect short-term and long-term impacts to aquatic species of special concern, while benefiting non-native invasive resident species that prey on native species. These impacts are expected to be exacerbated by the progression of climate change and would continue to pose negative impacts

to native species in the basin. Overall, the impacts to aquatic resources would be considered major and adverse as the alternative would have impacts to overall aquatic resources of the region and therefore would pose a severe or negative change in regional resource characteristics over time.

4.6.2 Alternative 2a, Full Removal of the Causeway with Riparian Habitat

Under Alternative 2a, the causeway responsible for blocking the flow along the southern extent of Bateman Island would be eliminated and thus introduce flow into the backwater environment west of the causeway. Introducing flow into the system would have secondary beneficial impacts to aquatic species by improving the overall water quality, thus producing more favorable water conditions conducive for the native and migratory anadromous fish species. Yakima River salmonid migration would expand into areas that previously experienced high-water temperatures and inconsistent dissolved oxygen levels. Improved migratory spawning conditions could result in an increased population of these fish species due to increased spawning opportunity and decreased migratory mortality.

Pacific lamprey may migrate into the Yakima River earlier due to lower water temperatures caused by circulating waters around Bateman Island.

Non-native predator fish would be present within the Yakima River Delta but would shift their predation habits. These are ambush predators that currently use eddies and areas of non-moving water to hide and catch salmon migrating through the Delta. A full removal of the causeway is anticipated to have few areas for predator fish to hide.

Riparian habitat along the shoreline of Bateman Island can increase areas for predator fish to hide thereby possibly decreasing the success of salmon migration. This also provides habitat for a variety of wading birds, frogs, and other aquatic animals.

Implementation of the alternative would have minor adverse direct short-term impacts to aquatic resources. The full removal of the causeway would eliminate the backwater environment which has historically been advantageous to non-native predatory fish species. Furthermore, the introduction of flow into the system would temporarily mobilize sediment which would increase the turbidity of the water. Overall, there would be major beneficial indirect long-term impacts to aquatic resources through the permanent alteration to the hydrological characteristics of the Delta and the beneficial secondary impacts to water quality. Improved water quality is beneficial to improving the health of the overall ecosystem, while simultaneously improving the migration and spawning success of anadromous fish species of special concern. Overall, the impacts would be less than significant to aquatic resources as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional aquatic resources.

4.6.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal with riparian habitat alternative, flow would be introduced to the backwater environment which would have beneficial impacts to aquatic resources by promoting favorable water conditions for migratory anadromous fish species. Yakima River salmon migration would expand into areas that previously experienced high-water temperatures. Populations of these fish may increase because of the opportunity for spawning and less mortality of these fish from the delays caused by high water temperatures.

Pacific lamprey may migrate into the Yakima River earlier due to lower water temperatures caused by circulating waters around Bateman Island.

Non-native predator fish would be present within the Yakima River Delta but would shift their predation habits. These are ambush predators that currently use eddies and areas of non-moving water to hide and catch salmon migrating through the Delta. A partial removal of the causeway is anticipated to have areas for predator fish to hide. This may increase the success of non-native predator fish in areas where the causeway remains.

Vegetation along the shoreline of Bateman can increase areas for predator fish to hide thereby possibly decreasing the success of salmon migration. This also provides habitat for a variety of wading birds, frogs, and other aquatic animals.

Implementation of Alternative 2b would have moderate adverse direct short-term impacts to aquatic resources through sediment mobilization and turbidity. Predator fish could potentially utilize the remnants of the causeway as an ambush point to prey on smolts during their out migration. However, there would be major beneficial indirect long-term impacts to aquatic resources through the introduction of flow into the system. Flowing water has secondary impacts to water quality which promotes beneficial conditions for aquatic fish species, specifically anadromous salmonids. Conditions conducive to the migration and spawning success of salmonids within the Yakima River help to promote improvements to the overall health of the ecosystem. Overall, the impacts would be less than significant to aquatic resources as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional aquatic resources.

4.6.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under Alternative 3a, the causeway responsible for blocking the flow along the southern extent of Bateman Island would be eliminated and thus introduce flow into the detrimental backwater environment. Introducing flow into the system would have beneficial impacts to aquatic species by producing more favorable water conditions conducive for the migration and spawning success for migratory species of special concern. Yakima River salmon migration would expand into areas that previously experienced high-water temperatures and inconsistent dissolved oxygen levels. Improved migratory spawning conditions could result in an increased population of these fish species due to a decreased risk of mortality.

Pacific lamprey may migrate into the Yakima River earlier due to lower water temperatures caused by circulating waters around Bateman Island.

Non-native predator fish would be present within the Yakima River delta but would shift their predation habits. These are ambush predators that currently use eddies and areas of non-moving water to hide and catch salmon migrating through the Delta. A full removal of the causeway is anticipated to have few areas for predator fish to hide.

Vegetation along Bateman Island would remain sparsely vegetated along the shoreline, except in areas where the shoreline is not very steep.

Implementation of the full removal alternative without riparian habitat would have minor adverse direct short-term impacts to aquatic resources. The removal of the causeway would eliminate the backwater environment which has historically been advantageous to many non-native predatory fish species. Furthermore, the introduction of flow into the system would temporarily mobilize sediment which would increase the turbidity of the water. Overall, there would be major beneficial indirect long-term impacts to aquatic resources through the full removal of the causeway. Eliminating the backwater environment would prevent detrimental increases in water temperatures and inconsistent dissolved oxygen levels during the summer months. This would help to eliminate the barriers to migration for native anadromous fish species which would aid in promoting the overall health of the ecosystem. Overall, the impacts would be less than significant to aquatic resources as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional aquatic resources.

4.6.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under Alternative 3b, flow would be introduced to the backwater environment which would have beneficial impacts to aquatic resources. The introduction of flow into the system would create favorable water conditions. Yakima River salmon migration would expand into areas that previously experienced high-water temperatures. Populations of these fish may increase because of the opportunity for spawning and less mortality of these fish from the delays caused by high water temperatures.

Pacific lamprey may migrate into the Yakima River earlier due to lower water temperatures caused by circulating waters around Bateman Island.

Non-native predator fish would be present within the Yakima River delta but would shift their predation habits. These are ambush predators that would use eddies and areas of non-moving water to hide and catch salmon migrating through the Delta. A partial removal of the causeway is anticipated to have areas for predator fish to hide. This may increase the success of non-native predator fish in areas where the causeway remains.

Vegetation along Bateman Island would remain sparsely vegetated along the shoreline, except in areas where the shoreline is not very steep.

Implementation of the partial removal alternative would have moderate adverse direct short-term impacts to aquatic resources through sediment mobilization and turbidity. There would be major beneficial indirect long-term impacts to aquatic resources through the introduction of flow into the system. Flowing water helps to combat the increase in water temperatures and inconsistency in dissolved oxygen levels in the Yakima River Delta during the summer months. This would help to eliminate the barriers to migration for native anadromous fish species which would aid in promoting the overall health of the ecosystem. Overall, the impacts would be less than significant to aquatic resources as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to the overall characteristics of regional aquatic resources.

4.7 THREATENED AND ENDANGERED SPECIES

4.7.1 Alternative 1 (No Action)

Under the no action alternative, the Yakima River Delta would continue to support Middle Columbia River steelhead and bull trout populations. However, existing sub-optimal water conditions for migratory species would continue to persist due to high water temperatures and inconsistent dissolved oxygen levels. In addition, non-native predator fishes that inhabit the Yakima River Delta area would continue to benefit from the large area of slack water habitat west of Bateman Island. These areas would continue to warm much earlier than surrounding areas more heavily influenced by flows from the Columbia River. The presence of these predators in the Delta may contribute to predation losses of juvenile salmonids and impair lamprey migration through the Yakima River Delta Area. These conditions are likely to worsen as temperatures rise with climate change.

Yellow-billed cuckoo and gray wolf populations currently do not exist within the Yakima River Delta. These populations would be un-impacted for all alternatives. The no action alternative would have no effect to Upper Columbia River steelhead nor to Upper Columbia River spring-run Chinook salmon.

Implementation of the no action alternative would have major adverse direct/ indirect short-term and long-term impacts to threatened and endangered species through the perpetuation of sub-optimal water conditions and the corresponding facilitation of non-native predator fish habitat. These factors act as a barrier to the migration and spawning success of salmonids within the Yakima River Delta. Furthermore, predator fish pose a significant threat to smolts during their outmigration. Climate change is expected to further amplify the current adverse conditions within the delta. Overall, the impacts to threatened and endangered species would be considered less than significant as the alternative would not have substantial influence on the regional characteristics and status of these species over time.

4.7.2 Alternative 2a, Full Removal of the Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, the Yakima River Delta would continue to support Middle Columbia River steelhead and bull trout populations. The removal of the causeway would produce favorable migratory and spawning conditions for steelhead, specifically during the summer months. In addition, the hydrological changes would become less favorable to non-native predatory fish. Predator fish prey on smolts in areas of eddies and stagnant water within the delta. There would be no remnants of the causeway remaining and therefore no habitat to support non-native fish that would prey on salmonids smolts. As a result, migratory passage and spawning success through the Yakima River would be greatly improved, thus improving populations in the long term.

Vegetation along the shoreline of Bateman could increase areas for predator fish to hide, and therefore possibly decrease the success of migrating salmonids.

Overall, implementation of the alternative would have major beneficial direct/indirect short-term and long-term impacts to threatened and endangered species. The removal of the causeway would have immediate and permanent improvements to water quality which would be conducive to the migration and spawning success of salmonids within the Yakima River. Over time, these improved water conditions would help to increase salmonid populations by increasing migration and spawning opportunities within the Yakima River. Overall, the alternative would pose a less than significant impact to threatened and endangered species as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to regional resource characteristics.

4.7.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

The partial removal of the causeway would produce favorable migratory and spawning conditions for steelhead, specifically during the summer months. In addition, the hydrological changes would become less favorable to non-native predatory fish, however, to a lesser extent than the full removal alternative. Predator fish prey on smolts in areas of eddies and stagnant water within the delta. Under the partial removal alternative, remnants of the causeway running from the mainland towards Bateman Island would remain. The remnants of the causeway would create ambush points for predatory fish to prey upon out-migrating smolts. As a result, migratory passage and spawning success through the Yakima River would be improved, and thus populations would benefit in the long term. However, the optimization of spawning success would be greatest with the full removal alternative.

Vegetation along the shoreline of Bateman could increase areas for predator fish to hide, and therefore possibly decrease the success of migrating salmonids.

Implementation of the partial removal with riparian habitat would have moderate beneficial direct short-term and major beneficial indirect long-term impacts to threatened and endangered species. The partial removal of the causeway would have immediate and permanent improvements in water quality which would be conducive to the migration and

spawning success of salmonids within the Yakima River. Over time, this would act to increase salmonid populations in the Delta. However, the remnants of the causeway would produce ambush points for non-native predatory fish which predate on out-migrating smolts. Overall, the alternative would pose a less than significant impact to threatened and endangered species as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to regional resource characteristics.

4.7.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

The removal of the causeway would produce favorable migratory and spawning conditions for steelhead, specifically during the summer months. In addition, the hydrological changes would become less favorable to non-native predatory fish. Predator fish prey on smolts in areas of eddies and stagnant water within the delta. There would be no remnants of the causeway remaining and therefore no habitat to support non-native fish that would prey on salmonids smolts. As a result, migratory passage and spawning success through the Yakima River would be greatly improved, thus improving salmonid populations in the long term.

Vegetation along Bateman Island would remain sparsely vegetated along the shoreline, except in areas where the shoreline is not very steep. The lack of vegetation would not create additional predator fish habitat, thus decreasing the mortality rate of out-migrating smolts.

Implementation of the full removal without riparian habitat alternative would have major beneficial direct short-term and major beneficial indirect long-term impacts to threatened and endangered species. The removal of the causeway would have immediate and permanent changes in water conditions conducive to the migration and spawning success of salmonids within the Yakima River. Lack of vegetation along the shoreline would not promote the creation of additional predatory fish habitat. Overall, the alternative would pose a less than significant impact to threatened and endangered species as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to regional resource characteristics.

4.7.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

The partial removal of the causeway would produce favorable migratory and spawning conditions for steelhead, specifically during the summer months. In addition, the hydrological changes would become less favorable to non-native predatory fish, however, to a lesser extent than that of the full removal alternative. Predator fish prey on smolts in areas of eddies and stagnant water within the delta. Under the partial removal alternative, remnants of the causeway running from the mainland towards Bateman Island would remain. The remnants of the causeway would create ambush points for predatory fish to prey upon out-migrating smolts. As a result, migratory passage and spawning success through the Yakima River would be improved, and thus populations would benefit in the long term. However, the optimization of spawning success would be greatest with the full removal alternative.

Vegetation along Bateman Island would remain sparsely vegetated along the shoreline, except in areas where the shoreline is not very steep. The lack of vegetation would not promote additional predator fish habitat, thus aiding to decrease the mortality rate of out-migrating smolts.

Implementation of the partial removal without riparian habitat would have moderate beneficial direct short-term and major beneficial indirect long-term impacts to threatened and endangered species. The partial removal of the causeway would have immediate and permanent changes in water conditions conducive to the migration and spawning success of salmonids within the Yakima River. However, the remnants of the causeway would produce ambush points for non-native predatory fish, which may predate on out-migrating smolts. Overall, the alternative would pose a less than significant impact to threatened and endangered species as the beneficial impacts would be localized to the Yakima River Delta and would not present a severe or notable change to regional resource characteristics.

4.8 WETLANDS

4.8.1 Alternative 1 (No Action)

Under the no action alternative, the Yakima River Delta would continue to support vegetated emergent and forested wetlands, as well as unvegetated mudflats. These environments would continue to be influenced by the water elevations of Lake Wallula and managed by USACE as HMUs. Most of the shoreline along Bateman Island is steep and cannot support wetlands because the water is too deep and/or the elevation is too high. As any river delta is a dynamic environment, deposition and erosion will occur over time and as a result the composition and extent of wetland functions and values is subject to change through natural processes in the Yakima River Delta under the No Action alternative. However, as the Delta interacts with the McNary pool, much of the energy in the Yakima River dissipates quickly and is unlikely to result in more than negligible changes to wetlands in the short or long-term.

Implementation of the no action alternative would have negligible direct short-term and negligible indirect long-term impacts to wetland resources. Overall, the impacts of the alternative would be less than significant as there would not be a severe or negative overall change in regional resource character over time.

4.8.2 Alternative 2a, Full Removal of the Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, areas along the shoreline of Bateman Island would be filled to allow the planting of riparian/wetland plants. This vegetation and substrate development would increase wetlands associated with Bateman Island thereby enhancing functions and values of wetlands within the area.

The implementation of the alternative 2a would have minor beneficial direct short-term impacts and minor beneficial indirect long-term impacts to wetland resources. Overall, the impacts to wetland resources would be less than significant as there would not be severe or negative change in regional resource character over time.

4.8.3 Alterative 2b, Partial Removal of the Causeway with Riparian Habitat

Under the partial removal with riparian habitat alternative, areas along the shoreline of Bateman Island would be filled to allow the planting of riparian/wetland plants. This vegetation and substrate development would increase wetlands associated with Bateman Island thereby enhancing functions and values of wetlands within the area.

The implementation of the alternative 2b would have minor beneficial direct short-term impacts and minor beneficial indirect long-term impacts to wetland resources. Overall, the impacts to wetland resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.8.4 Alternative 3a, Full Removal of the Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, the Yakima River Delta would continue to support vegetated emergent and forested wetlands, as well as unvegetated mudflats. These environments would continue to be influenced by the water elevations of Lake Wallula and managed by USACE as HMUs.

Most of the shoreline along Bateman Island is steep and cannot support wetlands because the water is too deep and/or the elevation is too high.

As a result, implementation of the 3a alternative would have negligible direct short-term and negligible indirect long-term impacts to wetland resources. Overall, the impacts to wetland resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.8.5 Alternative 3b, Partial Removal of the Causeway without Riparian Habitat

Under the partial removal without riparian habitat alternative, the Yakima River Delta would continue to support vegetated emergent and forested wetlands, as well as unvegetated mudflats. These environments would continue to be influenced by the water elevations of Lake Wallula and managed by USACE as HMUs.

Most of the shoreline along Bateman Island is steep and cannot support wetlands because the water is too deep and/or the elevation is too high.

As a result, implementation of the 3b alternative would have negligible direct short-term and negligible indirect long-term impacts to wetland resources. Overall, the impacts to wetland resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.9 WILDLIFE

4.9.1 Alternative 1 (No Action)

Under the no action alternative, there would be negligible direct and indirect impacts to wildlife in the short-term and long-term timeframe. As any river delta is a dynamic environment, deposition and erosion and other natural processes will occur over time and as a result the composition and extent of habitats is subject to change in the Yakima River Delta under the No Action alternative. However, as the Delta interacts with the McNary pool, much of the energy in the Yakima River dissipates quickly and is unlikely to result in more than negligible changes to habitat in the short or long-term.

The Yakima River Delta would continue to support various riparian birds, mammals, amphibians, and reptiles. Their habitats would generally continue as it currently exists. For more detailed information on the wildlife in the Yakima River Delta, refer to Section 2.9, Wildlife (in Affected Environment). Overall, the impacts to wildlife would be less than significant as there would not be a severe or negative change in regional resource characteristics over time.

4.9.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, the area would continue to support various riparian birds, mammals, amphibians, and reptiles. The riparian habitat around Bateman Island would be enhanced to a moderate degree and could provide food and shelter opportunities for shoreline and wading birds, aquatic mammals, and amphibians. Some mudflats that provide forage or resting habitat for shorebirds may shift or reduce causing a minor shift in these bird's behavior, especially in the first two years after removal of the causeway. The added riparian habitats developed could provide moderate levels of benefits to migratory birds and other riparian dependent species with expanded resting, foraging, and breeding habitat elements.

As a result, there would be minor adverse direct short-term impacts due to the temporary changes in animal behavior. The alternative would have negligible indirect long-term impacts to wildlife as new mudflats accrete in the confluence of the Columbia and Yakima River, and moderate long-term benefit to riparian-dependent species. Overall, the impacts to wildlife habitat would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.9.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal with riparian habitat, the area would continue to support various riparian birds, mammals, amphibians, and reptiles. The riparian and wetland habitat around Bateman Island would be enhanced to a moderate degree and could provide food and shelter opportunities for shoreline and wading birds, aquatic mammals, and amphibians. Some mudflats that provide forage or resting habitat for shorebirds may shift or reduce causing a

minor shift in these bird's behavior, especially in the first five years after partial removal of the causeway. The added riparian habitats developed could provide moderate levels of benefits to migratory birds and other riparian dependent species with expanded resting, foraging, and breeding habitat elements.

There would be minor direct short-term impacts due to the temporary changes in animal behavior. Implementation of the alternative would cause negligible indirect long-term impacts to wildlife as new mudflats accrete in the confluence of the Columbia and Yakima River, and moderate long-term benefit to riparian-dependent species. Overall, the impacts to wildlife resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.9.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, the area would continue to support various riparian birds, mammals, amphibians, and reptiles. The riparian habitat around Bateman Island would remain sparse and therefore, opportunities for foraging and resting habitat for shoreline and wading birds, aquatic mammals, and amphibians would be limited. Some mudflats that provide forage or resting habitat for shorebirds may shift or reduce causing a minor shift in these bird's behavior, especially in the first two years after removal of the causeway. There would be minor direct short-term impacts due to the temporary changes in animal behavior. The alternative would cause negligible indirect long-term impacts to wildlife as new mudflats accrete in the confluence of the Columbia and Yakima River. Overall, the impacts to wetland resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.9.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under the partial removal without riparian habitat, the area would continue to support various riparian birds, mammals, amphibians, and reptiles. The riparian habitat around Bateman Island would remain sparse and therefore, opportunities for foraging and resting habitat for shoreline and wading birds, aquatic mammals, and amphibians would be limited. Some mudflats that provide forage or resting habitat for shorebirds may shift or reduce causing a minor shift in these bird's behavior, especially in the first five years after removal of the causeway. There would be minor direct short-term impacts due to the temporary changes in animal behavior. The alternative would cause negligible indirect long-term impacts to wildlife as new mudflats accrete in the confluence of the Columbia and Yakima River. Overall, the impacts to wetland resources would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.10 VEGETATION

4.10.1 Alternative 1 (No Action)

Under the no action alternative, riparian vegetation would continue to grow in Federal and state managed lands. The Yakima River Delta would continue to support terrestrial and aquatic invasive species in areas where it has previously been established, often within areas of high disturbance. Aquatic invasive species would continue to form monocultures within the Delta and perpetuate conditions which contribute to a failing biodiversity. These species would have impacts to the following: pH fluctuations, dissolved oxygen fluctuations, decreased flow rates, increased water temperatures due to slower flow rates, increased deposition of fine sediments, the formation of aquatic predator habitat, and decreased spawning habitat for Fall Chinook Salmon. Invasive species would be managed in accordance with state/Federal laws and regulations. Interior forested and meadow vegetation would continue to grow and may experience periodic fire risk hazardous during certain times of the year.

Implementation of the no action alternative would have negligible direct/indirect adverse impacts to vegetation in both the short-term and long-term. The no action alternative would not alter the current state of vegetation within the Delta. It is expected that aquatic invasive species would thrive under the current conditions and continue to perpetuate the negative impacts to water quality, aquatic resources, and threatened and endangered species. Overall, the impacts to vegetation would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.10.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, riparian vegetation would continue to grow in Federal and state managed lands. Riparian areas along Bateman Island would be enhanced. Areas would continue to support invasive species in areas of high disturbance or areas where it has previously established. Invasive species would be managed in accordance with state/Federal laws and regulations. Interior forested and meadow vegetation would continue to grow and may experience periodic fires.

Implementation of the alternative 2a would have minor beneficial direct/indirect impacts to vegetation by enhancing riparian habitat along key areas of the Bateman Island shoreline. Aquatic invasive vegetation would continue to dominate the biome and perpetuate the detrimental impacts to the overall environment. Terrestrial vegetation would be un-impacted by the alternative. Overall, the impact to vegetation would be less than significant as there would not be a severe or negative change in regional resource characteristics over time.

4.10.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal with riparian habitat alternative, riparian vegetation would continue to grow in Federal and state managed lands. Much like alternative 2a, riparian areas along Bateman Island would be enhanced. Invasive species would continue to persist in areas of high

disturbance or areas where it has previously established. Invasive species would be managed in accordance with state/Federal laws and regulations. Interior forested and meadow vegetation would continue to grow and may experience periodic fires.

Implementation of the alternative 2b would have minor beneficial direct/indirect impacts to vegetation by enhancing riparian habitat along key areas of the Bateman Island shoreline. Aquatic invasive vegetation would continue to dominate the biome and perpetuate the detrimental impacts to the overall environment. Furthermore, terrestrial vegetation would be largely un-impacted by the alternative. Overall, the impact to vegetation would be less than significant as there would not be a severe or negative change in regional resource characteristics over time.

4.10.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, riparian vegetation would continue to grow in Federal and state managed lands. Riparian areas along Bateman Island would remain sparse. Invasive species would continue to persist in areas of high disturbance or areas where it has previously established. Invasive species would be managed in accordance with state/ Federal laws and regulations. Interior forested and meadow vegetation would continue to grow and may experience periodic fires.

Implementation of the alternative 3a would have negligible direct/indirect impacts to vegetation in both the short-term and long-term. Without the inclusion of additional riparian habitat, the current conditions for vegetation would be largely un-impacted. Aquatic invasive vegetation would continue to dominate the biome and perpetuate the detrimental impacts to the overall environment. Furthermore, terrestrial vegetation would be largely un-impacted by the alternative. Overall, the impact to vegetation would be less than significant as there would not be a severe or negative change in regional resource characteristics over time.

4.10.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under the partial removal without riparian habitat alternative, riparian vegetation would continue to grow in Federal and state managed lands. Riparian areas along Bateman Island would remain sparse. Invasive species would continue to persist in areas of high disturbance or areas where it has previously established. Invasive species would be managed in accordance with state/Federal laws and regulations. Interior forested and meadow vegetation would continue to grow and may experience periodic fires.

Implementation of the alternative 3b would have negligible direct/indirect impacts to vegetation in both the short-term and long-term. Without the inclusion of additional riparian habitat, the current conditions for vegetation would be largely un-impacted. Aquatic invasive vegetation would continue to dominate the biome and perpetuate the detrimental impacts to the overall environment. Terrestrial vegetation would be largely un-impacted by the alternative as well. Overall, the impact to vegetation would be less than significant as there would not be a severe or negative change in regional resource characteristics over time.

4.11 LAND USE

4.11.1 Alternative 1 (No Action)

Under the no action alternative, land use is not anticipated to change. The Yakima River Delta would continue to be classified as a Natural Open Space and offer recreation and wildlife viewing opportunities to the surrounding community. The zones surrounding the Delta would continue to consist of largely commercial/industrial business and single/multi-family residential areas.

Implementation of the no action alternative would have negligible direct/indirect adverse impacts to land use in both the short-term and long-term. Overall, the impacts to land usage would be less than significant as there would not be a severe or negative change in regional resource character over time.

4.11.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, deconstruction of the causeway would temporarily restrict access to Wye Park and possibly the boat ramp located adjacent to the park. This could persist for a few months until the full removal of the causeway and construction activities are completed. After deconstruction, the public use of Bateman Island would be restricted to those who can access it by boat or other floatation devices. Without the causeway, no pedestrian access to the island would occur.

However, the addition of riparian habitat may enhance land use activities by providing habitat for wildlife, thus providing benefits to recreators utilizing the natural space. Aside from this benefit, the effect of the riparian habitat to land use would remain minor.

Implementation of the alternative 2a would have moderate adverse direct short-term impacts to land use through the potential closure of recreational access to certain areas. However, there would be negligible indirect long-term adverse impacts to the land-use resource because the deconstruction activities would be temporary. Overall, there would be a less than significant impact to land use because there would not be a severe or negative change in regional resource character over time.

4.11.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal with riparian habitat alternative, deconstruction of the causeway would temporarily restrict access to Wye Park and possibly the boat ramp located adjacent to the park. This could persist for a few months until the partial removal of the causeway and construction activities are completed. Compared to the full removal alternatives, the partial removal of the causeway would be completed in less time and thus restricted recreational access would not last as long. After deconstruction, the public use of Bateman Island would be

restricted to those who can access it by boat or other floatation devices. Without the causeway, no pedestrian access to the island would occur. However, the remnants of the causeway would be accessible to the public to be utilized for recreational purposes like wildlife viewing, fishing, etc.

The addition of riparian habitat may enhance land use activities by providing habitat for wildlife, thus providing benefits to recreators utilizing the natural space. Aside from this benefit, the effect of the riparian habitat to land use would remain minor.

Implementation of the alternative 2b would have moderate adverse direct short-term impacts to land use through the closure of recreational access to certain areas during deconstruction. However, this restricted access would conceivably be less than that of the full removal alternatives. The no action alternative would have negligible indirect long-term adverse impacts to land-use resources once deconstruction is completed. Overall, there would be a less than significant impact to land use because there would not be a severe or negative change in regional resource character over time.

4.11.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, deconstruction of the causeway would temporarily restrict access to Wye Park and possibly the boat ramp located adjacent to the park. This could persist for a few months until the full removal of the causeway and construction activities are completed. After deconstruction, the public use of Bateman Island would be restricted to those who can access it by boat or other floatation devices. Without the causeway, no pedestrian access to the island would occur.

Without the addition of riparian habitat, the shoreline around Bateman Island would continue to remain sparse and provide limited value to recreators. However, the benefit of riparian habitat to the shoreline would be minor.

Implementation of the alternative 3a would have moderate adverse direct short-term impacts to land use through the potential closure of recreational access to certain areas during deconstruction. However, there would be negligible indirect long-term adverse impacts land-use resource because once deconstruction activities are completed. Overall, there would be a less than significant impact to land use because there would not be a severe or negative change in regional resource character over time.

4.11.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under the partial removal with riparian habitat alternative, deconstruction of the causeway would temporarily restrict access to Wye Park and possibly the boat ramp located adjacent to the park. This could persist for a few months until the partial removal of the causeway and construction activities are completed. Compared to the full removal alternatives, the partial removal of the causeway would be completed in less time and thus restricted recreational access would not last as long. After deconstruction, the public use of Bateman Island would be

restricted to those who can access it by boat or other floatation devices. Without the causeway, no pedestrian access to the island would occur. However, the remnants of the causeway would be accessible to the public to be utilized for recreational purposes like wildlife viewing, fishing, etc.

Without the addition of riparian habitat, the shoreline around Bateman Island would continue to remain sparse and provide limited value to recreators. Regardless, the benefits of riparian habitat to land use activities would be minor.

Implementation of the alternative 3b would have moderate adverse direct short-term adverse impacts to land use through the closure of recreational access to certain areas during de-construction. However, this restricted access would conceivably be less than that of the full removal alternatives. The no action alternative would have negligible indirect long-term impacts to land-use resources once de-construction is completed. Overall, there would be a less than significant impact to land use because there would not be a severe or negative change in regional resource character over time.

4.12 RECREATION

4.12.1 Alternative 1 (No Action)

Under the no action alternative, a variety of recreational opportunities would continue to exist within the Yakima River Delta. These opportunities are described in detail in Section 2.12, Recreation (in Affected Environment). Motorized boats would continue to utilize the deeper channel areas of the Columbia and Yakima Rivers. However, backwater areas west of Bateman Island would be accessible only to non-motorized boats due to the shallow water. Pedestrian access to Bateman Island would continue to be available. Trails and birdwatching opportunities would remain as described in Section 2.12.

Implementation of the no action alternative would have negligible direct/indirect adverse impacts to recreational resources as the current and future recreational opportunities would remain un-impacted. Overall, there would be a less than significant impact to recreation resources because there would not be a severe or negative change to regional resource character over time.

4.12.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Under the full removal of the causeway with riparian habitat alternative, motorized boats would continue to utilize deeper channel areas of the Columbia and Yakima River. Removal of the causeway would alter the hydrologic characteristic of the area and mobilize sediment deposited in the Delta. As the sediment flushes from the Delta, the backwater environment would improve for boaters allowing new fishing opportunities in the Delta.

The addition of riparian habitat would provide value to recreation by attracting wildlife, such as wading birds and aquatic mammals, who would utilize the vegetation along the shoreline of Bateman Island. Pedestrian access to Bateman Island would be restricted to those with boats or other floatation devices; however, trails on the island could still be used and birdwatching could still occur. Alternate trails and birdwatching opportunities with easy access (as described in Section 2.12), would be available nearby for pedestrians unable to get onto Bateman Island. The island would continue to be classified as a Natural Open Space and be utilized by recreators.

Implementation of alternative 2a would have both adverse and beneficial moderate direct/ indirect impacts to recreation resources in both the short-term and long-term. The addition of riparian habitat along the shoreline of Bateman Island would provide minor benefits to recreators by attracting wildlife for viewing. The removal of the causeway would result in improvements to the overall health of the ecosystem in the Yakima River Delta. These improvements such as better water quality, a pleasing aesthetic and visual quality, and healthier aquatic resources would provide additional recreation value and would be expected to continue into the future. Overall, there would be a less than significant impact to recreation because there would not be a severe or negative change to regional resource character over time.

4.12.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal of the causeway with riparian habitat alternative, motorized boats would continue to utilize deeper channel areas of the Columbia and Yakima River. Partial removal of the causeway would alter the hydrologic characteristics of the area and mobilize sediment deposited in the Delta. As the sediment flushes from the Delta, the backwater environment would improve for boaters allowing new fishing opportunities in the Delta.

The addition of riparian habitat would provide value to recreation by attracting wildlife, such as wading birds and aquatic mammals, who would utilize the vegetation along the shoreline of Bateman Island. Pedestrian access to Bateman Island would be restricted to those with boats or other floatation devices; however, trails on the island could still be used and birdwatching could still occur. Alternate trails and birdwatching opportunities with easy access (as described in Section 2.12), would be available nearby for pedestrians unable to get onto Bateman Island. The island would continue to be classified as a Natural Open Space and be utilized by recreators.

The partial removal of the causeway would leave approximately half of it extending out from the mainland. This remaining section would be like a pier, and the public would have access to it. It is anticipated that it could become a popular area for fishing as the now free-flowing river water would provide good habitat for several species of sport fish.

Implementation of alternative 2b would have both adverse and beneficial moderate direct/ indirect impacts to recreation resources in both the short-term and long-term. The addition of riparian habitat along the shoreline of Bateman Island would provide minor benefits to

recreators by attracting wildlife for viewing. The partial removal of the causeway would result in improvements to the overall health of the ecosystem in the Yakima River Delta. These improvements such as better water quality, a pleasing aesthetic and visual quality, and healthier aquatic resources would provide additional recreation value and would be expected to continue into the future. Overall, there would be a less than significant impact to recreation because there would not be a severe or negative change to regional resource character over time.

4.12.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, motorized boats would continue to utilize deeper channel areas of the Columbia and Yakima Rivers. Removal of the causeway would alter the hydrologic characteristic of the area and mobilize sediment deposited in the Delta. As the sediment flushes from the Delta, the backwater environment would improve for boaters allowing new fishing opportunities in the Delta.

Without the addition of riparian habitat along the western and southern side of Bateman Island, these shoreline areas would remain sparse which would limit opportunities to view wading birds and aquatic mammals. Pedestrian access to Bateman Island would be restricted to those with boats or other floatation devices, however trails on the island could still be used and birdwatching could still occur. Alternate trails and birdwatching opportunities with easy access (as described in Section 2.12), would be available nearby for pedestrians unable to get onto Bateman Island. The island would continue to be classified as a Natural Open Space and be utilized by recreators.

Implementation of alternative 3a would have both adverse and beneficial moderate direct/ indirect impacts to recreation in both the short-term and long-term. The removal of the causeway would result in improvements to the overall health of the ecosystem in the Yakima River Delta. These improvements such as better water quality, a pleasing aesthetic and visual quality, and healthier aquatic resources would provide additional recreation value and would be expected to continue into the future. The very nearby Yakima River Delta HMU is classified as a multi-use site that offers approximately six miles of trails for hikers and birdwatchers. The vegetation and plant community are very similar to that on Bateman Island, although somewhat denser. Birdwatching opportunities would be abundant with more terrestrial and wetland species of birds available. Overall, there would be a less than significant impact to recreation because there would not be a severe or negative change to regional resource character over time.

4.12.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under the partial removal of the causeway without riparian habitat alternative, motorized boats would continue to use deeper channel areas of the Columbia and Yakima River. Removal of the causeway would alter the hydrologic characteristics of the area and mobilize sediment deposited in the Delta. As the sediment flushes from the Delta, the backwater environment would improve for boaters and allow new fishing opportunities in the Delta.

Without the addition of riparian habitat along the western and southern side of Bateman Island, these shoreline areas would remain sparse which would limit opportunities to view wading birds and aquatic mammals. Pedestrian access to Bateman Island would be restricted to those with boats or other floatation devices, however trails on the island could still be used and birdwatching could still occur. Alternate trails and birdwatching opportunities with easy access (as described in Section 2.12), would be available nearby for pedestrians unable to get onto Bateman Island. The island would continue to be classified as a Natural Open Space and be utilized by recreators.

The partial removal of the causeway would leave approximately half of it extending out from the mainland. This remaining section would be like a pier, and the public would have access to it. It is anticipated that it could become a popular area for fishing as the now free-flowing river water would provide good habitat for several species of sport fish.

Implementation of alternative 3b would have both adverse and beneficial moderate direct/ indirect impacts to recreation in both the short-term and long-term. The partial removal of the causeway would result in improvements to the overall health of the ecosystem in the Yakima River Delta. These improvements such as better water quality, a pleasing aesthetic and visual quality, and healthier aquatic resources would provide additional recreation value and would be expected to continue into the future. Overall, there would be a less than significant impact to recreation because there would not be a severe or negative change to regional resource character over time.

4.13 AESTHETICS/VISUAL RESOURCES

4.13.1 Alternative 1 (No Action)

Under the no action alternative, the Delta would continue to support a natural system with a multitude of aesthetic value. The remnants of the 2017 Bateman Island fire would become less noticeable as vegetation recolonizes within the interior of the island. The island would continue to contain aesthetic resources as detailed in the existing conditions on aesthetic resources section.

Implementation of the no action alternative would have negligible direct/indirect short-term and long-term impacts to aesthetic resources by not altering the landscape in any way. However, the alternative does not allow for enhancements to the current aesthetic value of the Yakima River Delta area. Regardless, the Delta would continue to be frequented by recreators primarily for its aesthetic value. Overall, there would be a less than significant impact to aesthetic resources because there would not be a severe or negative change to regional resource character over time.

4.13.2 Alternative 2a, Full removal of Causeway with Riparian Habitat

Under the full removal with riparian habitat alternative, the aesthetic resources of the Yakima River Delta would be impacted. The causeway itself can be viewed as an aesthetic resource, thus its removal would adversely impact the overall historic aesthetic value of the area. Furthermore, pedestrian access to Bateman Island hiking trails would be restricted, thus less people would utilize the resource. However, the addition of riparian habitat and the reduction in visitation to the island could have the indirect effect of increasing the overall aesthetic value of the island by stabilizing the shoreline, creating habitat for animals, and decreasing human disturbance caused by recreation.

Implementation of the alternative 2a would have minor adverse and beneficial direct/indirect impacts to aesthetic resources in both the short-term and long-term. Removal of the causeway would permanently remove the causeway as an aesthetic resource, while also simultaneously eliminating pedestrian access to the island. The restricted access to Bateman and the addition of riparian habitat along the shoreline would aid to increase the aesthetic value of the island by reducing human disturbance and attracting wildlife. Overall, there would be a less than significant impact to aesthetic resources because there would not be a severe or negative change to regional resource character over time.

4.13.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Under the partial removal with riparian habitat alternative, the aesthetic resources of the Yakima River Delta would be impacted. The causeway itself has can be viewed as an aesthetic resource, thus its partial removal would adversely impact the overall historic aesthetic value of the area. Furthermore, pedestrian access to Bateman Island hiking trails would be restricted, thus less people would utilize the resource. However, the addition of riparian habitat and the reduction in visitation to the island could have the indirect effect of increasing the overall aesthetic value of the island by stabilizing the shoreline, creating habitat for animals, and decreasing human disturbance caused by recreation.

Implementation of the alternative 2b would have minor adverse and beneficial direct/indirect impacts to aesthetic resources in both the short-term and long-term. Removal of the causeway would permanently remove a portion of the causeway as an aesthetic resource, while also simultaneously eliminating pedestrian access to the island. The restricted access to Bateman and the addition of riparian habitat along the shoreline would aid to increase the aesthetic value of the island by reducing human disturbance and attracting wildlife. Overall, there would be a less than significant impact to aesthetic resources because there would not be a severe or negative change to regional resource character over time.

4.13.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

Under the full removal without riparian habitat alternative, the aesthetic resources of the Yakima River Delta would be impacted. The causeway itself has can be viewed as an aesthetic resource, thus its removal would adversely impact the overall historic aesthetic value of the

area. Furthermore, pedestrian access to Bateman Island hiking trails would be restricted, thus less people would utilize the resource. However, the reduction in visitation to the island could have the indirect effect of increasing the overall aesthetic value of the island by minimizing human disturbance caused by recreation.

Implementation of the alternative 3a would have minor adverse and beneficial direct/indirect impacts to aesthetic resources in both the short-term and long-term. Removal of the causeway would permanently remove the causeway as an aesthetic resource, while also simultaneously eliminating pedestrian access to the island. The restricted access to Bateman would aid to increase the aesthetic value of the island by reducing human disturbance, although, to a lesser extent than with the riparian habitat alternatives. Overall, there would be a less than significant impact to aesthetic resources because there would not be a severe or negative change to regional resource character over time.

4.13.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Under the partial removal with riparian habitat alternative, the aesthetic resources of the Yakima River Delta would be impacted. The causeway itself has can be viewed as an aesthetic resource, thus its partial removal would adversely impact the overall historic aesthetic value of the area. Furthermore, pedestrian access to Bateman Island hiking trails would be restricted, thus less people would utilize the resource. However, the reduction in visitation to the island could have the indirect effect of increasing the overall aesthetic value of the island by minimizing human disturbance caused by recreation.

Implementation of the alternative 3b would have minor adverse and beneficial direct/indirect impacts to aesthetic resources in both the short-term and long-term. Partial removal of the causeway would permanently remove a portion of the causeway as an aesthetic resource, while also simultaneously eliminating pedestrian access to the island. The restricted access to Bateman would aid to increase the aesthetic value of the island by reducing human disturbance, although, to a lesser extent than with the riparian habitat alternatives. Overall, there would be a less than significant impact to aesthetic resources because there would not be a severe or negative change to regional resource character over time.

4.14 GREENHOUSE GAS EMISSIONS AND CLIMATE CHANGE

4.14.1 Alternative 1 (No Action)

Under the no action alternative, GHG emissions would remain at levels similar to existing conditions. Streamflow is predicted to decrease in summer, exacerbating increased temperature effect on aquatic habitat. River hydrograph timing is predicted to continue to shift earlier in the year. The combination of increasing temperature and changing hydrology are predicted to result in loss of freshwater salmon habitat and other ecological impacts. Temperatures in the Columbia River Basin will almost certainly continue to rise over the next several decades, which will impact snowpack and subsequent seasonal runoff (Refer to Appendix A. Climate Change Assessment).

Increases in annual stream temperatures pose a tremendous strain on Washington's salmon populations. Salmon migrate to freshwater tributaries during the summer months for either spawning, rearing, or seaward smolt migrations. Summertime stock migrations are expected to be most impacted by the increasing annual water temperatures caused by climate change. These include summer-run steelhead, sockeye, and summer Chinook populations in the Columbia Basin. Because of the earlier timing of snowmelt and increased evaporation, most of Washington's river basins, including the Yakima River, are projected to experience reduced streamflow in summer and early fall that results in an extended period of summer low flows. In combination with increased summertime stream temperatures, reduced flow is likely to limit rearing habitat for salmon with stream-type life histories (wherein juveniles rear in freshwater for one or more years) and increase mortality rates during spawning migrations for summer-run adults (Madtua, et al. 2010).

Under the No Action Alternative there would be no Federal action, and therefore no added impacts to climate change, either in the short-or long-term. Climate change would continue to affect the temperature of the Yakima River Delta, thereby causing a barrier to ESA-listed fish migration. Overall, there would be a less than significant impact to climate change because there would not be a severe or negative change to regional climate change characteristics over time.

4.14.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

Carbon emissions would only be increased temporarily during construction activities associated with the implementation of Alternative 2a. The CEQ does not have any thresholds currently established for determining if GHGs that would be released would constitute a significant impact. Increased carbon emissions from this alternative would be localized, temporary, and estimated to be small in comparison to the total constant output of emission sources in the surrounding communities and would not be expected to have any measurable impact on local, regional, or global greenhouse gas emissions.

The full removal with riparian habitat alternative would not impact climate change, either directly or indirectly in the short or long-term timeframe, and therefore would pose a less than significant impact on the progression of climate change. Climate change would continue to adversely impact the Yakima River Delta through increased annual temperatures. However, the full removal of the causeway would lessen the overall impacts of climate change on the environment through the permanent alterations to the hydrology of the Delta. Increased annual temperatures would continue to pose a threat to migrating ESA species. Annual temperatures of the water coming from the Yakima River would continue to be increased by climate change. The addition of riparian habitat would have negligible influence on the effects or proliferation of climate change. Overall, there would be a less than significant impact to climate change because there would not be a severe or negative change to regional climate characteristics over time.

The removal of the causeway will alleviate detrimental ecosystem conditions by increasing stream flow (due to removal of the causeway currently blocking flow around Bateman Island) and lowering mean stream temperatures (improved by increased mixing of cooler Columbia River flows with the much warmer Yakima River flows). Without the causeway in place, more Columbia River flow is predicted to dynamically mix around Bateman Island, which will benefit native fish and wildlife, including juvenile and adult salmon and steelhead as they migrate through the delta.

4.14.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

Carbon emissions associated with implementation of Alternative 2b would be the same as Alternative 2a.

The partial removal with riparian habitat alternative would not impact climate change, either directly or indirectly in the short or long-term timeframe, and therefore would pose a less than significant impact on the progression of climate change. Climate change would continue to adversely impact the Yakima River Delta through increased annual temperatures. However, the partial removal of the causeway would lessen the overall impacts of climate change on the environment through the permanent alterations to the hydrology of the Delta. Increased annual temperatures would continue to pose a threat to migrating ESA species. Annual temperatures of the water coming from the Yakima River would continue to be increased by climate change. The addition of riparian habitat would have negligible influence on the effects of climate change, although could potentially decrease the temperature of the water along the shoreline of Bateman Island. Overall, there would be a less than significant impact to climate change because there would not be a severe or negative change to regional climate characteristics over time.

4.14.4 Alternative 3a, Full Removal of causeway without Riparian Habitat

Carbon emissions associated with implementation of Alternative 3a would be the same as Alternative 2a.

The full removal without riparian habitat alternative would not impact climate change, either directly or indirectly in the short or long-term timeframe, and therefore would pose a less than significant impact on the progression of climate change. Climate change would continue to adversely impact the Yakima River Delta through increased annual temperatures. However, the full removal of the causeway would lessen the overall impacts of climate change on the environment through the permanent alterations to the hydrology of the Delta. Increased annual temperatures would continue to pose a threat to migrating ESA species. Annual temperatures of the water coming from the Yakima River would continue to be increased by climate change. The exclusion of riparian habitat would have negligible influence on climate change and its effects. Overall, there would be a less than significant impact to climate change because there would not be a severe or negative change to regional climate characteristics over time.

4.14.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

Carbon emissions associated with implementation of Alternative 3b would be the same as Alternative 2a.

The partial removal without riparian habitat alternative would not impact climate change, either directly or indirectly in the short or long-term timeframe, and therefore would pose a less than significant impact on the progression of climate change. Climate change would continue to adversely impact the Yakima River Delta through increased annual temperatures. However, the partial removal of the causeway would lessen the overall impacts of climate change on the environment through the permanent alterations to the hydrology of the Delta. Increased annual temperatures would continue to pose a threat to migrating ESA species. Annual temperatures of the water coming from the Yakima River would continue to be increased by climate change. The exclusion of riparian habitat would have negligible influence on climate change or its effects on the environment. Overall, there would be a less than significant impact to climate change because there would not be a severe or negative change to regional climate characteristics over time.

4.15 CULTURAL AND HISTORIC RESOURCES

4.15.1 Alternative 1 (No Action)

The operations and maintenance of McNary Lock and Dam is causing significant impacts to cultural and historic resources within the project area as detailed within the Federal Columbia River Power System Programmatic Agreement (BPA et al. 2009), which establishes USACE compliance with Section 106 regarding those ongoing impacts. Also, the project area is within a known historic property of religious and cultural significance to Indian Tribes (HPRCSIT). All significant impacts are addressed by the Columbia River System Operation Environmental Impact Statement (BPA et al. 2020). Years of cultural resources monitoring within the project area has made note of adverse impacts associated with erosion and recreation, among others. This status is not anticipated to change so long as the dam continues to operate. It is anticipated that these impacts would continue to accrue across a broad spectrum of cultural resources, and USACE would continue to treat/mitigate for those impacts. These mitigation measures are in accordance with the regulations and the aforementioned programmatic agreement.

Implementation of the no action alternative would not alter the current conditions impacting cultural resources. Under the no action alternative, there would continue to be major adverse direct/indirect impacts to cultural resources through McNary operation and maintenance activities, and corresponding secondary factors such as recreation and erosion. These impacts would persist in both the short-term and long-term timeframes.

However, overall, there would be a less than significant impact to cultural resources as a result of this action, implementation of the alternative would not alter the historically documented and perpetual adverse impacts associated with McNary Lock and Dam operations and maintenance activities. For more detailed information on these impacts, please reference the Federal Columbia River Power System Programmatic Agreement document.

4.15.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

The implementation of alternative 2a would have marginal influence on the current adverse impacts on cultural resources from the operation and maintenance of McNary Lock and Dam. All significant impacts are detailed by the Federal Columbia River Power System Programmatic Agreement and addressed through the Columbia River System Operation Environmental Impact Statement.

Pedestrian use of the causeway and recreational activity on the island has historically caused adverse impacts to the cultural resources on Bateman Island. Under the alternative, full removal of the causeway would permanently eliminate pedestrian access to the island and therefore reduce impacts to cultural resources from recreational activities. Increased availability of salmonids and other aquatic life will positively impact the economies of tribal families by providing foods relied on for subsistence, but also meets an important environmental justice obligation of USACE to restore Treaty-reserved resources to tribal members that have been impacted by Federal, state, and private development. As such, this alternative will have strong economic, socioeconomic, and environmental justice benefits.

It should be noted that comparisons to other USACE-managed islands without pedestrian access suggest that removal of the causeway would not eliminate recreational activity on the island entirely. Furthermore, removal of the causeway could impede direct access to the island and therefore increase the response time to combat recreational impacts such as fires or looting.

The introduction of flow through the area between Bateman Island and the mainland could lead to new and increased erosion along the southern shoreline of Bateman Island. The addition of riparian habitat would help to stabilize the shoreline over time, but there could be some direct minor adverse impacts through the preparation of the shoreline for plantings and the actual ground-disturbing act of planting itself. The opportunity to benefit cultural resources by planting native or culturally significant riparian plant species may help by reestablishing aesthetic qualities related to the integrity of cultural resources within the project area, especially those with cultural and religious significance to Indian Tribes.

The causeway is connected to Bateman Island which is a historic property determined eligible for listing in the National Register of Historic Places (NRHP). USACE delineated the archaeological area of potential effect for the proposed undertaking as the causeway structure itself and consulted with the Washington Department of Archaeology and Historic Preservation (DAHP) and regional Tribes. All the Tribes overwhelmingly preferred full removal of the causeway in Alternative 2b, stating that the HPRCSIT, archaeological resources, and sacred site

will not be impacted and reducing foot traffic could be beneficial. The DAHP concurred with the USACE determination that the removal of the causeway will result in no adverse effects to the Bateman Island historic property. An archaeologist will monitor excavation of both terminal ends of the causeway structure and previously approved USACE Inadvertent Discovery Protocols will be followed in the unlikely event of discovery of cultural material and/or artifacts.

Implementation of the alternative 2a would have moderate adverse and beneficial direct/ indirect short-term and long-term impacts to cultural resources. Overall, the impact to cultural resources would be less than significant because implementation of the alternative would not alter the historically documented and perpetual adverse impacts associated with McNary Lock and Dam operations and maintenance activities.

4.15.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

The implementation of alternative 2b would have marginal influence on the current adverse impacts on cultural resources from the operation and maintenance of McNary Lock and Dam. All significant impacts are detailed by the Federal Columbia River Power System Programmatic Agreement and addressed through the Columbia River System Operation Environmental Impact Statement.

Pedestrian utilization of the causeway and recreational activity on the island has historically caused adverse impacts to the cultural resources on Bateman Island. Under the alternative, partial removal of the causeway would permanently eliminate pedestrian access to the island and therefore may lead to fewer impacts to cultural resources from recreational activities. In addition, environmental benefits that increase availability of salmonids and other aquatic life will positively impact the economies of tribal families by providing foods relied on for subsistence, but also meets an important environmental justice obligation of USACE to restore Treaty-reserved resources to tribal members that have been impacted by Federal, state, and private development. As such, this alternative will likely provide some economic, socioeconomic, and environmental justice benefits.

Comparisons to other USACE-managed islands without pedestrian access suggest that removal of the causeway would not eliminate recreational activity from taking place on the island entirely. Furthermore, partial removal of the causeway could impede direct access to the island and therefore increase the response time to combat recreational impacts such as fires or looting.

The introduction of flow through the area between Bateman Island and the mainland could lead to new and increased erosion along the southern shoreline of Bateman Island. The addition of riparian habitat would help to stabilize the shoreline over time, but there could be some direct minor adverse impacts through the preparation of the shoreline for plantings and the actual ground-disturbing act of planting itself. The opportunity to benefit cultural resources by planting native or culturally significant riparian plant species may help reestablishing aesthetic qualities related to the integrity of cultural resources within the project area, especially those with cultural and religious significance to Indian Tribes.

The causeway is connected to Bateman Island which is a historic property determined eligible for listing in the NRHP. USACE delineated the archaeological area of potential effect for the proposed undertaking as the causeway structure itself and consulted with the Washington Department of Archaeology and Historic Preservation (DAHP) and regional Tribes. All the Tribes overwhelmingly preferred full removal of the causeway rather than partial removal as in Alternative 3a. They stated that the HPRCSIT, archaeological resources, and sacred site will not be impacted and that reduce foot traffic could be beneficial. The DAHP concurred with the USACE determination that the removal of the causeway will result in no adverse effects to the Bateman Island historic property. An archaeologist will monitor excavation of both terminal ends of the causeway structure and previously approved USACE Inadvertent Discovery Protocols will be followed in the unlikely event of discovery of cultural material and/or artifacts.

Implementation of the alternative 2b would have moderate adverse and beneficial direct/ indirect short-term and long-term impacts to cultural resources. Overall, the impact to cultural resources would be less than significant because implementation of the alternative would not alter the historically documented and perpetual adverse impacts associated with McNary Lock and Dam operations and maintenance activities. For more detailed information on these impacts, reference the Federal Columbia River Power System Programmatic Agreement and Columbia River System Environmental Impact Statement.

4.15.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

The implementation of alternative 3a would have marginal influence on the current adverse impacts on cultural resources from the operation and maintenance of McNary Lock and Dam.

Pedestrian use of the causeway and recreational activity on the island has historically enabled adverse impacts to the cultural resources on Bateman Island. Under the alternative, full removal of the causeway would permanently eliminate pedestrian access to the island and therefore may lead to less impacts to cultural resources from recreational activities. In addition, environmental benefits that increase availability of salmonids and other aquatic life will positively impact the economies of tribal families by providing foods relied on for subsistence, but also meets an important environmental justice obligation of USACE to restore Treaty-reserved resources to tribal members that have been impacted by Federal, state, and private development. As such, this alternative will have strong economic, socioeconomic, and environmental justice benefits.

Comparisons to other USACE-managed islands without pedestrian access suggest that removal of the causeway would not eliminate recreational activity from the island entirely. Furthermore, removal of the causeway could impede direct access to the island and therefore could increase the response time to combat recreational impacts such as fires or looting.

The introduction of flow through the area between Bateman Island and the mainland could lead to new and increased erosion along the southern shoreline of Bateman Island. Exclusion of riparian habitat would prevent adverse impacts to cultural resources from ground-disturbing planting activities but does sacrifice the potential indirect long-term benefits of shoreline stabilization and the opportunity to plant culturally significant riparian plant species.

The causeway is connected to Bateman Island, which is a historic property determined eligible for listing in the NRHP. USACE delineated the archaeological area of potential effect for the proposed undertaking as the causeway structure itself and consulted with the Washington Department of Archaeology and Historic Preservation (DAHP) and regional Tribes. All the Tribes overwhelmingly preferred full removal of the causeway as in Alternative 3a, stating that the HPRCSIT, archaeological resources, and sacred site will not be impacted and that reduce foot traffic could be beneficial. The DAHP concurred with the USACE determination that the removal of the causeway will result in no adverse effects to the Bateman Island historic property. An archaeologist will monitor excavation of both terminal ends of the causeway structure and previously approved USACE Inadvertent Discovery Protocols will be followed in the unlikely event of discovery of cultural material and/or artifacts.

Implementation of the alternative 3a would have moderate adverse and beneficial direct/ indirect short-term and long-term impacts to cultural resources. Overall, the impact to cultural resources would be less than significant because implementation of the alternative would not alter the perpetual adverse impacts to the island associated with McNary Lock and Dam operations and maintenance activities. For more detailed information on these impacts, reference the Federal Columbia River Power System Programmatic Agreement and Columbia River System Environmental Impact Statement.

4.15.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

The implementation of alternative 3b would have marginal influence on the current adverse impacts on cultural resources from the operation and maintenance of McNary Lock and Dam. All significant impacts are detailed by the Federal Columbia River Power System Programmatic Agreement and addressed through the Columbia River System Environmental Impact Statement.

Pedestrian utilization of the causeway and recreational activity on the island has historically posed adverse impacts to the cultural resources on Bateman Island. Under the alternative, partial removal of the causeway would permanently eliminate pedestrian access to the island and therefore may lead to fewer impacts to cultural resources from recreational activities. Comparisons to other USACE-managed islands without pedestrian access suggest that removal of the causeway would not eliminate recreational activity from on the island entirely. Furthermore, it stands to reason that partial removal of the causeway would impede direct access to the island and therefore increase the response time to combat recreational impacts such as fires or looting.

The introduction of flow through the area between Bateman Island and the mainland could lead to new and increased erosion along the southern shoreline of Bateman Island. Exclusion of riparian habitat would prevent minor direct adverse impacts to cultural resources from plantings but sacrifices the potential indirect long-term benefits of shoreline stabilization and the opportunity to plant culturally significant riparian plant species.

The causeway is connected to Bateman Island which is a historic property determined eligible for listing in the NRHP. USACE delineated the archaeological area of potential effect for the proposed undertaking as the causeway structure itself and consulted with the Washington Department of Archaeology and Historic Preservation (DAHP) and regional Tribes. All the Tribes overwhelmingly preferred Alternative 3a, stating that the HPRCSIT, archaeological resources, and sacred site will not be impacted and that reduce foot traffic could be beneficial. The DAHP concurred with the USACE determination that the removal of the causeway will result in no adverse effects to the Bateman Island historic property. An archaeologist will monitor excavation of both terminal ends of the causeway structure and previously approved USACE Inadvertent Discovery Protocols will be followed in the unlikely event of discovery of cultural material and/or artifacts.

Implementation of the alternative 3b would have moderate adverse and beneficial direct/ indirect short-term and long-term impacts to cultural resources. Overall, the impact to cultural resources would be less than significant because implementation of the alternative would not alter the perpetual adverse impacts associated with McNary Lock and Dam operations and maintenance activities. For more detailed information on these impacts, reference the Federal Columbia River Power System Programmatic Agreement and Columbia River System Environmental Impact Statement.

4.16 ECONOMICS/SOCIOECONOMICS/ENVIRONMENTAL JUSTICE

4.16.1 Alternative 1 (No Action)

The Tri-Cities population would continue to remain stable and is anticipated to slightly grow over time. No changes to the job market or workforce are expected. The poverty level would remain approximately 8.5 percent. Changes to population demographics are not expected to occur. Implementation of the no action alternative would have negligible direct/indirect short-term and long-term impacts to the economics, socioeconomics, or environmental justice of the area surrounding the Yakima River Delta. Overall, there would be a less than significant impact to these resources as there would not be a severe or negative change to the regional resource characteristics over time.

4.16.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

The Tri-Cities population would continue to remain stable and is anticipated to slightly grow. There would be no changes to the job market or the workforce. The poverty level is anticipated to remain around 8.5 percent. In addition, there would be no anticipated changes to the population demographics. Removal of the causeway would eliminate pedestrian access to

Bateman Island. This would require those who would like to recreate on the island to possess either a boat or other floatation device. Restricting access from pedestrian recreators would inadvertently disenfranchise those who cannot afford those luxuries and thus would have a minor adverse impact to people of lower socioeconomic categories.

Tribes would benefit from this alternative by allowing an increase in ESA-listed fish to migrate up the Yakima and a reduction in fish predation habitat.

Plantings of culturally significant riparian vegetation would provide minor benefits to tribes in the area; however, the overall influence of riparian habitat on these resources would be negligible.

Implementation of the alternative would have minor adverse direct/indirect short-term and long-term impacts to economics, socioeconomics, and environmental justice through the restriction of access to Bateman Island. Overall, there would be a less than significant impact to these resources as there would not be a severe or negative change to the regional resource characteristics over time.

4.16.3 Alternative 2b. Partial Removal of Causeway with Riparian Habitat

The Tri-Cities population would continue to remain stable and is anticipated to slightly grow. There would be no changes to the job market or the workforce. The poverty level is anticipated to remain around 8.5 percent. In addition, there would be no anticipated changes to the population demographics. Partial removal of the causeway would eliminate pedestrian access to Bateman Island. This would require those who would like to recreate on the island to possess either a boat or other floatation device. Restricting access from pedestrian recreators would inadvertently disenfranchise those who cannot afford those luxuries and thus would have a minor adverse impact to people of lower socioeconomic categories. However, the partial removal of the causeway could provide some fishing opportunities.

Tribes would benefit from this alternative by allowing an increase in ESA-listed fish to migrate up the Yakima and a reduction in fish predation habitat.

Plantings of culturally significant riparian vegetation would provide minor benefits to tribes in the area; however, the overall influence of riparian habitat on these resources would be negligible.

Implementation of the alternative would have minor adverse direct/indirect short-term and long-term impacts to economics, socioeconomics, and environmental justice through the restriction of access to Bateman Island. Overall, there would be a less than significant impact to these resources as there would not be a severe or negative change to the regional resource characteristics over time.

4.16.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

The Tri-Cities population would continue to remain stable and is anticipated to slightly grow. There would be no changes to the job market or the workforce. The poverty level is anticipated to remain around 8.5 percent. In addition, there would be no anticipated changes to the population demographics. Removal of the causeway would eliminate pedestrian access to Bateman Island. This would require those who would like to recreate on the island to possess either a boat or other floatation device. Restricting access from pedestrian recreators would inadvertently disenfranchise those who cannot afford those luxuries and thus would have a minor adverse impact to people of lower socioeconomic categories.

Tribes would benefit from this alternative by allowing an increase in ESA-listed fish to migrate up the Yakima and a reduction in fish predation habitat.

Exclusion of riparian habitat would have negligible influence on the impact to these resources.

Implementation of the alternative would have minor adverse direct/indirect short-term and long-term impacts to economics, socioeconomics, and environmental justice through the restriction of access to Bateman Island. Overall, there would be a less than significant impact to these resources as there would not be a severe or negative change to the regional resource characteristics over time.

4.16.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

The Tri-Cities population would continue to remain stable and is anticipated to slightly grow. There would be no changes to the job market or the workforce. The poverty level is anticipated to remain around 8.5 percent. In addition, there would be no anticipated changes to the population demographics. Partial removal of the causeway would eliminate pedestrian access to Bateman Island. This would require those who would like to recreate on the island to possess either a boat or other floatation device. Restricting access from pedestrian recreators would inadvertently disenfranchise those who cannot afford those luxuries and thus would have a minor adverse impact to people of lower socioeconomic categories.

Tribes would benefit from this alternative by allowing an increase in ESA-listed fish to migrate up the Yakima and a reduction in fish predation habitat.

Exclusion of riparian habitat would have negligible influence on the impact to these resources.

Implementation of the alternative would have minor adverse direct/ indirect short-term and long-term impacts to economics, socioeconomics, and environmental justice through the restriction of access to Bateman Island. Overall, there would be a less than significant impact to these resources as there would not be a severe or negative change to the regional resource characteristics over time.

4.17 PUBLIC INFRASTRUCTURE

4.17.1 Alternative 1 (No Action)

The new Duportail Street Bridge would continue to allow improved access and management of the Yakima River natural open space, as well as provide congestion relief. Within the Yakima River Delta, there are no anticipated changes to road, railroad, or public utility alignments in the future. Amon Creek Wasteway would likely continue to provide irrigation water and marginally support fish species, as identified in existing conditions.

The no action alternative would not impact the Columbia Park Marina or City of Richland public boat launch. As a result, there would be a negligible direct/indirect short-term and long-term impact to public utilities and infrastructure because the Bateman Island causeway shelters these resources from the flow of the Yakima River. Overall, there would be a less than significant impact to public utilities and infrastructure because there would not be a severe or negative change to the regional resource characteristics over time.

4.17.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

The new Duportail Street Bridge would continue to allow improved access and management of the Yakima River natural open space, as well as provide congestion relief. Within the Yakima River Delta, there are no anticipated changes to road, railroad, or public utility alignments in the future. Amon Creek Wasteway would likely continue to provide irrigation water and marginally support fish species, as identified in existing conditions.

The Columbia Park Marina and City of Richland public boat launch would be moderately affected by the removal of the causeway. Boaters would experience some changes to water flow conditions that may cause boating to be moderately affected. However, the flows would not prohibit navigation.

Riparian habitat would have no impact to public utilities.

Implementation of the alternative would have moderate direct/indirect short-term and long-term impacts to public utilities. Overall, there would be a less than significant impact to public utilities and infrastructure because there would not be a severe or negative change to the regional resource characteristics over time.

4.17.3 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

The new Duportail Street Bridge would continue to allow improved access and management of the Yakima River natural open space, as well as provide congestion relief. Within the Yakima River Delta, there are no anticipated changes to road, railroad, or public utility alignments in the future. Amon Creek Wasteway would likely continue to provide irrigation water and marginally support fish species, as identified in existing conditions.

The Columbia Park Marina and City of Richland public boat launch would have moderate adverse impacts from the partial removal of the causeway. Boaters would experience some changes to water flow conditions that may cause boating to be slightly more difficult. However, the flows would not prohibit navigation.

Riparian habitat would have no impact to public utilities.

Implementation of the alternative would have moderate adverse direct/indirect short-term and long-term impacts to public utilities. Overall, there would be a less than significant impact to public utilities and infrastructure because there would not be a severe or negative change to the regional resource characteristics over time.

4.17.4 Alternative 3a, Full Removal of Causeway without Riparian Habitat

The new Duportail Street Bridge would continue to allow improved access and management of the Yakima River natural open space, as well as provide congestion relief. Within the Yakima River Delta, there are no anticipated changes to road, railroad, or public utility alignments in the future. Amon Creek Wasteway would likely continue to provide irrigation water and marginally support fish species, as identified in existing conditions.

The Columbia Park Marina and City of Richland public boat launch would be moderately affected by the removal of the causeway. Boaters would experience some changes to water flow conditions that may cause boating to be moderately affected. However, the flows would not prohibit navigation.

Exclusion of riparian habitat would have no impact to public utilities.

Implementation of the alternative would have moderate adverse direct/indirect short-term and long-term impacts to public utilities. Overall, there would be a less than significant impact to public utilities and infrastructure because there would not be a severe or negative change to the regional resource characteristics over time.

4.17.5 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

The new Duportail Street Bridge would continue to allow improved access and management of the Yakima River natural open space, as well as provide congestion relief. Within the Yakima River Delta, there are no anticipated changes to road, railroad, or public utility alignments in the future. Amon Creek Wasteway would likely continue to provide irrigation water and marginally support fish species, as identified in existing conditions.

The Columbia Park Marina and City of Richland public boat launch would be moderately affected by the removal of the causeway. Boaters would experience some changes to water flow conditions that may cause boating to be moderately affected. However, the flows would not prohibit navigation.

Exclusion of riparian habitat would have no impact to public utilities.

Implementation of the alternative would have moderate adverse direct/indirect short-term and long-term impacts to public utilities. Overall, there would be a less than significant impact to public utilities and infrastructure because there would not be a severe or negative change to the regional resource characteristics over time.

4.18 HAZARDOUS, TOXIC, AND RADIOACTIVE WASTE

Phase I HTRW Environmental Site Assessment (ESA) has been conducted for the project area in accordance with ASTM Standard Practice E-1527-13 and USACE Engineer Regulation (ER) 1165-2-132**.** The investigation relies on site reconnaissance and review of reasonably ascertainable environmental records, including regulatory database information and historic information, to determine the likelihood that the project area contains a recognized environmental condition (REC) or HTRW**.** The Phase I ESA was conducted in general accordance with ASTM Standard Practice E-1527-13 and constitutes "all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice," as defined at 42 USC §9601(35) (B)**.** No RECs were identified in the proposed action area**.** One REC was identified in the vicinity of the proposed action area and should be avoided. (Refer to Appendix B for more details.) A Phase 2 ESA is not recommended.

4.18.1 Alternative 1 (No Action)

No disturbance would occur to hazardous, toxic, or radioactive waste. The proposed action area would not involve known contaminants. As a result, implementation of the no action alternative would not alter the current conditions of hazardous, toxic, or radioactive waste in the Yakima River Delta. Therefore, implementation of the no action alternative would not alter the current conditions of hazardous, toxic, or radioactive waste in the Yakima River Delta. Therefore, there would be negligible direct/indirect short-term and long-term impacts to these factors in the short-term and long-term. Overall, there would be a less than significant impact because there would not be a severe or negative change to the regional resource characteristics over time.

4.18.2 Alternative 2a, Full Removal of Causeway with Riparian Habitat

The Phase I ESA identified one REC within the vicinity of the proposed action area. This REC can be avoided by construction activities for both the causeway and the riparian habitat planting area. Assuming proper protocols are followed during deconstruction of the causeway, there would be negligible direct/indirect short-term and long-term impacts to hazardous, toxic, or radioactive material in the Delta. Overall, there would be a less than significant impact because there would not be a severe or negative change to the regional resource characteristics over time.

4.19 Alternative 2b, Partial Removal of Causeway with Riparian Habitat

The Phase I ESA identified one REC within the vicinity of the proposed action area. This REC can be avoided by construction activities for both the causeway and the riparian habitat planting area. Assuming proper protocols are followed during partial deconstruction of the causeway, there would be negligible direct/indirect short-term and long-term impacts to the release of hazardous, toxic, or radioactive material in the Delta. Overall, there would be a less than significant impact because there would not be a severe or negative change to the regional resource characteristics over time.

4.19.1 Alternative 3a, Full Removal of causeway without Riparian Habitat

The Phase I ESA identified one REC within the vicinity of the proposed action area. This REC can be avoided by construction activities for both the causeway and the riparian habitat planting area. Assuming proper protocols are followed during deconstruction of the causeway, there would be negligible direct/indirect short-term and long-term impacts to hazardous, toxic, or radioactive material in the Delta. Overall, there would be a less than significant impact because there would not be a severe or negative change to the regional resource characteristics over time.

4.20 Alternative 3b, Partial Removal of Causeway without Riparian Habitat

The Phase I ESA identified one REC within the vicinity of the proposed action area. This REC can be avoided by construction activities for both the causeway and the riparian habitat planting area. Assuming proper protocols are followed during partial deconstruction of the causeway, there would be negligible direct/indirect short-term and long-term impacts to the release of hazardous, toxic, or radioactive material in the Delta. Overall, there would be a less than significant impact because there would not be a severe or negative change to the regional resource characteristics over time.

4.21 CUMULATIVE EFFECTS

4.21.1 Scope of Cumulative Effects Analysis

CEQ Regulations implementing NEPA require Federal agencies to consider the cumulative impacts of their actions. Cumulative effects are defined as “the impact on the environment, which results from the incremental impact of an action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (Federal or non-Federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over time” (40 CFR § 1508.7).

This section evaluates the cumulative effects of actions that could potentially affect the environmental resources discussed in the previous sections. A resource may be differentially impacted in both time and space. The implication of those impacts depends on the

characteristics of the resource, the magnitude and scale of project impacts, and the environmental setting. The scope of this analysis extends beyond the Yakima River Delta project to other areas that may also include the identified resources of concern.

Guidance for setting appropriate boundaries for a cumulative effects analysis is available from the CEQ and the Environmental Protection Agency (EPA). Generally, the scope of a cumulative effects analysis should be broader than the scope of analysis used in assessing different or indirect effects. The analysis should delineate appropriate geographic areas, including natural effects. Discussed below are the past, present, and reasonably foreseeable future actions considered for the cumulative effects analysis, the effects of the actions on the resources assessed, and a summary of the cumulative effects of the Action Alternatives. The geographic boundary for the cumulative effects analysis for Air Quality, Noise, Sediments, Hydrology, Water Quality, Aquatic Resources, Threatened and Endangered Species, Wetlands, Wildlife, Vegetation, Land Use, Recreation, Climate Change, Cultural and Historic Resources, Economics/ Socioeconomics/ Environmental Justice, Public Infrastructure, Hazardous, Toxic, and Radioactive Waste, and Aesthetics/ Visual resources includes actions taking place within the Tri-Cities Levee System and the Yakima River Watershed. Figure 4-1 delineates the geographic boundaries used in this analysis.

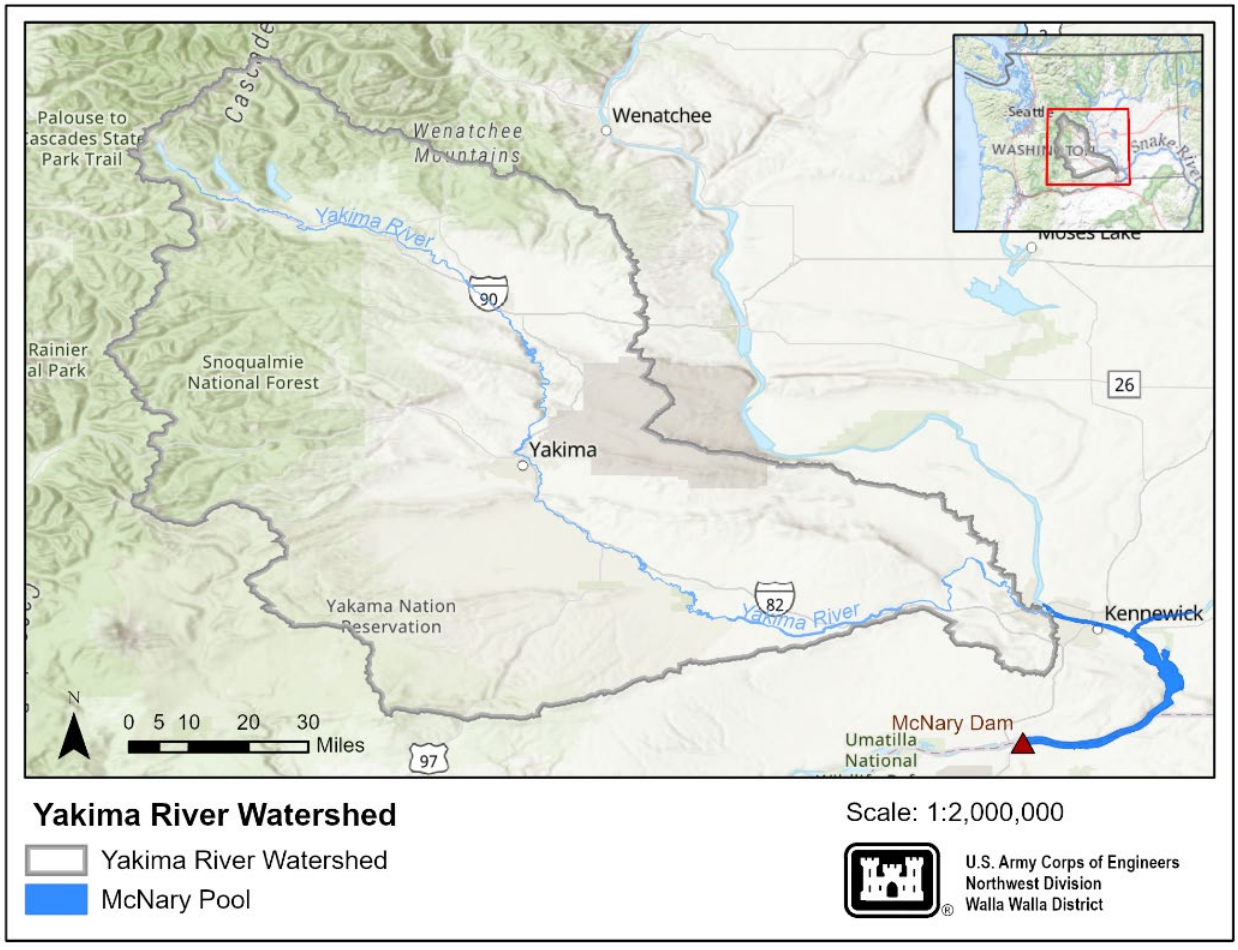

Figure 4-1. Geographic Boundary in Cumulative Effect Analysis

An 83-year timeframe was used, which is from when the causeway to Bateman Island was believed to have been built (1939) to the present, plus an additional 10 years to include the "reasonably foreseeable future." For an action to be considered "reasonably foreseeable," there must be a strong indication it would occur.

4.21.2 Past and Present Conditions

The resources assessed have experienced various impacts since the mid-1900s. Construction and operations of the dams and associated levee systems, agricultural development, road building, city development, and fish harvest have all contributed to the current state of area resources. The following sections summarize reasonably foreseeable future actions considered in this analysis, and the effects of those actions on the resources considered. The resource conditions described in their respective sections of Section 2, Affected Environment, and Section 4, Environmental Consequences, account for the impacts to resources related to past and present conditions. The following section considers the further cumulative effects of alternatives combined with reasonably foreseeable future actions and conditions for all resources.

4.21.2.1 Reasonably Foreseeable Future Actions

Pasco Shoreline Master Program

The Washington State Shoreline Management Act of 1971 (SMA) provides a statewide framework for managing, accessing, and protecting shorelines; and is the fundamental authority for developing, updating, and amending Shoreline Master Programs (SMPs). These SMPs are both planning and regulatory documents and are designated to carry out the policies of the SMA on local shorelines. The SMA has three broad policies: 1) protect the environmental resources of state shorelines; 2) promote public access and enjoyment opportunities; and 3) give priority to uses that require a shoreline location.

The City of Pasco underwent an extensive review process that culminated in the adoption of a new master Program by the Pasco City council. Pasco's SMP was reviewed by Ecology and accepted without revision in June 2016. It is expected that Pasco implemented the updated SMP upon Ecology approval.

McNary Shoreline Management Plan

Under the McNary Shoreline Management Plan, new private boat docks can be built on the McNary reservoir provided all identified compliance requirements are met and permits are acquired from USACE. The Plan, through consultation with NMFS and the USFWS, has placed a cap on the number of private docks (100) that can be constructed on the McNary shoreline, and that number cannot be exceeded.

Richland Stormwater Program

In 2016, the City of Richland updated its Stormwater Management Plan. Future Improvements to the city's stormwater management program may include modifications or additions to infrastructure.

Yakima River Watershed Restoration Projects

There is a network of organizations that are creating and enhancing riparian, riverine, and wetland habitats throughout the upper Yakima River basin. These projects are anticipated to continue into the future to assist in improving water quality, reducing invasive species, and improving habitat for ESA-listed fish.

4.21.2.2 Cumulative Effects

Potential environmental effects associated with the alternatives considered, when combined with past, present, and reasonably foreseeable future actions, is not expected to result in significant effects to the human environment as discussed below.

Air Quality: Work would result in minor adverse air quality impacts via pollution caused by construction activities and vegetation removal. There would be minor beneficial effects from the establishment of riparian vegetation for Alternatives 2a and 2b. Other than pollution levels that are typical for this urban setting, such as caused by traffic, boats, and industrial activities, Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to air quality are expected to be less than significant.

Noise: Work would result in temporary increase to noise levels caused by construction activities. Recreators or local businesses could experience impacts to comfort and wellbeing during the construction period. However, construction would be conducted during daylight hours between 7:00 AM and 9:00 PM. Other than noise levels that are typical for this urban setting, such as traffic and boats, and combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to noise are expected to be less than significant.

Sediments: Work would result in moderate temporary adverse effects from sediment mobilization caused by construction activities and long-term negligible effects of natural erosion processes. In combination with natural sediment levels that are typical for this riverine setting, upstream shoreline management and ecosystem restoration planning, and shoreline management plan implementation relating to Lake Wallula could further reduce sediment impacts and would have a net positive effect to seasonal bed loading. Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to sediments are expected to be less than significant.

Hydrology: Work would result in major beneficial effects to natural hydrology by restoring natural flows through the Yakima River Delta on both sides of Bateman Island. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to hydrology are expected to be less than significant.

Water Quality: Water quality would temporarily decline during the construction and removal of the causeway. Contaminated sediment would be mobilized, creating a turbidity plume that would settle within the confluence of the Yakima River and Columbia River. This sediment would continue to move through the McNary pool and dissipate under other sedimented deposited naturally by the Columbia River. Overall, there would be a highly beneficial effect to water quality through lower summer water temperatures, thereby improving overall river function and ecosystem health. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to water quality are expected to be less than significant.

Aquatic Resources: Work would result in minor temporary adverse effects from construction activities and long-term major benefits effects to restored aquatic habitats and functions. In combination with shoreline management and other Yakima River ecosystem restoration planning, these benefits would be magnified, including non-native species management. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to aquatic resources are expected to be less than significant.

Threatened and Endangered Species: The function of the Yakima River Delta is not expected to be impacted by the removal of the causeway, or by other actions, onsite or otherwise, associated with the Tri-Cities or the rest of the Yakima River Watershed. The Yakima River Delta Ecosystem Restoration Project would provide an opportunity to greatly improve the migration success of salmonids through the delta. This would mean an increase in ESA listed fish reaching constructed fish habitat restoration sites located in the headwaters of the Yakima Rivers. Improved access to these areas would allow for a higher spawning success and return rate, thereby increasing the potential of recovery success for these species. Without these improvements to salmonid migration and spawning success, past and future restoration efforts would not reach their full potential. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to threatened and endangered species are expected to be less than significant.

Wetlands: Work would result in minor long-term beneficial effects from construction of new wetland/riparian habitat areas for alternatives 2a and 2b and only negligible effects from natural shifts in wetland functions and values under alternatives 3a and 3b. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to wetlands are expected to be less than significant.

Wildlife: Work would result in moderate temporary adverse effects from construction activities and long-term negligible effects to land use from a change in access to Bateman Island. In combination with shoreline management and other Yakima River ecosystem restoration

planning, these benefits would be magnified, including non-native species management. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to wildlife are expected to be less than significant.

Vegetation: Implementation of the proposed action would not result in changes to riparian vegetation, but alternatives 2a and 2b would produce minor beneficial long-term effects to riparian vegetation communities. Riparian habitats would remain consistent with the existing conditions for 3a and 3b. Present and future actions (e.g., levee maintenance) may reduce riparian vegetation in localized areas in the region, however, impacts are expected to be minimal and other restoration actions, may have a net benefit to riparian vegetation in the upstream reaches of the Yakima River. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to vegetation are expected to be less than significant.

Land Use: Work would result in moderate temporary adverse effects from construction activities and long-term negligible effects to land use from a change in access to Bateman Island. While there are other shoreline management planning efforts, most are intended to improve land use or alleviate issues, and thus would inherently not contribute to cumulative adverse effects. Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to land use are expected to be less than significant.

Recreation: Work would result in moderate short-term adverse and long-term beneficial effects, initially from construction and ultimately from higher-value recreation opportunities under all alternatives. The shoreline and urban recreation planning activities are inherently beneficial in nature and would contribute to cumulative beneficial effects to recreational opportunities overall. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to recreation are expected to be less than significant.

Aesthetics/ Visual: Work would result in minor short-term adverse effects from construction activities, with long-term benefits of improves aesthetic conditions for all action alternatives. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to aesthetic and visual values are expected to be less than significant.

Climate Change: Work would result in negligible short- or long-term adverse effects from construction and including possible benefits from new wetland/riparian habitat areas under alternatives 2a and 2b. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to and from climate change are expected to be less than significant.

Cultural and Historic Resources: Work would result in moderate short-term adverse effects relating to construction and moderate long-term beneficial effects from providing inherent protection to cultural resources on Bateman Island. Other land management plans can

contribute to the cumulative protection of cultural resources to a minor degree. Combined with other reasonably foreseeable future actions in the geographic area, cumulative negative effects to cultural and historic resources are expected to be less than significant.

Economics/ Socioeconomics/ Environmental Justice: Work would result in minor short and long-term adverse effects from construction and changes in access to Bateman Island, along with potential effects to a nearby marina. Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to economics, socioeconomics and environmental justice are expected to be less than significant.

Public Infrastructure: Work would result in moderate short- and long-term adverse effects from construction activity impacts and the inherent effects of causeway removal, including effects to the nearby marina/boat ramp. Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to public infrastructure are expected to be less than significant.

Hazardous, Toxic, and Radioactive Waste: Work would result in negligible short- and long-term adverse effects from construction and indirect sediment mobilization. There are other known sources of impacts to HTRW risk levels noted in the HTRW report that could contribute to cumulative effects. However, these are managed and monitored under protective compliance requirements. Combined with other reasonably foreseeable future actions in the geographic area, cumulative effects to HTRW conditions are expected to be less than significant.

4.22 IMPACT MINIMIZATION MEASURES/BEST MANAGEMENT PRACTICES

During the construction phase of the proposed action (removal of the Bateman Island Causeway), USACE will implement the following impact minimization measures and best management practices to reduce construction-related effects on environmental resources:

1) Silt curtains will be deployed prior to construction above and below the causeway to minimize turbidity from construction activities.
2) Prior to closing either segment of bubble curtain, a portable bubbler or similar method would be used, dragged along the bottom of the area within the silt curtain towards the opening. The opening would be closed behind the bubble curtain as it exits the silt curtained area.
3) Begin removal of the causeway in the winter when few, if any, juvenile salmonids would be present. This will occur during the winter in-water work window from December 1 through February 28.
4) During in-water work, turbidity monitoring will occur. If state water quality standards are exceeded, work will be modified or paused until turbidity levels return to acceptable limits. An extended mixing zone will be employed (900 feet). Monitoring will include data collected upstream in the Yakima River near the Highway 240 bridge, at 300 feet downstream of the construction zone, and at 900 feet downstream of the construction zone (at the end of the mixing zone).

5) Sediment transport monitoring at 1-, 3-, 5- and 10-year intervals will visually assess mudflat development and shoreline erosion. Sediment depth at key navigation points and water intakes will be assessed using simple hydroacoustic techniques to ensure that intakes are not being obstructed. This information will help confirm assumptions regarding sediment deposition post-construction.
6) Construction best management practices will be followed to minimize impacts from potential petroleum spills.
    a. Equipment inspected daily for spills and leaks with immediate cleanup or repair as appropriate before work is started.
    b. Ensure spill cleanup kits available on-site.
    c. No fueling or fuel storage within 100 feet of water.
7) Construction materials will not be released into the water, except for clean fill or riprap installed to protect the shorelines from erosion.
8) Silt curtains would be used to minimize turbidity from any excavated or stockpiled materials as described above.
9) Interstitial spaces of fill material will be filled with gravel or soil as appropriate to prevent the creation of predator habitat.
10) Use of nature-based designs will be maximized in the development of shoreline stabilization elements.
11) Disturbance of the existing subsurface materials within the boundaries of the disturbed shoreline will be minimized as much as practicable during design and construction by providing requirements and constraints in the construction specifications that require the contractor to protect the existing subsurface materials.

During design phase adjustments to the excavated surface will be identified to minimize or eliminate excavation and refine the disturbed footprint, ensuring subsurface materials are protected as much as feasible.

SECTION 5 - RECOMMENDED PLAN

5.1 FINAL ARRAY OF ALTERNATIVES AND SELECTION OF RECOMMENDED PLAN

5.1.1 Final Array of Alternatives

USACE coordinated with Cooperating Agencies (United States Fish and Wildlife Service, Ecology, CTUIR, and Yakama Nation to gather input on the initial array of alternatives. At that time, the Yakama Nation presented data to demonstrate the control and reduction of predation benefits survival of juvenile salmonids during migration. Additionally, limitations of the GSHM were recognized as the model does not incorporate the effects of predation or lack of habitat connectivity, which are important characteristics of salmonid habitat in Lake Wallula. This led the Project Delivery Team (PDT) to establish a new constraint, stating the project will not increase anticipated predation of listed species. Due to the concern that the remaining causeway in the partial removal alternative would create ideal predator habitat due to the continued restriction of flow, the PDT eliminated Action Alternative 2b (Partial Causeway Removal with Riparian Habitat) and 3b (Partial Causeway Removal without Riparian Habitat) from further consideration. This resulted in the No Action Alternative and Action Alternatives 2a (Full Removal with Riparian Habitat) and 3a (Full Removal without Riparian Habitat) to be carried forward as the final array of alternatives (Table 5-1). Environmental analysis of all action alternatives still included partial removal to further understand potential impacts, as indicated in Section 4.

Table 5-1. Final Array of Alternatives

Alternatives
1. No Action
2a*. Full Causeway Removal with Riparian Habitat
3a. Full Causeway Removal without Riparian Habitat

*Upon CE/ICA, the addition of "-1," "-2," and "-3" to Alternative 2's naming convention indicates the different riparian sites added

5.1.2 Cost Effectiveness and Incremental Cost Analysis

This section describes the model inputs for performing the cost effectiveness and incremental cost analysis (CE/ICA) using IWR Planning Suite II, version 2.0.9 (USACE certified model). This software was developed to inform decision-making regarding plan selection and/or NER plan identification; the results do not constitute a decision on their own. Specifically, CE/ICA can assist with alternative formulation by combining solutions to planning problems and calculating the additive effect of each combination. This is done by the software utilizing inputs on benefits (AAHUs) and costs while implementing the identified combinability and dependency relationships.

Dependency relationships occur between solutions when the implementation of one solution is dependent on the implementation of one or more other solutions. Combinability relationships occur between solutions when the implementation of one solution cannot be combined with the implementation of one or more other solutions.

CE/ICA inputs are summarized in Table 5-2. Each riparian site is dependent upon the implementation of the full causeway removal due to the main goal of the project centered around listed salmonids. Potential benefits from riparian sites alone would not be sufficient to provide enough restoration for fish habitat and would be limited to only providing shade and woody debris. No combinability relationships occur, meaning that there is no solution (RF, WSFULL, NOTCHFULL, EEFULL, and CFULL) that is not combinable with another solution—i.e., RF can be combined with any and all other solutions, WSFULL can be combined with any and all other solutions, and so on. However, each riparian site has a dependent relationship upon CFULL, meaning each riparian site must always be implemented in combination with CFULL.

Table 5-2. Cost Effectiveness Incremental Cost Analysis Inputs*

Alternative ID	Description	Total AAC ($1,000s)	Output (AAHUs)	Dependency	Combinability
RF	Riparian Site 1 (Full Breach)	$71.3	1.1	Dependent Upon CFULL	N/A
WSFULL	Riparian Site 2 (Full Breach)	$169.3	2.2	Dependent Upon CFULL	N/A
NOTCHFULL	Riparian Site 3 (Full Breach)	$4.7	0.5	Dependent Upon CFULL	N/A
EEFULL	Riparian Site 4 (Full Breach)	$30.3	1.1	Dependent Upon CFULL	N/A
CFULL	Causeway Removal - Full	$454.9	53.6	N/A	N/A

*FY23 OCT 2022 Price Level and 2.50% Federal Discount Rate

The CE/ICA results for the final array of alternatives are displayed in Figure 5-1, along with possible plan combinations. When alternatives are combined, total benefits (AAHUs) are the sum of the individual alternative's AAHUs shown in Table 5-2. Cost effective plans are those in which no other plan produces the same level of output at a lower cost and/or no other plan produces more output at the same cost. The CE/ICA analysis evaluated 17 possible plan combinations. Of these, 11 plans—including the No Action Alternative—were identified as cost effective, as indicated by a red triangle in Figure 5-1. Six plans were identified as Best Buys, cost-effective plans which give the highest incremental output at the lowest incremental cost and displayed as a green square. Non-cost-effective plans are displayed as a blue circle.

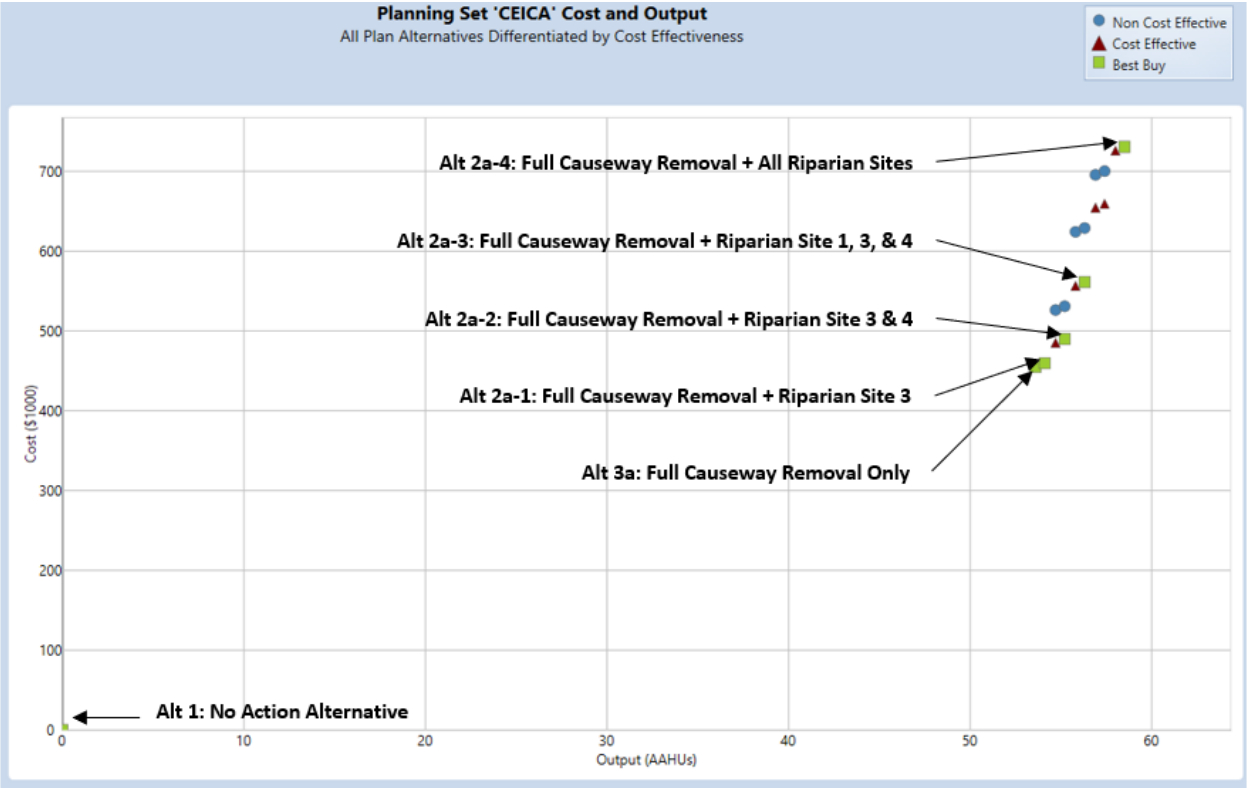

Figure 5-1. Plot of Possible Plan Combinations for Final Array of Alternatives

Figure 5-2 compares the output against the incremental cost per unit for the final Best Buy plans. This resulted in the full removal only Alternative, 3a, with the highest incremental benefit of 53.6 AAHU at the lowest incremental cost per AAHU of $8,500 per AAHU. Table 5-3 details the data of these six Best Buy plans and their respective incremental cost per output.

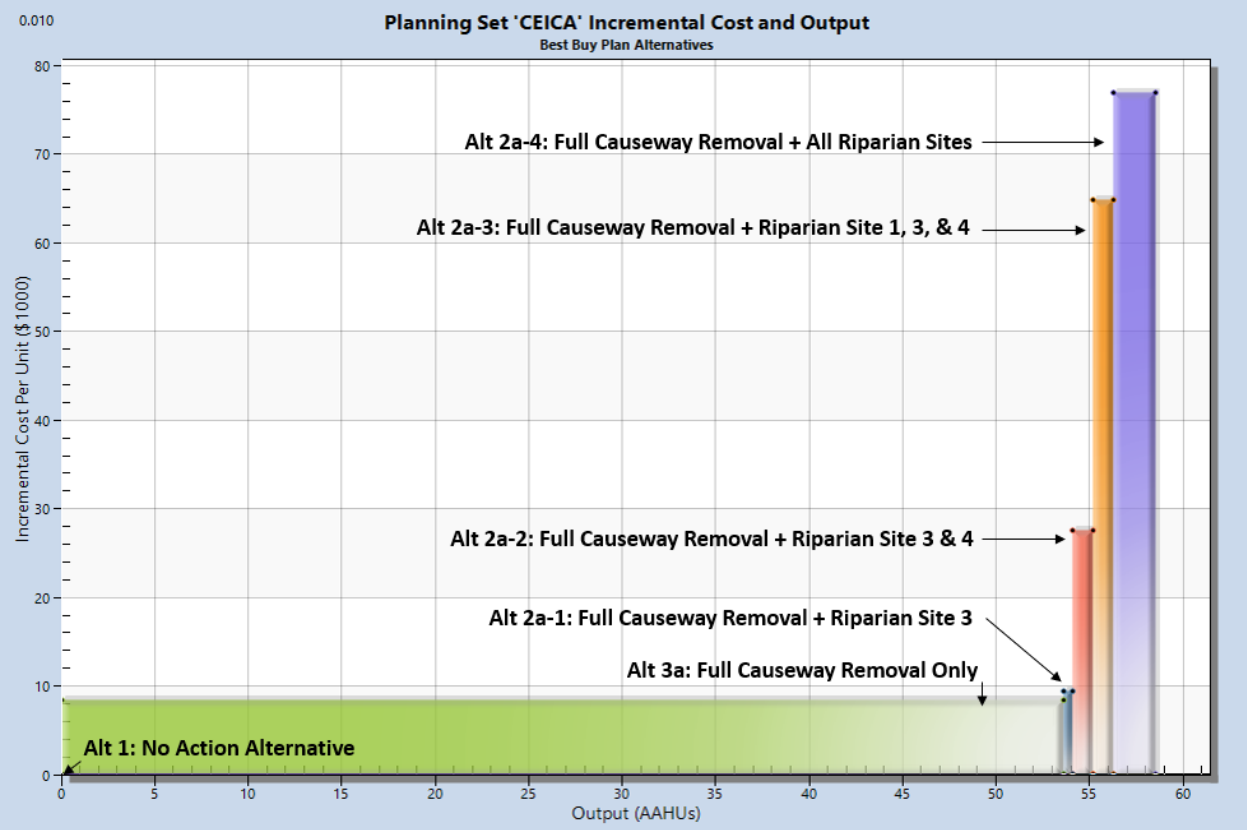

Figure 5-2. Best Buy Plans for Final Array of Alternatives

Table 5-3. Incremental Cost per Output for Best Buy Plans for Final Array of Alternatives*

Best Buy Plan	Alternative	Output (Net AAHUs)	AAC ($1,000)	Average Cost ($1,000/AAHUs)	Incremental Cost ($1,000)	Incremental Output (AAHUs)	Incremental Cost/Output
1	No Action	0	$0	$0	$0	0	$0
2	Alt 3a - Full Causeway Removal Only	53.6	$454.9	$8.5	$454.9	53.6	$8.5
3	Alt 2a-1 - Full Causeway Removal + Riparian Restoration Site 3	54.1	$459.6	$8.5	$4.7	0.5	$9.4
4	Alt 2a-2 - Full Causeway Removal + Riparian Restoration Sites 3 & 4	55.2	$489.9	$8.9	$30.3	1.1	$27.6
5	Alt 2a-3 - Full Causeway Removal + Riparian Restoration Sites 1, 3 & 4	56.3	$561.2	$10.0	$71.3	1.1	$64.8
6	Alt 2a-4 - Full Causeway Removal + All Riparian Restoration Sites (1-4)	58.5	$730.5	$12.5	$169.3	2.2	$76.9

*FY23 OCT 2022 Price Level and 2.50% Federal Discount Rate

The first best buy plan is the No Action Alternative, which provides 0 habitat units (HUs)at $0 each.

Alternative 3a, full causeway removal only, provides an incremental benefit of 53.6 AAHUs at an incremental cost of $8,500 per AAHU. The most significant benefits to the Yakima River Delta project are tied to causeway removal. Alternative 3a meets project objectives by 1) restoring the aquatic ecosystem function and 2) improving the quality and complexity of the aquatic and riparian habitat.

Alternative 2a-1, which is the next best buy plan and includes full causeway removal plus riparian restoration at Site 3, was used to evaluate if the addition of riparian restoration sites is worth additional cost to the project. With the addition of Site 3 to the plan, there is an additional 0.5 AAHUs at an incremental cost of $9,400 per AAHU. This was deemed not worth additional project cost, due to limitations for Federal funding within the CAP authority and NFS preference. Federal funding is limited to a total of $10 million for a CAP 1135 project. The full removal (Alternative 3a) is close to this limit and the additional cost for riparian plantings would potentially go beyond the funding scope of the project. Additionally, it is assumed from coordination with local natural resource agencies, vegetation will naturally establish without cost to actively plant due to the existing vegetation community acting as a seed source. Plantings have been incorporated into the Monitoring and Adaptive Management Plan to further understand the changes to the riparian and wetland community post construction. Therefore, the PDT determined that riparian restoration measures do not provide significant contributions to the study objectives and restoration needs in the Yakima River Delta compared to causeway removal.

For the final best buy plan, Alternative 2a-2, the cost continues to increase significantly for minimal benefit. The incremental benefit provided was determined to be 1.1 AAHUs at an incremental cost of $27,600 per AAHUs after adding in Site 4. In comparison, Alternative 2a-1 provides an incremental benefit of 1.1 AAHUs at an incremental cost of $64,800 per AAHU., Alternative 2a-3, provides an incremental benefit of 2.2 AAHUs at an incremental cost of $76,900 per AAHU with the addition of Site 2 (all riparian sites; Alternative 2a-4 in comparison to Alternative 2a-3).

5.1.3 Evaluation of Final Array of Alternatives

The study/team further evaluated and compared the final array of alternatives using four criteria known as “accounts” to facilitate evaluation and effects of alternative plans (Economic and Environmental Principles for Water and Related Land Resources Implementation Studies, established by the Water Resources Council in 1983):

1. The national economic development (NED) account displays changes in the economic value of the national output of goods and services.

2. The Environmental Quality (EQ) account displays non-monetary effects on significant natural and cultural resources. (Refer to Section 4 for more details on the effects of each alternative.)
3. The Regional Economic Development (RED) account registers changes in the distribution of regional economic activity that result from each alternative plan.
4. The Other Social Effects (OSE) account registers effects to a person's quality of life that are not reflected in the other three accounts.

National Economic Development. NED account displays changes in the economic value of the national output of goods and services. This project does not have significant beneficial or adverse NED effects. The quantified NED effects are total project cost and project operation, maintenance, repair, rehabilitation, and replacement (OMRR&R). The no-action alternative would result in no project expenditure associated and would have no positive or negative impact on national output of goods and services.

Additional effects to NED resources, such as flood risk reduction or recreation, generated by the alternatives in the final array are not expected to have a significant impact.

Environmental Quality (EQ). The EQ account is intended to indicate the long-term effects that the alternative plans may have on significant environmental resources. Significant environmental resources are defined by the Water Resources Council as those components of the ecological, cultural, and aesthetic environments which, if affected by the alternative plans, could have a material bearing on the decision-making process. Significance is derived from institutional, public, or technical recognition that a resource or an effect is significant. All alternatives were formulated to maximize benefits to the local significant resources. Any potential impacts to resources will continue to be considered, evaluated, and avoided or minimized to the extent possible. Section 4 describes the effects that alternative plans have on environmental resources.

The NER account displays increases in ecosystem restoration benefits compared to costs, consistent with the Federal objective. The intent of comparing alternative plans in terms of NER is to evaluate the overall benefits that the plans may provide to an ecosystem. Beneficial effects are increases in the ecological value of the output of goods and services attributable to a plan. In this case, NER benefits are the creation or expansion of habitat compared to existing and future without project.

Regional Economic Development (RED). The RED benefit category measures changes in the distribution of regional economic activity that result from alternative plans. Changes in economic activity and employment that occur locally or regionally when a project is implemented are excluded from the NED account to the extent that they are offset through transfers of this economic activity and employment to other regions of the Nation. The effects on the regional economy, including income effects, income transfers, and employment effects not addressed in the NED account are evaluated in the RED account. Two measures of the effects of the plan on regional economies are used in the account: regional income and regional employment.

The input-output macroeconomic model RECONS was used to address the impacts of the construction spending associated with Alternative 3a, the Recommended Plan. The Regional Economic Development account is intended to illustrate the effects that the proposed plans would have on regional economic activity, specifically, regional income and regional employment. RED analysis considered potential beneficial effects of plan implementation as a function of construction expenditures which would accrue to businesses within the regional economy.

The expenditures associated with All Work Activities, with Ability to Customize Impact Area and Work Activity at Yakima River Delta, Benton County, Washington for Alternative 3a (the Recommended Plan) design and construction are estimated to be $12.4 million. Of this total expenditure, $11.2 million will be captured within the local impact area. The remainder of the expenditures will be captured within the state impact area and the nation. These direct expenditures generate additional economic activity, often called secondary or multiplier effects. The direct and secondary impacts are measured in output, jobs, labor income, and gross regional product (value added) as summarized in Table 5-4. The regional economic effects are shown for the local, state, and national impact areas. In summary, the expenditures of $12.4 million support a total of 171 full-time equivalent jobs per year, $11.9 million in labor income, $11.2 million in the gross regional product, and $19.0 million in economic output in the local impact area during a one-year construction period. More broadly, these expenditures support 277 full-time equivalent jobs per year, $19.1 million in labor income, $22.4 million in the gross regional product, and $39.6 million in economic output in the nation. All benefits captured here are provided in annual units in FY24 OCT 2023 price levels.

Other Social Effects (OSE). The OSE benefit category relates to the quality of human life, health, and safety in the community. Destruction or disruption of the built environment, aesthetic values, community cohesion, economic viability, and availability of public facilities and services may be analyzed under this benefit category. Assessments of beneficial and adverse effects are based on comparisons to the No Action Alternative. The purpose of the OSE analysis is to show the beneficial and adverse effects of an ecosystem restoration project on the social wellbeing of the study area. The OSE account typically includes long-term community impacts in the areas of public facilities and services, recreational opportunities, transportation and traffic, and manmade and natural resources. The OSE account also integrates information into the planning process that is not reflected in the other three accounts used by USACE to evaluate projects and alternative plans. The OSE effects for this study focus on impacts to tribal fishing, recreational opportunity, and economic vitality and take into account the two City of Richland census tracts identified as disadvantaged communities as part of the environmental justice analysis for the study.

During recent discussions with the Cooperating Agencies, including the Yakama Nation and the CTUIR, it was communicated that the predation concern is significant enough to cause negative effects to local tribal fishing practices in the area. Due to ongoing stressors to juvenile salmon, survival continues to be impacted, resulting in species decline. To respect Tribal sovereignty and self-government and to fulfill Federal trust and treaty responsibilities to Tribal Nations, land

within the boundaries of Federally Recognized Tribes is designated as disadvantaged by the CEJST. Tribal fishing practices have been negatively impacted by this species decline for many years; therefore, any effort to improve conditions for salmonids is a benefit for tribal fisheries and culture. Partial removal of the causeway in Alternatives 2b and 3b would continue to provide high-quality predator habitat that would negatively impact salmonids in the Yakima River Basin. Full removal of the causeway in Alternatives 2a and 3a would remove impediments to smolt passage through the Delta and reduce predation opportunities, thereby improving survival of salmonids.

Additionally, the CTUIR has stated that lamprey, an important tribal First Foods that is relied on culturally by the tribes, would benefit from a wider, lower velocity channel at the confluence with the Columbia River. Lower water velocity could improve habitat and benefit lamprey migration and ultimately their populations, one of the goals of Tribal restoration efforts in partnership with USACE. Other Social Effects (OSE) consider the contributions of the restoration to the economic vitality of the region. Ecosystems and natural resources are important to jobs and economic growth in the study area. Any increase in predation in the Delta threatens to undermine very large investments into the Yakima Basin already made or planned by the YRBWEG Workgroup. The YRBWEG Workgroup has implemented or planned over 60 projects in the Yakima Basin, focused on restoring ecosystems within the watershed. The full cost of the integrated plan developed by the YRBWEG Workgroup is over $4.1 billion and includes significant habitat improvements upstream of the proposed project area. These projects include stream restoration, passage improvements, riparian restoration, operational changes, and additional water rights. The Yakima River Delta project is the most downstream site that would impact the success of upstream basin investments. That suggests that even small reductions in predation within the Delta with Alternatives 2a and 3a would have a cumulative benefit on the species by leveraging the efforts of the amount of investment in the system by the YRBWEG Workgroup. Conversely, a partial causeway structure in Alternatives 2b and 3b would undermine billions of dollars in region-wide efforts to support salmonids in the Yakima River Basin.

Additionally, recreation opportunities are an important component of the local economy and community values. All alternatives would eliminate pedestrian access to Bateman Island, disproportionately affecting disadvantaged, low-income communities without ability to access a boat. However, improvements to fisheries may provide additional fishing opportunities in the future. Other recreation sites within the Tri-Cities would likely offset changes in recreation at Bateman Island.

Table 5-4. Alternative Comparison (each "+" denotes meeting criteria, each "–" denotes not meeting criteria)

Alternatives	Evaluation Criteria and 4 Accounts (NED, EQ, RED, OSE)							
	Completeness (Feasible and Constructible)	**Effectiveness (Objectives met and no constraints violated)**	**Efficient (All Best Buys)**	**Acceptable (Environmental and Social)**	**NED (Total Project First Costs)**	**NER/EQ (Net AAHUs)**	**RED**	**OSE**
1. No Action		**-**		**-**				**-**; Ongoing impact to tribal fisheries limiting improvements to fisheries and cultural resource protections would continue.
2. Full Causeway With Riparian Habitat								
2a. Full Removal + Sites (Best Buys 2a-1, 2a-2 and 2a-3, 2a-4)	**+**	**+ +;** Decreases potential for predatory fish habitat	Best Buy Plan; average annual cost of $460,000-$731,000, and incremental cost of $9,400-$76,900 per AAHU	**+**; slightly higher ecological lift with riparian habitat. Creation of additional bird habitat. Loss of foot access to island.	first costs ranging from **$13M-$17.5M**	benefits ranging from **54.1 to 58.5** AAHUs	~25-65% more regional and national benefits than Alt 3a	**++**; Positive impacts to tribal fishing and cultural values, economic vitality of the region, and contributions to the Yakima Basin Integrated Plan. Potential negative impacts to pedestrian recreation at Bateman Island. Best added combined aesthetic and ancillary riparian habitat benefits.
3. Full Causeway Without Riparian Habitat								
3a. Full Removal **(Recommended Plan/NER/Total Net Benefits Plan)**	**+**	**+**; does not provide riparian habitat. Decreases potential for predatory fish habitat	Best Buy Plan; average annual cost of $455,000, and incremental cost of $8,500 per AAHU relative to the No Action Alternative	**+**; Loss of foot access to island. NFS preference of natural succession over active restoration.	first cost of **$12.9M**	benefits of **53.6** AAHUs	Local impacts for 1-year construction: - 231.3 full-time equivalent jobs - $10,300,000 in labor income - $10,700,00 in the gross regional product - $14,800,000 in economic output National impacts for 1-year construction: - 386.0 full-time equivalent job - $19,400,00 in labor income - $22,700,000 in the gross regional product - $19,500,00 in economic output	**+;** Positive impacts to tribal fishing and cultural values, economic vitality of the region, and contributions to the Yakima Basin Integrated Plan. Potential negative impacts to pedestrian recreation at Bateman Island. Lacks aesthetic and ancillary riparian habitat benefits.

5.1.4 Identification of the NER Plan and Summary of the Recommended Plan

The USACE objective in ecosystem restoration planning is to contribute to the NER. Contributions to the NER (outputs) are increases in the net quantity and/or quality of desired ecosystem resources. The NER plan must reasonably maximize ecosystem restoration benefits relative to costs, consistent with the Federal objective. The selected plan must be shown to be cost effective and justified to achieve the desired level of output. In addition to the NER account, the plan that also maximizes total net benefits for social, environmental, and economic considerations (see four accounts in Section 5.1.3) should be identified. This plan is referred to as Total Net Benefits Plan.

The evaluation and comparison of alternatives led the PDT to recommend *Alternative 3a* as the Recommended Plan as well as the NER plan and the Total Net Benefits Plan. This alternative maximizes the study objectives and habitat benefits while still maintaining efficiency and effectiveness. This plan also addresses predation concerns, provides cohesion to the local tribal community, as well as employment and income from the construction. This plan would also improve the economic vitality of the region by improving ecosystem function and fish passage at the Yakima-Columbia River Delta, thereby enhancing benefits of upstream water resources projects already constructed or planned by various stakeholders in the Yakima River Basin.

5.2 PLAN COMPONENTS: DESIGN AND CONSTRUCTION CONSIDERATIONS

Full removal of the causeway would involve contractors utilizing heavy equipment staged on mainland side, near Columbia Park trail, that will lead to disturbance of the north-most portion of the corridor, (an area measuring roughly 200 feet x 300 feet) where the causeway abuts the shoreline. Equipment will travel from the mainland side at the staging location (See Figure 5-3) with excavation beginning south of Bateman island working back towards the mainland. Equipment will transport earthen material to an upland disposal area. Removal of vegetation, along with prepping of the existing surface along the south shore of the island will be required to facilitate contractor access to the work site and the placement of fill within the area. There will be approximately 37,000 cubic yards of material with 500 linear feet of causeway removal and 800 linear feet of work area. Removal of the entire causeway will involve a cut of 37,000 cubic yards of material over an 800-foot-long alignment. No excavation is being proposed at the intact sections of the island or shoreline. This is intentional to minimize and eliminate any excavation into the shoreline or island to the greatest extent possible. Rip-rap is included within contingencies in costs at this time. More modeling is needed during design to understand placements and size of rip-rap. Construction will be limited to winter to minimize impacts to listed salmon. (Refer to Figure 5-4 for plans and cross sections.)

It is anticipated that disturbance of the existing subsurface materials within the boundaries of the shoreline can be minimized, if not eliminated, during design and construction by providing requirements and constraints in the construction specifications that require the contractor to protect the existing subsurface materials. Some options available to the designer include

requiring the contractor to operate on additional fill or temporary matting placed in the construction area(s) to operate heavy equipment from during construction. The practicability of such options will be assessed during the design phases and implemented as appropriate.

It should also be noted that the corridor presented for the feasibility study was conceptualized for the purposes of estimating earthwork volumes and producing preliminary cost estimates. It is preliminary design proposal and is subject to revision and adjustments to meet project constraints. As design progresses, adjustments to the corridor surface will be made to minimize or eliminate surface cuts (excavation) and refine the corridor presented, ensuring subsurface materials are protected as required.

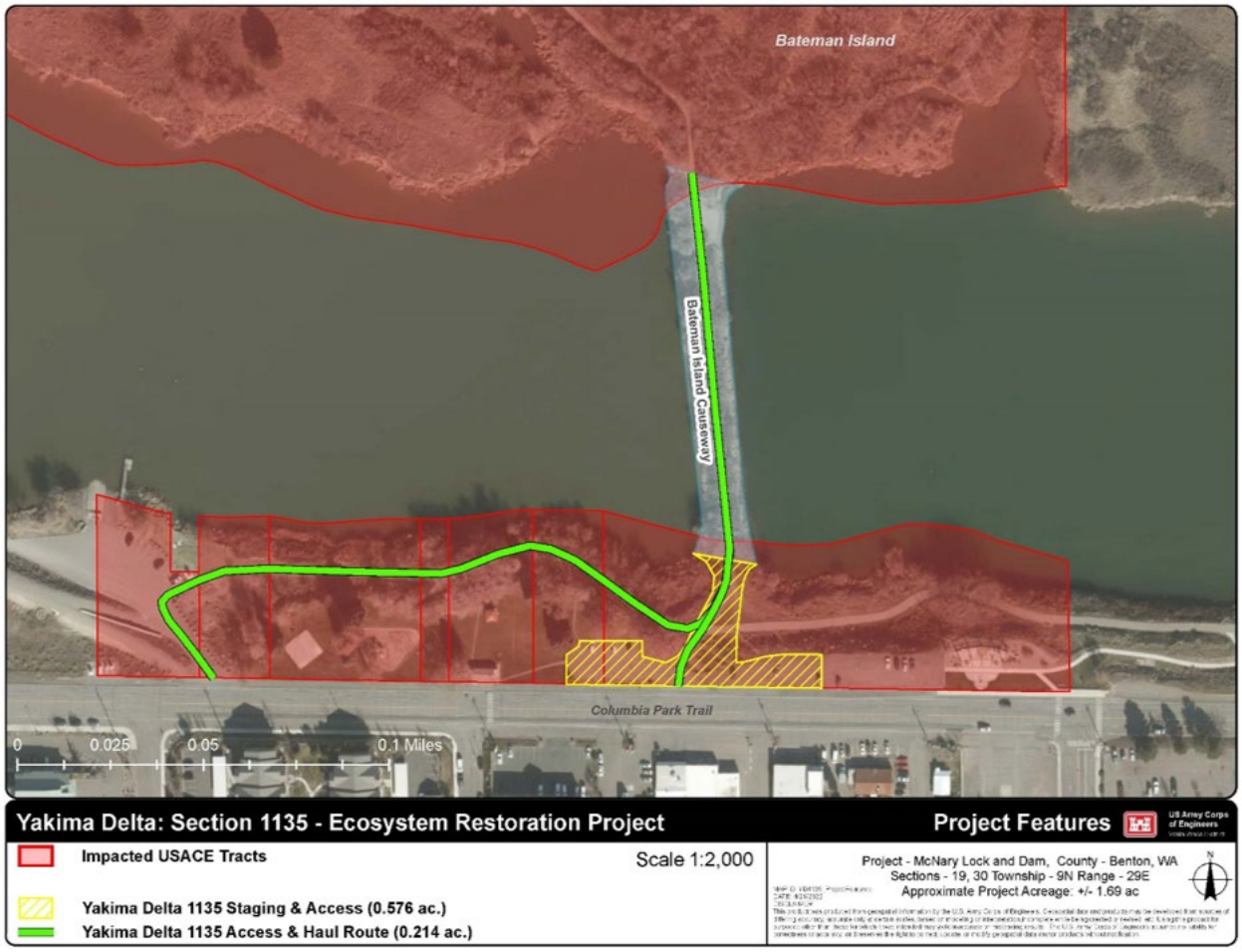

Figure 5-3. Potential Staging and Access

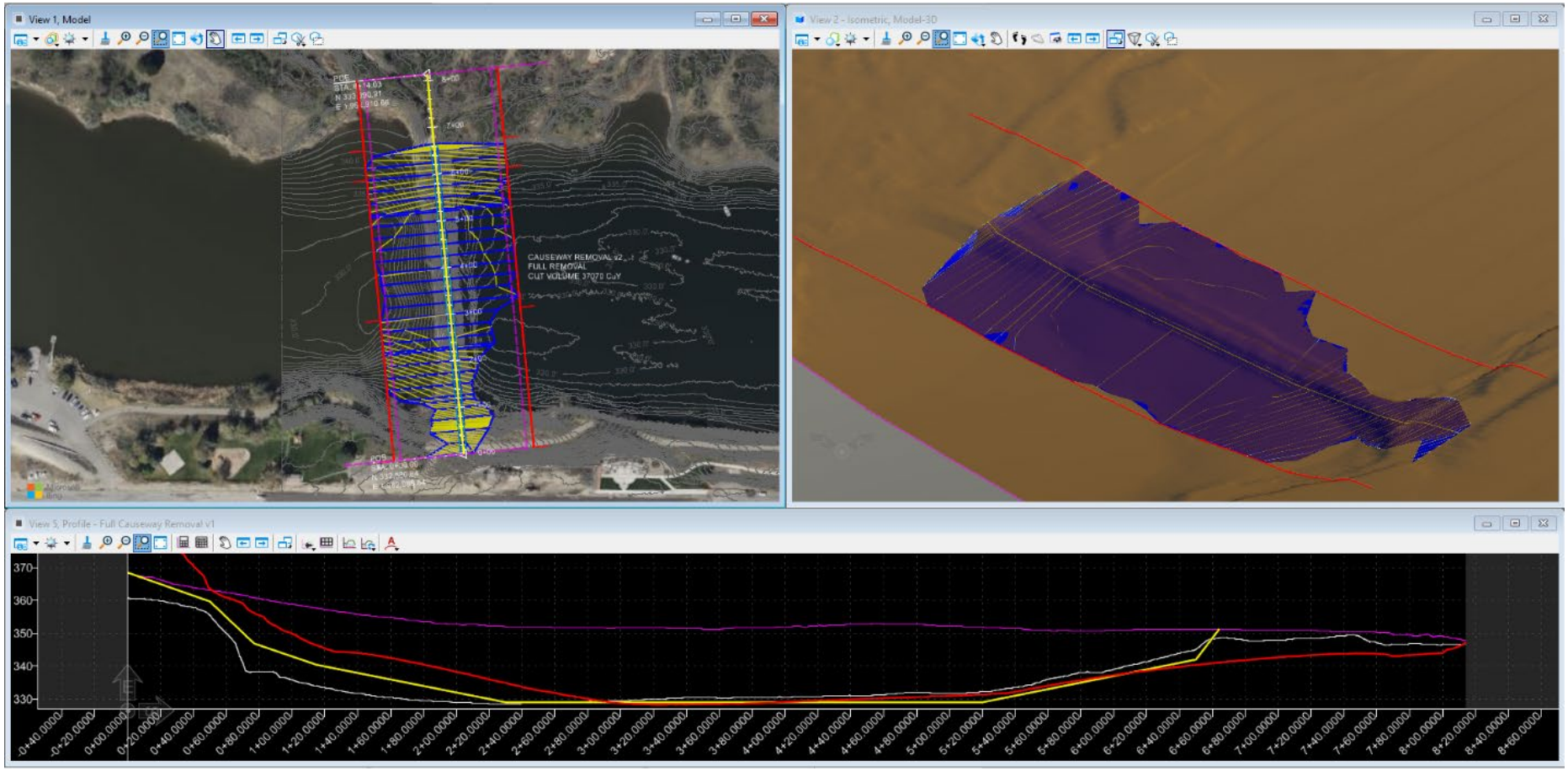

Figure 5-4. Cross Sections for Full Removal of Causeway

Blue lines represent proposed areas to remove (cut) material from the channel, shown in the plan and 3D model views. The yellow lines in the profile views represent the centerline elevation of the of the cut section and the white and red lines show the left and right edges of the cut sections—where the design surface intersects with the existing terrain surface. The magenta line represents the existing terrain.

Potential staging areas have been identified at this time and will be finalized during Design and Implementation (Figure 5-3). Temporary short-term impacts to the use of the park and associated parking will occur during construction.

The built-up sediment behind the causeway is anticipated to transport towards the Columbia River with the change in flows. Based on aerial imagery, an approximately 150-acre area could generate approximately 250,000 cubic yards of sediment slurry per foot of eroded depth. There is also the north delta area of another 60+ acres which could be subject to fine sediment erosion as well from increased Columbia mixing. Removal of Bateman Causeway would impact sediments on the west side of Bateman Island and causeway, have little to no impact on banks under the full breach scenario, and present only a minor bank erosion hazard under scenarios including partial breaches or a marina breakwater. Flow rates and velocities will increase south of Bateman Island following reconnection of the Yakima and Columbia Rivers. Sediments on the west side of the island are derived from land that was submerged with filling of McNary Pool and the accumulation of sediment inputs from the Yakima watershed, most notably the agricultural areas prior to installation of erosion controls. Much of these sediments will be eroded once the causeway is breached. Once mobilized in the water column, the sediment will flow into the Columbia River and downstream. Yakima discharges will see a temporary increase in the suspended sediment concentration, limiting visibility, and creating a brown appearance to the water. This condition will persist until the sediment laden waters mix with the much greater volume of the Columbia River, making their impact negligible. Under sustained mid to high flow velocities, the sediment is expected to erode over 2-6 weeks for a full breach alternative. This estimate assumes high velocities are sustained over the entire period and is likely overly conservative; 2-3 months is a more reasonable “full breach” estimate considering expected variation in velocities.

In accordance with ER 1165-2-132, Hazardous, Toxic, and Radioactive Waste for USACE Civil Works Projects, construction of civil works projects in HTRW-contaminated areas should be avoided where practicable. Where HTRW-contaminated areas or impacts cannot be avoided, response actions must be acceptable to the Environmental Protection Agency (EPA) and applicable state regulatory agencies. All HTRW response actions, including offsite disposal of materials containing Comprehensive Environmental Response, Compensation and Liability Act-regulated substances, is 100 percent NFS responsibility.

5.3 LANDS, EASEMENTS, RIGHTS-OF-WAY, RELOCATIONS, AND DISPOSAL SITE CONSIDERATIONS

The lands impacted are owned by USACE and WDNR. The Bateman Island causeway is situated between Bateman Island and the shoreline and is approximately 500 feet in length. Both the island and shoreline in this area are owned by USACE. USACE Real Estate staff have determined that the causeway was not constructed or owned by USACE, and this causeway is considered an illegal structure within the river.

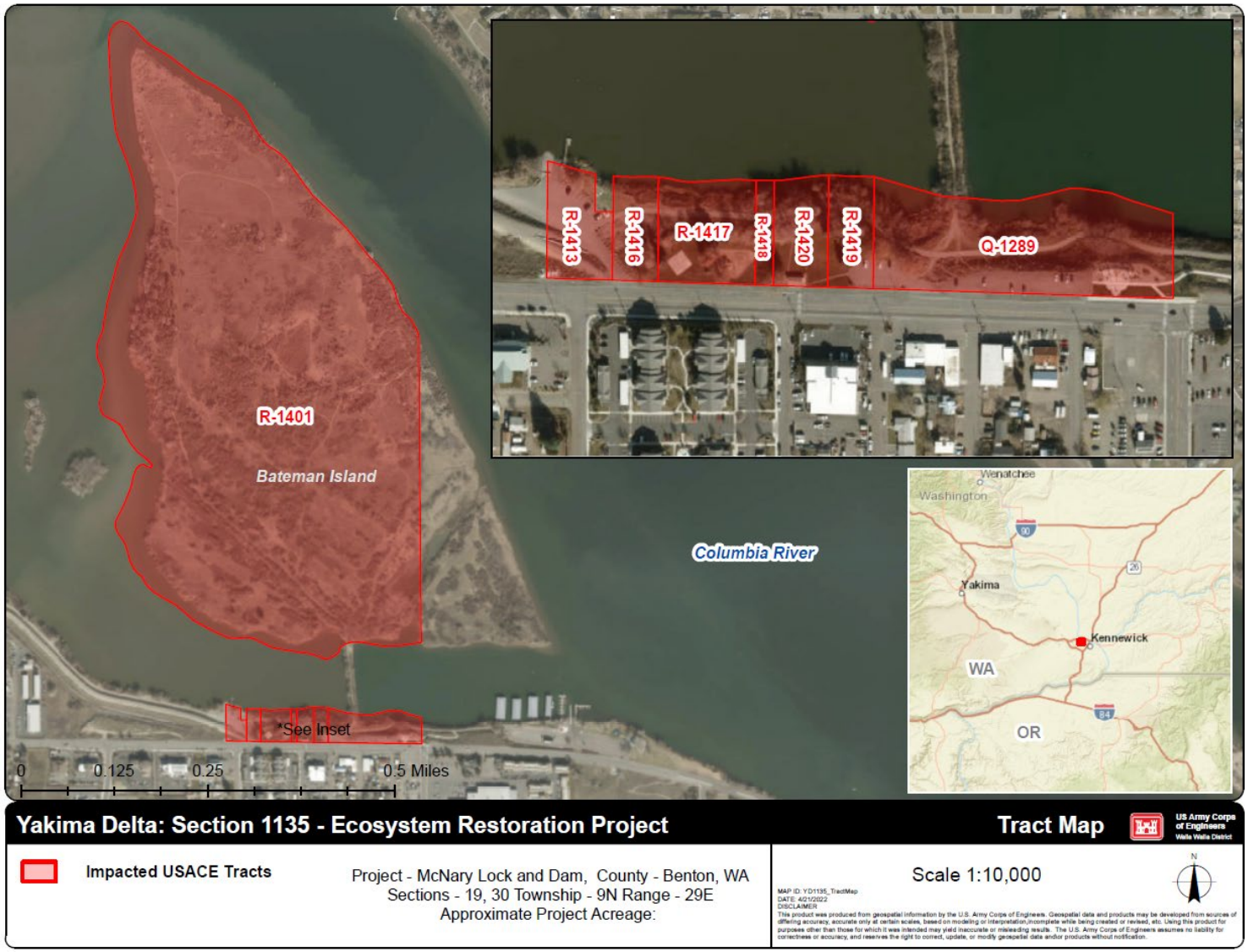

Figure 5-5. USACE Tracts Impacted by Yakima River Delta 1135 Project

The tracts shown in Figure 5-5 are owned by USACE and outgranted to the City of Richland in the form of a 460d Parks and Recreation Lease. The 50-year lease to the City was renewed in 2004 and will expire in 2054. The Columbia Park Marina located downstream of the causeway is a sub-lessee of the City and is currently in a month-to-month status since the expiration of the sub-lease in 2017. USACE has reviewed the City's sub-lease proposal and has denied the application in favor of a month-to-month tenancy to ensure the sub-lessee is following state and Federal laws and to align the terms of both the WDNR Lease and the USACE Lease.

There are no relocations anticipated for this project.

USACE is currently working with the NFS to locate a disposal site for an anticipated 40,000 cubic yards of material. The potential disposal locations exist in the local area, including landfills, material handling yards, and local and state government-owned lands. Costs were estimated for disposal using the City of Richland landfill with a hauling distance of 15 miles; however, this is for cost estimating purposes only and requires coordination to finalize. The NFS is aware that all Lands, Easements, Rights-of-Way, Relocations, Disposals (LERRD) required for the project is their sole responsibility.

Further information on LERRD and other real estate related topics is provided in Appendix F, Real Estate Plan (costs in Appendix F based on land cost estimate).

5.4 OPERATION AND MAINTENANCE CONSIDERATIONS

Operation and maintenance are the responsibility of the NFS in accordance with Section 107(b) of WRDA 1992, Public Law 102-580. At this time, there is no extensive long-term operation and maintenance anticipated for this project. However, minimal operation and maintenance costs of $15,000 annually have been added to the project costs after the first 10 years as contingency for bank stabilization.

5.5 MONITORING AND ADAPTIVE MANAGEMENT CONSIDERATIONS

Per Section 2039 of WRDA 2007, monitoring for ecosystem restoration studies will be conducted to determine Project success. "Monitoring includes the systematic collection and analysis of data that provides information useful for assessment of Project performance, determining whether ecological success has been achieved, or whether adaptive management may be needed to attain Project benefits." Adaptive Management and Monitoring (AM&M) will be conducted for approximately 10 years post-construction and will cost a total of $223,000.Post-project performance assessment monitoring will help determine if the goals and objectives are being approached by the constructed measures. The following proposed monitoring has been identified to gather more information from uncertainties resulting in the full removal of the causeway:

- Turbidity
- Sediment and mudflat

- Adjacent riparian and wetland habitat
- Shoreline erosion
- Backwater Water temperatures

Success criteria is defined to understand the point when an adaptive management measure is required to correct deficiencies. The adaptive management measures identified for this project are as follows:

- If shoreline erosion is deemed excessive, then planting of soft revetment (willow plantings) will be implemented.
- If riparian habitat does not naturally establish, then a one-time planting will be implemented. The focus for these plantings will be at sites 1-4 that were identified during the alternative formulation.

Information regarding the AM&M are provided in Appendix G, Adaptive Management and Monitoring Plan.

The Federal Columbia River Power System, Systemwide Programmatic Agreement (2009) establishes the Payos Kuus Cuukwe Cooperating Group to advise the Lead Federal Agencies (BPA and USACE) in their implementation of Section 106 of the National Historic Preservation Act (NHPA). The Payos Kuus Cuukwe group has already identified erosion at Bateman Island as an ongoing adverse effect occurring because of the operation and maintenance of the McNary Lock and Dam Project. The causeway in its current configuration is suspected of being the cause of on-going erosion on the island. Specifically, the group suspected that the still backwater area created by the causeway had become popular with water skiers due to the still water, and the operation of power boats within that constricted area was causing waves to lap up on the shoreline, and cause erosion of the bank upstream of the causeway. The group implemented a treatment for that erosion in October of 2015, placing “no wake” buoys to discourage power boats from creating waves within the cove.

The on-going erosion adjacent to the causeway is an on-going concern for the Payos Kuus Cuukwe group, as well as at other areas on Bateman Island, continues to be a “medium” priority concern for the group. The entire island is also currently recommended for annual monitoring to identify changes in erosion, or other factors impacting cultural resources. It is unknown how the implementation of the Recommended Plan may alter current erosion on-going within the study area. It is possible that implementation of the plan may result in a lessening of the current erosion ongoing immediately adjacent to the Bateman Island causeway. Regardless, the continued work of the Paos Kuus Cuukwe cooperating group, and the implementation of the Systemwide Programmatic Agreement, continues to provide the most effective framework for monitoring changing conditions, and addressing any changes observed.

5.6 TOTAL PROJECT COSTS SUMMARY

The Section 1135 of the WRDA of 1986, as amended, has Design and Implementation phase as cost-shared 75 percent Federal and 25 percent non-Federal with 100 percent of LERRD costs being the non-Federal responsibility. The maximum Federal cost per project including feasibility, design and construction costs is $10.0 million. The NFS's cash requirement, can be reduced by up to the tribal waiver amount (currently $648,000, FY24) for Tribal non-Federal sponsor. It is anticipated that the Yakama Nation will enter an agreement with USACE as a co-sponsor or lead sponsor at the next phase of the project. In order to keep the project within the Federal limit of $10 million, Yakama Nation has requested to only use $250,000 of the full $648,000 cost share waiver to be applied as specified by Section 1156 of WRDA 1986.

The estimated total project first cost is $12.4 million (October 2023 FY24 price level). The cost share of the Recommended Plan's total project first cost is shown in Table 5-5. The Federal share is $9.5 million, and the NFS share is $2.9 million.

Including the $450,000 Federal feasibility study costs and $350,000 NFS feasibility study costs, the total project costs are $13.2 million. Adjusting for the $10.0 million limit, the Federal total cost share is $10.0 million and the NFS total cost share is $3.2 million as detailed in Table 5-6.

Respectively, 32, 27, and 25 percent contingencies were applied to construction, design, and LERRD costs.

Table 5-5. Recommended Plan Cost Summary and Project Cost Share* ($1,000s)

	Federal Costs	Non-Federal Costs	Total Costs
75/25 Unadjusted Total Project First Cost Share	$9,300	$3,100	$12,400
LERRDs	$0	-$98	-$98
Subtotal	**$9,300**	**$3,002**	**$12,302**
Section 1156 Cost Share Waiver	$250	-$250	-
Post-Waiver Subtotal	**$9,550**	**$2,752**	**$12,302**
Add LERRDs Responsibility	$0	$98	$98
Total Project First Cost	**$9,550**	**$2,850**	**$12,400**

*FY24 October 2023 Price Level

Table 5-6. Recommended Plan Cost Summary and Project Cost Share with Feasibility Study* ($1,000s)

	Federal Costs	Non-Federal Costs	Total Costs
Total Project First Cost	$9,550	$2,850	$12,400
Feasibility Study	$450	$350	$800
Total Project First Cost w/ Feasibility Study	**$10,000**	**$3,200**	**$13,200**
$10M Federal Project Limit			
Total Cost Shares	**$10,000**	**$3,200**	**$13,200**

*FY24 October 2023 Price Level

Table 5-7 provides an economic summary of the ecosystem benefits of the Recommended Plan in FY24 OCT 2023 price levels. The FY24 Federal discount rate of 2.75 percent, a 1-year construction period, and a 50-year period of analysis is used unless otherwise noted. IDC is estimated to be $170,000, average annual equivalent cost (AAEC) is $466,000, and total average annual cost (AAC) is $481,000 with the inclusion of $15,000/year for minimal operations, maintenance, repair, rehabilitation, or replacement (OMRR&R) costs anticipated. Average annual cost per AAHU is estimated to be $9,000. The removal of the causeway restores approximately 360.4 acres of aquatic habitat for fish migration via improved water temperatures. The $1,300 AAC per acre restored represents this.

Table 5-7. Economic Summary of the Recommended Plan * ($1,000s)

	Cost and Benefit Summary
Federal Discount Rate (FY24)	2.75%
Federal Discount Rate, Monthly	0.23%
Construction Period, Years	1
Period of Analysis, Years	50
Total Project First Cost	$12,400
Average Annual Cost	
Interest During Construction (IDC)	$170
Average Annual Equivalent Cost	$466
Annual OMRR&R	$15
Total Average Annual Cost	$481
Average Annual Benefits	
Output (AAHUs)	53.6
Average Annual Cost/AAHU	$9.0
Average Annual Cost/Acre Restored	$1.3

* FY24 OCT 2023 Price Level

5.7 DIVISION OF IMPLEMENTATION RESPONSIBILITIES

USACE is responsible for Project management and coordination with the NFS. USACE will submit the feasibility report, program funds, finalize plans and specifications, complete all NEPA requirements, advertise and award a construction contract, and perform construction contract supervision and administration.

The NFS has provided technical and other advisory assistance during all phases of the project and will continue to aid during implementation and monitoring. Any post-project performance assessment monitoring (beyond 10 years) will be the responsibility of the NFS.

5.8 RISK AND UNCERTAINTY

Ecosystem restoration may have relatively low implementation risks, but the associated risk and uncertainty of achieving the proposed level of outputs for the NER plan were considered. The primary risks associated with the Yakima River Delta Ecosystem Restoration project are the potential for undesirable outcomes, possibly resulting from natural hazards or human actions. Those potential risks include the following:

Increased velocities impacting marina. There is a risk that the increase in velocities due to the removal of the causeway will negatively impact the nearby marina, specifically the overnight storage that is located farther from the shoreline. The modeling efforts have indicated velocities to the north of the marina would increase slightly from approximately 0.25 ft/sec to approximately 0.45 ft/sec 90 percent of any given year; however, modeled velocities could potentially increase to 2.25 ft/sec 1 percent of any given year. (Refer to Appendix E, Hydrologic and Hydraulic Analysis, for more details.) USACE has included signage with construction costs and will be included with the plans and specifications during design. This signage is a reminder to the public of the change in conditions and to promote boating safety.

The addition of the conceptual marina barrier was modeled to further increase the velocities in the channel from 0.25 ft/sec to 1.0 ft/sec at a 90 percent exceedance duration; and at a 1 percent exceedance duration, the velocity increase would be from 0.5 ft/sec to 4.5 ft/sec (refer to Appendix E, Hydrologic and Hydraulic Analysis for more details). Due to this potential to increase velocities in the channel and no additional benefits provided for listed salmon, marina protection has not been identified as part of the Recommended Plan. Any unpredictable consequence (for example, damage from ice/debris) is assumed by USACE and the NFS to be rare and should be considered an Act of Nature.

Firefighting on Bateman Island. Full removal of the causeway will result in a change to public services on the island. It is assumed by USACE and the NFS that firefighting would be limited with no vehicular access. This change in public services will result in delayed fire response. In discussion with fire experts from the City of Richland and State of WA DNR, reduction of fuel can be achieved by management of invasive species. As an approach to minimize this risk, USACE has included invasive species management into the Monitoring and Adaptive

Management Plan (refer to Appendix G). Additionally, USACE has included signage in construction costs and will be included with plans and specifications to inform the general public emergency services are limited. Most, but not all, fires on Bateman Island are human caused and limited access to the island is likely to reduce fire frequency. Other islands nearby that have no pedestrian access very rarely experience fires.

Accumulated sediments. Sediment sampling and a sediment transport model was conducted after public review to address the concern that the accumulated sediment may be contaminated and that it is not clear where these sediments may be deposited once the causeway is removed. The sediment transport model resulted in the following (2024, NHC, Sediment Sampling in the Yakima River Delta):

- The Low Flow scenario, representative, of typical minimum annual flows, results in relatively low sediment mobility and low overall dispersion of particles through the domain. A less conservative settling assumption only results in approximately 6% of all particles released being transported through the entire domain and exiting the downstream boundary. With a more conservative settling assumption, none of the particles leave the Delta area under the Low Flow MS scenario.
- A High Columbia, Low Yakima (High Flow 1) scenario, approximately 2-year return period, results in a significant flux of particles from the Delta and between 60% and 73% of particles released being transported through the entire domain and exiting the downstream boundary.
- A High Columbia, High Yakima (High Flow 2) scenario, approximately 25-year return period, results in a significant flux of particles from the Delta and between 64% and 70% of particles released being transported through the entire domain and exiting the downstream boundary.

All the three scenarios indicate that almost all the particles will remain on the river right (south side of the channel) with some gradual spreading into the middle of the channel near the downstream end of the model domain. Due to the particles being outside the thalweg the tendency for settlement of the particles is higher on the far right. Particle numbers generally decrease progressively in the downstream direction due to particle deposition along the transport path for all flow scenarios.

Sediment sampling was conducted in May 2024 with laboratory analysis completed in June 2024. All sediments, except for nickel, were found to be under toxic thresholds. Nickel was found to be over the exceedance; however, it was determined that background conditions in the Columbia River east of Bateman Island, suggests naturally occurring nickel concentrations in this area are greater than the Sediment Cleanup Objective SCO, and that the nickel values measured in the Delta are not indicative of contamination, but rather natural, in-situ conditions. Section 2.18 has been updated from the draft report with this information. Additionally, construction will be limited to the winter work window for removal of the

causeway, resulting in a majority of the accumulated sediment transporting out of the Delta to the Columbia River with the following spring freshet. USACE has included additional water quality monitoring (refer to Appendix G, Monitoring and Adaptive Management Plan) and will continue coordination with Ecology and EPA during design prior to construction.

Climate change residual risk. Outstanding risks associated with climate change have been identified and summarized in Table 5.8.

Table 5-8. Residual Risks to Yakima River Delta 1135 Recommended Plan Due to Climate Change

Triggers	Hazard	Harm	Qualitative Likelihood (Low, Moderate, High)	Qualitative Justification for Likelihood Rating
1. Increased summer air temperatures. 2. Decreased summer precipitation accumulation. 3. Increased duration between precipitation events.	Increases in summer air temperatures combined with decreases in summer precipitation could result in decreased soil moisture and impact riparian vegetation features of the Recommended Plan .	A reduction in riparian vegetation around Bateman Island could allow invasive vegetation to continue to dominate the biome and cause detrimental impacts to the project environment. Reducing vegetation could also increase localized erosion around Bateman Island and the shoreline of the mainland.	Low to Moderate	Riparian habitat features of the Recommended Plan will be designed and implemented to function over a wide elevation range spanning from below reservoir pool to upper benches on Bateman Island. Transitional and upper bench vegetation will be implemented to ensure continued access groundwater at or below the reservoir pool level. In addition, the AM&M plan will allow project stakeholders and agency co-managers to monitor and offset observed detrimental effects.
Decreased summer flows.	A decrease in summer flows could reduce residual pool depth and thermal inertia of upstream reaches and increase water temperatures. This effect is expected to be much greater on the Yakima River.	Warm water temperatures would be associated with decreased dissolved oxygen levels, and effect other water quality parameters, impacting native aquatic species.	Low to Moderate	Removing the causeway allows increased mixing of the Columbia and Yakima Rivers resulting in a net increase of thermal inertia of the Yakima River Delta and lowering water temperatures.
Sediment	Increased sediment as primary indicator to water supply in Yakima and Columbia River watersheds as indicated by VA assessment	Increased erosion due to causeway removal and short-term sediment mobilization following spring freshet events.	Low to Moderate	Removing the causeway could help reduce sediment buildup in the Yakima River Delta west of Bateman Island There may be moderate adverse effects in the near-

Triggers	Hazard	Harm	Qualitative Likelihood (Low, Moderate, High)	Qualitative Justification for Likelihood Rating
				term following removal of the causeway as legacy sediment deposition behind the causeway is more readily eroded. Long-term effects are expected to diminish due to new areas forming inside the delta

SECTION 6 - COMPLIANCE WITH APPLICABLE LAWS, REGULATIONS, AND EXECUTIVE ORDERS

Section 6 identifies the legal, policy, and regulatory requirements applicable to the Recommended Plan. The following paragraphs address the principal environmental review and consultation requirements applicable to the Recommended Plan.

6.1 TREATIES, TRUST RESPONSIBILITY, AND NATIVE AMERICAN TRIBES

Treaties are legally binding contracts between sovereign nations that establish those nations' political and property relations. Treaties between Native American tribes and the United States confirm each nation's rights and privileges. It is important to be clear that "the rights of sovereign Indian tribes pre-existed their treaties; they were not granted them by treaties or by the United States Government. Rather, the treaties gave their rights legal recognition." (Hunn et al. 2015). These reserved rights were retained by the tribes and are exercised by their members today.

Treaties with the Nez Perce (Treaty of June 11, 1855, Treaty with the Nez Perce, 12 Stat. 957 [1859]; Treaty of June 9, 1863, Treaty with the Nez Perce, 14 Stats. 647 [1867]), the CTUIR (Treaty of June 9, 1855, with the Walla Walla, Cayuse, etc., 12 Stat. 945 [1859]), and the Yakama (Treaty of June 9, 1855, Treaty with the Yakama, 12 Stat. 951) established reservations and explicitly reserved unto the Tribes certain rights, including the exclusive right to take fish in streams running through or bordering reservations and the right to take fish at all usual and accustomed places in common with citizens of the territory, amongst other rights. Like other treaty obligations of the United States, Indian treaties are "the supreme law of the land," and they are the foundation upon which Federal Indian law and the Federal Indian trust relationship is based.

USACE does not anticipate that implementation of the proposed alternative will result in significant impacts to Treaty rights. Generally, it is anticipated that implementation of the preferred alternative will result in positive impacts to fish species that are also treaty resources.

USACE works to meet trust obligations, protect trust resources, and obtain Tribal views of trust and treaty responsibilities or actions related to USACE, in accordance with provisions of treaties, laws and EOs as well as principles lodged in the Constitution of the United States.

6.2 FEDERAL LAWS

6.2.1 National Environmental Policy Act (NEPA)

As required by NEPA and subsequent implementing regulations promulgated by the CEQ, this EA was prepared to determine whether the proposed action constitutes a "…major Federal action significantly affecting the quality of the human environment…" and whether an Environmental Impact Statement is required.

This FR/EA identifies, considers, and describes the potential environmental effects associated with ecosystem restoration of the Yakima River Delta. The Draft FR/EA and associated FONSI was open for 30-day public review and comment period starting January 30, 2023, and ending April 10, 2023. While preparing the FR/EA, USACE did not identify any impacts that would significantly affect the quality of the human environment. A total of 253 comments were received either at the open house, mailed to the Walla Walla District office, emailed, or through the online comment form. One hundred seventy-eight comments were in support of the project, with 59 of those in support of the project expressing concerns regarding the loss of pedestrian access to Bateman Island. The remaining 75 comments were not in support of the full removal of the causeway, stating concerns primarily over pedestrian access, water quality, and firefighting. (Refer to Section 7.3.3. and Appendix H for responses to substantial comments.)

6.2.2 Endangered Species Act of 1973

The ESA established a national program for the conservation of threatened and endangered fish, wildlife, and plants, and the habitat upon which they depend. Section 7(a)(2) of the ESA requires Federal agencies to consult with the USFWS and NMFS (the Services), as appropriate, to ensure their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their critical habitats. Section 7(c) of the ESA and the Federal regulations on endangered species coordination (50 CFR § 402.12) require Federal agencies to prepare a biological assessment (BA) of the potential effects of major actions on listed species and their critical habitat.

USACE prepared a BA to evaluate the potential effects to ESA-listed species. USACE has determined the proposed action is “likely to adversely affect” ESA-listed fish species. USACE conducted formal consultation with the Services for ESA-listed Chinook, Sockeye, steelhead, and bull trout. Biological Opinions from the Services have been received (Appendix H). All mitigative measures and/or appropriate BMPs will be incorporated into the design phase of the project and implemented during construction.

6.2.3 Clean Water Act of 1972

The CWA is the primary Federal law protecting the quality of US surface waters, including lakes, rivers, and adjacent wetlands. It was enacted in 1972 and established the basic structure for regulating discharges of pollutants and fill material into the waters of the US. Section 404 of the CWA established a program to regulate the discharge of dredged or fill material. Section 401 provides the state certifying authority an opportunity to certify that discharges from activities that require a Federal license or permit would not violate state water quality standards and, if necessary, deny the request or impose conditions to ensure that there would be no such violation. USACE regulations require USACE to seek Section 401 water quality certifications for its civil works projects, even though there may not be a Federal license or permit associated with the project.

Section 402 of the CWA also regulates the discharge of pollution from a point source, including storm water. If construction activities disturb an acre or more of ground and the potential for storm water run-off into the Yakima River or Columbia River exists, a Construction General Permit must be obtained at least fourteen days before ground disturbing activities begin.

Construction methodologies include use of a long-armed excavator working from the dry to remove causeway materials. As the excavator moves back from Bateman Island to the south shore, material will be removed from the island-side, placed in trucks, and deposited off site. The water surface elevation is the same on either side of the causeway currently, and while the causeway does change the way the water flows at the confluence of the Columbia and Yakima Rivers, it does not impound any water.

The sediment at the causeway site is composed of basalt gravels and cobbles to fine silt. During the removal of the causeway, any immediate fallback onto the surface from which it was removed would be incidental to the removal activity. The temporary disturbance to sediment associated with this excavation method would result in minor, temporary turbidity during the construction period. The causeway removal would also require placement of stabilizing rock (fill material) along the south shoreline of Bateman Island and the north shoreline of the mainland, for the purpose of bank stabilization and mitigation against erosion, which would trigger the need for compliance with the CWA Sections 401 and 404.

Therefore, USACE submitted a Pre-filing Meeting Request for CWA Section 401 WQC to Ecology on January 5, 2023. USACE has determined that Nationwide Permit (NWP) 27, Aquatic Habitat Restoration, Enhancement, and Established Activities, applies to the project. Use of NWP 27 satisfies compliance requirements of Section 404, including the Section 404(b)(1) guidelines. Any general and regional conditions associated with NWP 27 would be incorporated into the project. Coordination with EPA and Ecology has been ongoing through the feasibility study.

Accumulated sediment in the Delta upstream of the causeway that may be mobilized during the causeway removal and in the months following the causeway removal would travel downstream through the Tri-Cities and deposit in natural accretion areas primarily along the right bank in natural contours. This mobilization would happen gradually, primarily during the construction period and during freshet periods over the following months and years, depending on river flow levels. This mobilization would result in minor, temporary turbidity, the effects of which would dissipate rapidly without causing an identifiable effect on any aquatic function. The sediment within the Delta was also examined for pollutants by the NFS (NHC 2024) and none were found at levels exceeding state water quality standards.

While the Recommended Plan does not require the preparation of a project-specific 404(b)(1) analysis as it falls under the 404(b)(1) analysis completed for NWP 27, with individual certification anticipated from Ecology as described above, the preferred alternative would meet the definition of the least environmentally damaging practicable alternative under NWP 27.

6.2.4 Magnuson-Stevens Fishery Conservation and Management Act-Essential Fish Habitat

The consultation requirement of Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) directs Federal agencies to consult with NMFS on all actions, or proposed actions that may adversely affect Essential Fish Habitat (EFH). Adverse effects include the direct or indirect physical, chemical, or biological alterations of the waters or substrate and loss of, or injury to, benthic organisms, prey species and their habitat, and other ecosystem components, if such modifications reduce the quality or quantity of EFH. Adverse effects to EFH may result from actions occurring within EFH or outside EFH, and may include site-specific or EFH-wide impacts, including individual, cumulative, or synergistic consequences of actions (50 CFR 600.810).

Chinook and Coho salmon are protected by the MSA. Implementation of the Recommended Plan would have short-term effects on species and critical habitat but is by design and purpose intended to provide benefits to EFH, and thus would result in no adverse effect on Chinook or Coho EFH and would comply with the Act.

6.2.5 Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act (FWCA) requires consultation with the USFWS and state fish and wildlife agencies to evaluate the impact to fish and wildlife species where the “waters of any stream or other body of water are proposed or authorized, permitted or licensed to be impounded, diverted… or otherwise controlled or modified” by any agency under a Federal permit or license. The FWCA also requires equal consideration and coordination of wildlife conservation with other water resources development programs.

Implementation of the Recommended Plan would restore and enhance the habitat and channel of a natural water body. USACE requested coordination under the FWCA on June 12, 2020, with both the USFWS and NMFS. USACE received a response letter from USFWS on September 18, 2020, indicating that the USFWS would engage through the NEPA planning process and that development of a significant FWCA deliverable is unnecessary in this case. NMFS responded June 23, 2022, stating they had reviewed the proposed action and had no recommendations for project modification. Coordination continued with the USFWS and NMFS from December 2020 through May 2022 via phone, email, and meetings. NMFS provided an e-mail response to USACE for this project on September 29, 2022, stating that the full removal of the causeway would satisfy the FWCA.

6.2.6 Migratory Bird Treaty Act

The Migratory Bird Treaty Act (MBTA) (16 U.S.C. §§ 703-712, as amended) prohibits the taking of and commerce in migratory birds (alive or dead), any parts of migratory birds, their feathers, or nests. Take is defined in the MBTA to include by any means or in any manner, any attempt at hunting, pursuing, wounding, killing, possessing, or transporting any migratory bird, nest, egg, or part thereof. There is also a memorandum of understanding between the Department of Defense and the USFWS, signed July 31, 2006, to promote the conservation of migratory birds.

A wide variety of species listed under the MBTA occur within the Yakima River Delta project area. There would be no take of migratory birds and the Recommended Plan would not conflict with the purpose of the MBTA.

6.2.7 Bald and Golden Eagle Protection Act

The Bald and Golden Eagle Protection Act (BGEPA) prohibits the taking or possession of and commerce in bald and golden eagles, with limited exceptions, primarily for Native American Tribes. Take under the BGEPA includes both direct taking of individuals and take due to disturbance. Disturbance is further defined in 50 CFR 22.3.

Bald and golden eagles are known to nest and roost within the Yakima River Delta on USACE-managed lands. While all nest sites have not been formally documented, locations of some nests are known. None of these nests are within 660 feet of proposed construction activities. No nest trees would be affected by the proposed action.

Implementation of the Recommended Plan would comply with the BGEPA and would not result in disturbance or take of bald or golden eagles since no known nests are within 660 feet of the proposed project area.

6.2.8 National Historic Preservation Act

NHPA of 1966, as amended, directs Federal agencies to assume responsibility for all cultural resources under their jurisdiction. Section 106 of the NHPA requires agencies to consider the potential effect of their actions on properties listed, or eligible for listing, on the NRHP. The NHPA implementing regulations, 36 CFR Part 800, require Federal agencies to consult with the State Historic Preservation Officer (SHPO), Tribes, and other interested parties to ensure all historic properties are adequately identified, evaluated, and considered in planning for proposed undertakings.

Compliance with Section 106 of the NHPA is complete and included consultation with the Washington State Historic Preservation Officer (SHPO) and Federally Recognized Tribes, as appropriate. USACE determined that implementation of the Recommended Plan would result in no adverse effects to historic properties and received concurrence on that determination from the Washington SHPO on January 24, 2023 (refer to Appendix H).

6.2.9 American Indian Religious Freedom Act

The American Indian Religious Freedom Act (AIRFA) of 1978 (42 USC 1996) established protection and preservation of Native Americans' rights of freedom of belief, expression, and exercise of traditional religions. Courts have interpreted AIRFA to mean that public officials must consider Native Americans' AIRFA interests before undertaking actions that might harm those interests.

6.3 EXECUTIVE ORDERS

6.3.1 Executive Order 13007, Native American Sacred Sites

EO 13007 directs Federal agencies to accommodate access to and ceremonial use of tribal sacred sites by tribal religious practitioners. Agencies are to avoid adversely affecting the physical integrity of such sacred sites and to maintain the confidentiality of sacred sites when appropriate. The EO directs government-to-government consultation with tribes concerning sacred sites. Some sacred sites may qualify as historic properties under the NHPA. Bateman Island has been indicated as within a historic property and sacred site as designated by the CTUIR and Yakama Nation during the consultation process. Impacts are addressed in this EA.

All sacred sites were avoided during development of alternatives.

6.3.2 Executive Order 13175, Consultation and Coordination with Indian Tribal Governments, and Presidential Memorandum, Government to Government Relations with Native American Tribal Governments

EO 13175 sets forth guidelines for all Federal agencies to establish regular and meaningful consultation and collaboration with Indian tribal officials in the development of Federal policies that have tribal implications; strengthen the United States government-to-government relationships with Indian tribes; and reduce the imposition of unfunded mandates on Indian tribes.

The Presidential Memorandum of 1994 states in part that, “each…department and agency shall consult, to the greatest extent practicable and permitted by law, with tribal governments prior to taking actions that affect federally recognized tribal governments.”

Both the Yakama Nation and the CTUIR were contacted and agreed to participate as cooperating agencies in project development. Depending on the level of concerns, the tribe coordination was involved informing the project decisions of cultural and tribal resources that may be affected by the project decision. Meetings were held with these tribes individually to discuss challenges specific to their needs as well as informing the project team potential opportunities within the Yakima River as well as upstream of the project.

6.3.3 Executive Order 13112, Invasive Species

EO 13211 directs Federal agencies to prevent the introduction of invasive species, to provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.

The purpose of this project is to restore aquatic and riparian habitat. An element of the proposed action is the control of invasive plant species in the project area to ensure a healthy riparian habitat. Control activities include implementation of Best Management Practices

during construction (e.g., requirements for weed free materials), and an invasive species control plan in the project area as part of the Operations, Maintenance, Repair, Replacement, and Rehabilitation.

SECTION 7 - CONSULTATION, COORDINATION, AND PUBLIC INVOLVEMENT*

7.1 AGENCY CONSULTATION

The feasibility study has been coordinated with appropriate Federal, State, and local agencies throughout the planning process. Agencies consulted include Ecology, NMFS, USFWS, WDFW, and Washington SHPO. USACE also sent letters to the offices of U.S. Senators Maria Cantwell and Patty Murray and U.S. Representatives Kathy McMorris Rodgers and Dan Newhouse.

7.2 TRIBAL CONSULTATION

Tribal governments consulted include the CCT, CTUIR, the Nez Perce Tribe, the Wanapum, and the Yakama Nation.

7.3 PUBLIC INVOLVEMENT

7.3.1 Scoping

The scoping process for the feasibility study consisted of a charette workshop held on October 8 and 9, 2019, and a public scoping meeting held on November 20, 2019. Letters announcing the public scoping period were sent to interested members of the public, Tribal governments, organizations, stakeholders, congressional offices, and Federal and state agencies offering the opportunity to comment on the scope of the proposed action. Announcements for the scoping period were also distributed in five newspapers that cover five Washington State counties, local radio stations, and social media. USACE received a total of 78 comments during the scoping period.

All scoping comments received were separated into general themes: scope of the project, purpose of the project, potential alternatives, environmental considerations, and cumulative effects. These comments were considered in identifying opportunities, developing measures and alternatives, and defining problems and constraints associated with the proposed action.

7.3.2 Cooperating Agencies

USACE invited six entities (agencies, Services, and Tribes) to participate in the feasibility study as cooperating agencies. There were four that accepted: United States Fish and Wildlife Service, Ecology, CTUIR, and Yakama Nation. These four cooperating agencies were involved in alternative formulation and identification of the Recommended Plan. These agencies participated in the review and comment period of the draft documents.

7.3.3 Public Review

The public comment period was open from January 30, 2023, through April 10, 2023. A news release announcing public review of the draft report was posted with the associated documents on the project website at https://www.nww.usace.army.mil/missions/projects/yakima-river-delta-ecological-restoration on January 30, 2023. Letters of notification were emailed to the

Pacific Northwest congressional delegation as well as the Nez Perce Tribe, the Yakama Nation, CCT, and CTUIR. A press conference/media availability was conducted on January 31, 2023, with a local news outlet, and a media availability session was held on the same day.

Additionally, an open house was held on February 23, 2023, at the Reach Museum in Richland. A total of 70 people signed in at the open house where staff from USACE, WDFW, Yakama Nation, WDNR, and WDOE were present to answer questions. A total of 253 comments were received either at the open house, mailed to the Walla Walla District office, emailed, or through an online comment form. One hundred seventy-eight comments were in support of the project, with 59 of those in support of the project expressing concerns regarding the loss of pedestrian access to Bateman Island. The remaining 75 comments were not in support of the full removal of the causeway, stating concerns primarily over pedestrian access, water quality, and firefighting. Due to many comments with a repetitive focus on those categories, responses to those are summarized below. Other substantive comment responses are provided in Appendix H.

1. Pedestrian access.

a. Comments focused on impacts to recreation due to loss of pedestrian access to Bateman Island for birdwatching and hiking; and requested that USACE further evaluate costs for a bridge to replace access.

b. Response: USACE evaluates loss to local recreation from a regional perspective. There are adjacent recreational opportunities located within a 5-mile radius of Bateman Island. Specifically, Yakima River Delta HMU, Columbia Park, Columbia Point Marina Park, and Chiawana Park provide the same recreation uses as Bateman Island. Recreation will still exist regionally after the removal of the causeway with a focus on improved and increased recreational fishing with hiking shifting to these adjacent locations. Other anticipated uses that result from the removal of the causeway include bank fishing for salmon, improved conditions for swimming, and the restoration of water passage around the delta. All of this information was used to determine that the loss of pedestrian access is not a significant impact to the region.

USACE evaluated costs to maintain access, and considered fish passage friendly options of a bridge, arches, and bottomless culverts. These costs ranged from an additional $17M-$22.6M and did not provide additional habitat benefits; therefore, these were eliminated without further analysis.

2. Water quality with associated sediment transport.

a. Comments focused on concerns that the accumulated sediment may be contaminated and that it is not clear where these sediments may be deposited once the causeway is removed. The City of Pasco and Kennewick indicated their drinking water intakes are 6 miles downstream from the project location along the Columbia River.

b. Response: Sediment sampling and a sediment transport model was conducted after public review to address this concern. The sediment transport model resulted in the following (2024, NHC, Sediment Sampling in the Yakima River Delta):

- The Low Flow scenario, representative, of typical minimum annual flows, results in relatively low sediment mobility and low overall dispersion of particles through the domain. A less conservative settling assumption only results in approximately 6 percent of all particles released being transported through the entire domain and exiting the downstream boundary. With a more conservative settling assumption, none of the particles leave the Delta area under the Low Flow MS scenario.
- A High Columbia, Low Yakima (High Flow 1) scenario, approximately 2-year return period, results in a significant flux of particles from the Delta and between 60 percent and 73 percent of particles released being transported through the entire domain and exiting the downstream boundary.
- A High Columbia, High Yakima (High Flow 2) scenario, approximately 25-year return period, results in a significant flux of particles from the Delta and between 64 percent and 70 percent of particles released being transported through the entire domain and exiting the downstream boundary.

All the three scenarios indicate that almost all the particles will remain on the river right (south side of the channel) with some gradual spreading into the middle of the channel near the downstream end of the model domain. Due to the particles being outside the thalweg, the tendency for settlement of the particles is higher on the far right. Particle numbers generally decrease progressively in the downstream direction due to particle deposition along the transport path for all flow scenarios.

Sediment sampling was conducted in May 2024 with laboratory analysis completed in June 2024. All sediments, with the exception of nickel, were found to be under toxic thresholds. Nickel was found to be over the exceedance; however, it was determined that background conditions in the Columbia River east of Bateman Island suggests naturally occurring nickel concentrations in this area are greater than the Sediment Cleanup Objective SCO, and that the nickel values measured in the Delta are not indicative of contamination, but rather natural, in-situ conditions. Additionally, construction will be limited to the winter work window for removal of the causeway, resulting in majority of the accumulated sediment transporting out of the Delta to the Columbia River with the following spring freshet. USACE has included additional water quality monitoring (refer to Appendix G, Monitoring and Adaptive Management Plan) and will continue coordination with Ecology and EPA during design prior to construction.

3. Firefighting

a. Comments focused on concern for the ability to fight fires on Bateman Island with the loss of access.

b. Response: Due to there being no residential or commercial structures located on Bateman Island, the loss of vehicular access to fight fires is not deemed a significant impact. The concern of smoke and embers reaching the adjacent shoreline will require additional management of Bateman Island to ensure these impacts are minimal. Based on discussion with firefighting personnel, invasive species control can be used to reduce the fuel load, lowering the potential for major fire outbreaks (refer to the Monitoring and Adaptive Management Plan). Use of local aircraft and boats to fight fire can be limited due to other competing priorities but could be employed when available as has occurred in the recent past. Ongoing coordination with state and local agencies is necessary during design and prior to construction.

SECTION 8 - RECOMMENDATION

USACE Walla Walla District has conducted an environmental analysis in accordance with the NEPA of 1969, as amended. This FR/EA, dated September 2024, for the Yakima River Delta Ecosystem Restoration project evaluates the feasibility of restoring ecosystem structure, function, and processes of the Yakima River Delta near Richland, Washington, degraded by construction and operation of McNary Dam to benefit native fish and wildlife, including juvenile and adult salmon and steelhead as they migrate through the Delta. The FR/EA evaluated various alternatives that would allow for modification of the Yakima River Delta within the McNary Project pool. The Recommended Plan, also the NER and Total Net Benefits Plan, is the full breach of the causeway without riparian habitat and includes the following:

- Removal of approximately 37,000 cubic yards of fill from the causeway to restore the Yakima River to a free-flowing condition along the southern side of Bateman Island. The causeway creates stagnant water within the backwater of the Yakima River Delta and blocks passage for ESA-listed fish.
- Implementation of the associated monitoring and adaptive management plan. Monitoring would continue until the project has been determined as successful based on the identified criteria in the Monitoring and Adaptive Management Plan, Appendix G to this FR/EA. Monitoring is expected to last no more than ten years.

All applicable laws, EOs, regulations, and local government plans were considered in the evaluation of the alternatives. The Recommended Plan does not constitute a major Federal action that would significantly affect the quality of the human environment; therefore, an EIS is not recommended (see Finding of No Significant Impact).

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KATHRYN A. WERBACK
Lieutenant Colonel, EN
Commanding

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